Equipoise Consulting, Inc.

Energy Analysis

Project Management

Training

Final Report for

Pacific Gas & Electric's
1998 Combustion Appliance
Safety Testing Pilot Program

in association with

Ridge and Associates and

Field Research Corporation

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1 EXECUTIVE SUMMARY

This report documents the process evaluation of the Combustion Appliance Safety (CAS) Testing component of PG&E's 1998 Energy Partners Program (EPP). Some sections cover both the EPP and the CAS Testing Program combined, since an understanding of how the programs work together is necessary for the CAS evaluation discussions.

PG&E offers the EPP to low income customers throughout its service territory. The program offers energy conservation measures to customers at no cost to them. The measures cover non-infiltration measures, infiltration measures, and minor home repair.

Many of the specific measures save energy by decreasing unnecessary air flow into and out of the home. As a result, PG&E deemed it necessary to assure customer safety by performing comprehensive CAS testing of all gas appliances, and the ambient air in the house, for carbon monoxide (CO) production. These tests are conducted both before and after installation of energy efficiency measures that affect air flow. The post-installation tests are conducted on 20% of the homes, to assure that the newly sealed homes are still safe.

PG&E's 1998 EPP contract, incorporating the pilot CAS Testing component, began in March of 1998. As of mid-August 1998, approximately 7,300 residential units had participated in the CAS testing program.

1.1 Findings

The overall findings of the CAS Testing process evaluation are presented in Exhibit 1.1 by program actor (EPP general office, Central Inspection Program (CIP), prime contractor, subcontractor, Stockton Training Center (STC), and Customer) in order to make it easier to identify where opinions diverge and how they might effect the program flow.

Exhibit 1.1
Subjective Summary of Overall Evaluation Findings

IIIII = Works Very Well , I = Does Not Work at All

Category	EPP	CIP	Prime	Sub	STC	Customer
Understanding CAS Goals						
Understanding of CAS Goals	IIIII	IIIII	IIIII	IIIII	IIIII	NA
How Well Has CAS Met Goals	IIIII	IIIII	III	IIII	NA	NA
EPP Marketing						
Most Effective Method	Targeted Door to Door				NA	NA
Influential Features	Free Measures, CAS Testing				NA	NA
Discouraging Features	Number of Visits, Don't believe it's free				NA	NA
Program Implementation						
Smoothness of CAS Delivery	IIIII	IIII	II	II	NA	NA
Issue Resolution / Responsiveness	IIII	IIII	II	II	NA	NA
Delivers Customer Safety	IIIII	IIIII	IIIII	IIIII	IIIII	IIII
Hardship from Identified Repairs	Yes				NA	No (Limited sample)
Tracking System						
Operation and Accessibility	III	II	I	I	NA	NA
Awareness of Field Status	IIIII	IIIII	II	II	NA	NA
Customer Satisfaction						
Customer Satisfaction with CAS	IIII	IIIII	III	IIII	NA	IIIII
CAS Auditor Training						
How Well Trained	IIIII	IIIII	Don't know	Don't know	IIIII	IIIII

The following findings are grouped by evaluation category.

Overall

- The program is well designed and fielded.
- The program features have been held constant during the time the program has been offered and are uniformly understood by all program implementers.

Customer Satisfaction

- Most implementation staff consider customer satisfaction high. The customer survey corroborated this by showing that 95% of the customers were either very satisfied or satisfied.

Administrative Process

- All parties participating in the program implementation clearly understand the CAS program goals.
- All implementers agreed that the CAS program was achieving its goals.
- The marketing of the EPP appears highly developed. The program appears on target to deliver the required number and distribution of participants.
- EPP/CIP/Contractor organizational structure appears to limit ability to effect changes in the program.
- All parties agree that the CAS Testing program is assuring customer health and safety.
- None of the parties felt that there was any equal or better alternative to CAS Testing. Some expressed concern about the long term benefit of CAS testing and recommended CO detectors as an extension to the program.
- While the program is achieving its goals, there are some operational issues. These are the reasons for the discrepancy between PG&E staff and contractor staff ranking of "smoothness of delivery" and "problem resolution".
    - CIP staffing and hours of operation appear to adversely affect the CAS implementation. This could also be a communication issue.
    - The CAS program has a working system for handling customer complaints but does not appear responsive to suggested changes from contractors implementing the program.
- CAS failures resulting in appliance adjustments and "red tagging" appeared to impose minimum hardship on the customer.
- Operational issues and inaccessibility of the tracking system are recognized, to differing degrees, by all implementers.
- Information flows up from the subcontractors, but not back down to them in a useful format or timely fashion.
- Database incompatibility causes problems in data flow.

CAS Training Effectiveness

- The CAS auditors are felt to be very well trained by the PG&E staff.
- The vast majority of customers (97%) thought that the inspectors seemed knowledgeable about their job.

1.2 Program Design Options

Equipoise presents two scenarios for program changes. In the first (preferred) scenario we suggest that PG&E change the actual structure of the program to allow the contractors to perform the CAS testing. The second scenario, which is less optimal, provides suggestions for improving the current program design.

1.2.1 Scenario One: Move Initial CAS Testing to Contractors

Many of the communication and scheduling issues evolved from the EPP decision to have PG&E control all phases of the CAS testing process. This was done because PG&E feels it is inappropriate that those conducting the installations should also be performing the CAS test. The evaluation determined that contractors perform both CAS testing and installations under the California state low-income weatherization program. These testers are trained at PG&E's Stockton Training Center and audited by a reliable independent consultant. We believe that a variation on this model would be appropriate for the PG&E program.

The proposed changes in structure are:

1. Give the contractors the responsibility of performing the pre-installation CAS testing. Each contractor must have their testers trained at the STC.
2. Have PG&E perform the quality assurance of the CAS testing by continuing its practice of accompanying all newly trained testers until they are assured that the tester is correctly applying the information taught. PG&E may want to consider spot checking the CAS tests to reinforce quality assurance.
3. PG&E should continue its practice of performing post-installation CAS tests. PG&E should reassess the percentage of sites required to satisfy their liability concerns under this scenario.

This scenario would have the following advantages and disadvantages:.

Advantages.

1. Potentially reduce the number of customer contacts required to deliver the program, which could result in an increase in participation,
2. Likely to increase installation of infiltration measures by streamlining the delivery process,
3. Improve installation contractor knowledge of customer job status allowing them to address issues inhibiting installation completion.

Disadvantages.

1. Would require an added visit by PG&E to "qualify" the measures for installation. This is a program feature universally desired by contractors,
2. The entity conducting the testing has a vested interest in test passing, potentially biasing the results,
3. Could decrease customer safety, unless the same high level of CAS program and administrative standards are employed. Increases PG&E's potential liability.

1.2.2 Scenario Two: Improve Current Process

We realize that PG&E may not be able to implement the first scenario for various reasons. Therefore, we present the following suggestions which could improve the process flow if no organizational changes are made.

1. PG&E should reassess the current organizational structure to encourage greater responsiveness as issues are brought up.
2. PG&E should develop a list of desired reports and act on getting them in circulation. Specifically, a CAS aging report appears to be needed immediately.
3. PG&E should extend the hours of CIP dispatch operation. This would facilitate person-to-person scheduling for all recruitment and increase the likelihood of completed CAS testing.
4. All data transfer should have some kind of data confirmation protocols whether information is passed electronically or by fax.
5. PG&E should require contractors to have the same database software and software version as CIP.
6. All contractor team leaders should accompany a CAS tester during at least one CAS test. This will allow them to give the energy specialists a better idea of what occurs during the CAS test so the Energy Specialists (ESs) can better inform the customer.
7. PG&E should conduct an in-depth assessment of CIP dispatch response times (statistical variation and time of day). Conflicting information from CIP and the contractors needs resolution.
8. PG&E should assess extending the hours of CAS testing. This may decrease the number of "Can't Get Ins" (CGI's) currently experienced by the program.

1.2.3 Either Scenario

There are a few suggested changes which Equipoise makes for either scenario. These are:

1. PG&E should evaluate the viability of installing CO detectors as part of the Energy Partners Program, not as a replacement for CAS testing, but as an augmentation to further assure customer safety. While the CO detector has drawbacks, it may supply some additional safety as appliance conditions change.
2. PG&E should assess if the CAS testers could be allowed to light pilot lights and continue to be within union and safety guidelines for working with gas appliances.

The body of the report expands on all of these suggested changes.

2 INTRODUCTION

This report documents the process evaluation of the Combustion Appliance Safety (CAS) Testing component of PG&E's 1998 Energy Partners Program (EPP). Section 3 presents the evaluation methodology. Sections 4 and 5 provide the results and program design options. The appendices contain the program forms and documentation supporting the program implementation.

2.1 Program Description

This program description covers both the EPP and the CAS Testing Program together, since an understanding of how the programs work together is necessary for the following evaluation discussions. Indeed, the PG&E CAS Testing protocols did not exist prior to incorporation into the EPP.

PG&E offers the EPP to low income customers throughout its service territory. The program offers energy conservation measures to customers at no cost to them. The measures can be categorized as non-infiltration measures, infiltration measures, and minor home repair. Specific measures that could possibly be offered to any particular customer, depending on need and ability to properly install, are listed in Exhibit 2.1.

Exhibit 2.1
Summary of Measures Offered by Energy Partners Program

Non Infiltration Measures (NIM)	Infiltration Measures	Minor Home Repair
Attic Insulation	Caulking Windows/Doors	Threshold
Attic Venting	If SF, Caulk > 200 ft	Door Repair
Showerheads	Evaporative Cooler Cover	Glass Replacement
Water Heater Wrap	Electrical Outlet Gaskets	Window Repair
Pipe Wrap	Weatherstrip Attic Door	Electrical Outlet Cover
Furnace Filters	Weatherstrip Doors	External Wall Repair
Minor NIM Repair	Minor Infiltration Measure Repair	Attic Access Door Repair
Replace Refrigerator		Shower Adapter

Many of these measures save energy by decreasing unnecessary air flow into and out of the home. As a result, PG&E deemed it necessary to assure customer safety by performing a comprehensive CAS test on all gas appliances, which includes testing for carbon monoxide (CO) production, prior to installation of the measures that affect air infiltration or exfiltration. While on site, PG&E also tests the ambient air levels in the house, to determine if unacceptably high levels of CO are present. These tests are conducted both before and after installation of energy efficiency measures that affect air flow. The post

installation tests are conducted on 20% of the homes, to assure that the newly sealed homes are still safe.

If the pre-installation CAS test identifies appliances that are malfunctioning, then the installation of infiltration measures is put on hold until the situation is remedied. In many cases this is simply a matter of a PG&E Gas Service Representative (GSR) adjusting the appliance. In other cases it requires the customer, or the landlord, to effect repairs. Often the length of time required for customers to effect repairs results in the infiltration prevention measures not being installed.

PG&E's 1998 EPP contract, incorporating the pilot CAS Testing component, began in March of 1998. As of mid-August 1998, approximately 7,300 residential units had participated in the CAS testing program.

A more detailed assessment of the work flow of the EPP/CAS Testing process is presented in Section 4 of this report.

2.2 Research Objectives

The evaluation objectives were originally stated in the Scope of Work and were refined during the project initiation meeting. Those objectives are:

1. Conduct a process evaluation of the CAS component of PG&E's Energy Partners Program – including an evaluation of the Program Administration Process.
2. Assess customer satisfaction with the CAS Program.
3. Assess the effectiveness of the training process of CAS test personnel**.**

These research objectives were addressed through the research methodology discussed in the next section of this report.

2.3 Development of Current Program Structure

The following description of the 1998 Combustion Appliance Safety (CAS) testing pilot component of the Low Income Energy Efficiency program was written by PG&E staff. It is included in this report to satisfy some of the requirements of the June 18, 1998 Order Modifying Resolution E-3515, Conclusion of Law 4.

PG&E's Low Income Energy Efficiency program, also known a Energy Partners, installs a number of items designed to reduce home air infiltration. In homes where energy efficient infiltration measures such as caulking, weather-stripping and outlet gaskets will be installed, CAS testing of all gas appliances is required as part of the initial inspection process in order to ensure the health and safety of these households. This section discusses the CAS testing process and why PG&E has chosen the existing program as the pilot for 1998. Other sections of this report deal more specifically with concerns of the delivery methods for CAS testing.

In order to assure that appliances are operating safely, and that carbon monoxide (CO) is not present in excessive amounts, thereby creating a health hazard for the customer, PG&E provides Combustion Appliance Safety (CAS) testing of all gas appliances. Some parties have suggested that a CO alarm would be sufficient to protect the health and safety

of these customers. A CO alarm does not replace the CO test component of CAS testing. While CO alarms test the ambient air in the conditioned space, they will not detect excessive CO levels in the internal flues of gas appliances. In addition to testing for CO in the conditioned space, PG&E's test detects CO in the appliances' flue gases, at the source, before it has a chance to migrate to the ambient air of the household.

The presence of CO in an appliance's flue indicates inefficiency in the appliance's combustion system. Efficiently operating appliances exhaust carbon **di**oxide (CO_2)and water vapor. A CO alarm will not detect inefficient combustion if the appliance's venting system is operating correctly. However, PG&E's CO testing will detect inefficient combustion.

Moreover, a CO alarm would not identify other combustion related safety hazards. At the time of this report, about 7300 residences had participated in the 1998 CAS testing pilot. Of the 290 appliance failures resulting from the CAS test, only 37 were caused by high CO levels. The other 253 failures were for reasons that a CO alarm would not detect such as:

- cracks or holes in combustion chambers,
- bypassing valves,
- bypassing safety shut-offs,
- broken radiants,
- plugged burners,
- warped burners,
- gas leaks,
- defective gas flex connectors,
- illegal flex connectors,
- missing vents,
- missing draft diverter,
- missing flex adapter,
- overgassed,
- delayed ignition,
- flame distortion,
- floating flame,
- flex line through floor or wall,
- sooting.

Clearly, CO alarms will eliminate only a small percentage of the hazardous situations.

An additional concern with CO alarms is the location of the alarm. Alarms exposed to moisture or placed in an inappropriate location could result in a false alarm or no alarm.

CO alarms will respond to CO produced by sources other than gas appliances such as cigarette smoke, auto exhaust, and excessive moisture. Some customers will remove or disconnect the alarm due to chronic false alarms or low battery alert signals.

PG&E believes that CAS testing is necessary whenever the home of a low income customer is to receive measures to reduce air infiltration. The results of the pilot also indicate that a simple CO alarm would be an inadequate replacement.

CAS Test Components

The nine components of the complete CAS test are described listed below.

Gas Leakage

The dwelling will fail the CAS test when an inspector detects natural gas leakage during the inspection (inside or outside) of the dwelling.

Drafting

When the inspector determines that the byproducts of combustion are not being expelled through the vent system, the appliance will fail the CAS test.

Carbon Monoxide

The appliance or dwelling will fail the CAS test when the inspector detects carbon monoxide (CO) levels:

1. 100 ppm or higher at the flue of an appliance other than a gas range,
2. 100 ppm or higher at a gas range/cooktop,
3. 225 ppm or higher at a gas range/cooktop after adjustment by a qualified technician,
4. 10 ppm or higher than the outside ambient reading as an inside initial ambient reading with all gas appliances off , without an obvious source of the increased CO such as the customer smokes, fireplace is in operation, apartment above garage with vehicle operating,
5. a second ambient reading with appliances on is higher than the initial ambient reading.

Flue and/or Venting System Defects

Disconnection, holes, missing sections or gaps in the flue or venting system will cause the appliance to fail the CAS test.

Inadequate Combustion/Ventilation Air

The inspector will verify that there is adequate combustion/ventilation air openings for all tested open burner or induced draft furnaces, room heaters, wall furnaces and water heaters located in a confined space. Inadequate combustion/ventilation air openings will cause the appliance(s) to fail the CAS test.

Supply Duct(s) and Fresh Air Supply

A visual inspection of the duct system, including the fresh air return, will be made to determine if air leaks could depressurize an appliance in an enclosed location. Gaps or missing sections will cause the appliance(s) to fail the CAS test.

Unvented Appliance Used As A Heater

By observation and customer interviews, the inspector will determine if an unvented gas appliance is used to heat the living space. When an unvented appliance is the primary heat source or when an unvented appliance, including a range, cooktop stove, or oven, is used as a heater because the primary heating appliance is defective, the dwelling will fail the CAS test.

Appliance Operating Characteristics

The inspector will verify that the flame roll out shield and doors to the appliance are in place, and that burner ignition is not delayed. Missing components, roll out shield, or delayed ignition will cause the appliance to fail the CAS test.

Mobile Home Gas Cooking Appliance Ventilation

The inspector will verify that the mobile home has an operational exhaust fan located in the kitchen area. No fan or an inoperable fan will result in a failure of the CAS test.

3 EVALUATION METHODOLOGY

This section presents the evaluation methodology, including specifics on the data sources and the process analysis.

3.1 Description of Method

The 1998 CAS Testing Program evaluation encompassed the CAS component of the Energy Partners Program. There were three elements to this evaluation – administration/implementation process, training effectiveness, and customer satisfaction. The first two components were evaluated through structured interviews of relevant PG&E and implementation contractor staff. Although similar, the interviews were customized for the EPP staff, the Central Inspection Program (CIP)/CAS staff, the prime contractor, and the subcontractors. The trainers interview varied substantially from the other interviews because of the different types of information being sought.

The information gleaned through the structured interviews was synthesized to create an overall picture of the CAS process, its strengths, and its weaknesses. Simple cross-tabulation of responses was used to identify issues and support conclusions.

Customer satisfaction data was gathered through a telephone survey. The 200 data points gathered were analyzed using simple frequency and cross-tab techniques.

3.2 Data Sources

One of the key elements in extracting the most information from any evaluation is maximum use of all available data sources. Equipoise used all applicable existing data available from PG&E. The primary existing data sources were:

- The PG&E CIP CAS database for 1998. This database contains information on the CAS program.
- PG&E program design documentation, designers, implementation documentation, and implementers.

These data sources, combined with guidance from PG&E evaluation staff identifying key program staff, were used to create the evaluation data collection plan and guide the data collection efforts.

Additional data was collected from the following sources using the stated data collection techniques:

- Telephone survey of the CAS Program participants.
- Interviews of the PG&E general office employees responsible for the design and implementation of the CAS Program.
- Interviews of the current and previous prime contractor employees responsible for the implementation of the EPP.
- Interviews of current subcontractors' employees responsible for fielding the program, some of whom were subcontractors in previous years.

- Interviews of the PG&E employees at the Stockton Training Center responsible for the design and implementation of CAS Testing training. This included a tour of the facilities used for training and a demonstration of the tools used for sensing combustion by-products.

The completed number of data points by data collection type and source is shown in Exhibit 3.1.

Exhibit 3.1
Data Collection

Organization	Type of Staff Interviewed	Telephone Survey	Structured Interviews by Phone	Structured Interviews in Person	Total
PG&E	**General Office**	0	0	2	**2**
	Central Inspection Program	0	0	2*	**2**
	Stockton Training Center	0	0	2	**2**
Prime Contractors	**Managers**	0	1#	2	**3**
	Energy Specialist	0	0	~12*	**12**
Sub-contractors	**Managers**	0	4	1	**5**
Customers	**Random**	200	0	0	**200**
Total	**-**	**200**	**5**	**21**	**226**

* Group interview.
# 1996 EPP Prime Contractor

In total, 226 telephone surveys or structured interviews were conducted. The 200 telephone interviews employed "closed-ended" questions (i.e., allowed only certain predetermined responses to be entered) while the 26 structured interviews allowed open-ended responses and encouraged probing discussion of important issues.

3.3 Sample Design

This portion of the report presents the sample design for the customer telephone surveys. The sample frame was composed of the 7,337 households contained in the program database for the period March through August 1998.

The sample unit was the individual household. Equations 1 and 2 below can be used to determine the sample size necessary to attain a desired level of precision for estimating the mean satisfaction of customers with the program.

$$n_0 = \frac{t^2 S^2}{d^2} \qquad (1)$$

where:

n_0 = Required sample size without finite population correction
t = Critical value of t associated with the desired level of confidence
d = Desired level of accuracy
S^2 = Variance of satisfaction in sample

To account for the fact that the sample may be a reasonably large fraction of the population, Equation 2 is used to adjust downward the initial required sample size, n_0.

$$n = \frac{n_0}{1 + \frac{n_0}{N}} \qquad (2)$$

where:

n = Required sample size with finite population correction
n_0 = Required sample size without finite population correction
N = Size of the population

The sample size required to estimate the mean satisfaction for all 7,337 households is based on the following five assumptions:

1. t = 1.645 at the 90 percent level of confidence;
2. the mean level of satisfaction will be 2.5;
3. the estimate must be within ± 10 percent of the mean (d=.25) ;
4. the variance estimate is 4 and is based on an assumed standard deviation of 2 or a coefficient of variation of 0.80.; and
5. since the level of customer satisfaction is assumed to be unrelated to such variables as demographic characteristics, size of gas bill, geography, etc., no stratification of the sample is needed, i.e., a simple, proportional random sample will suffice.

Using these five assumptions in conjunction with Equation 1, n_o was estimated to be 172. Using Equation 2, n was estimated to be 168 and should therefore be sufficiently large to provide an estimate of the mean satisfaction for all 7,337 households at the desired level of precision. In order to be conservative and to further increase the precision of the estimate, interviews were completed with 200 households, which reduces the error from 10 percent to 9.5 percent.

Because this is a simple, proportional random sample, it is self-weighting. That is, the estimate of the mean based on the sample does not need to be weighted and represents the best estimate of the population parameter, the mean satisfaction.

4 RESULTS

4.1 Overview

This section presents the analysis of all staff interviews and the customer survey. It addresses the program administrative process, the customer satisfaction, and the training effectiveness goals of the evaluation.

In reviewing this section, it is important to remember several points:

- The results are subjective summaries of the evaluation team. They are usually based on the results of more than one question and are always based on responses from more than one person.
- An in-depth discussion of each point along with many other aspects of the same question is presented further on in this section.

4.2 CAS Testing Administrative Process Assessment

One of the three primary research objects of this evaluation is to assess the operation of the CAS Testing program operation and its integration into the EPP. This section divides that task into the following elements:

- Assessment of all parties' understanding of CAS goals and how well these goals are being met.
- Assessment of EPP marketing, including which elements enhance and inhibit participation.
- Assessment of the CAS implementation and its interaction with the EPP.
- Assessment of the CAS tracking operation and effectiveness as part of the overall program.

4.2.1 Understanding and Achievement of CAS Testing Goals

The CAS Testing Program was designed to assure the safety of PG&E customers undergoing weatherization programs. The program was developed because PG&E was concerned about customers when houses with malfunctioning appliances were sealed more tightly during weatherization. Thus, the two primary objectives of the program are to assure the health and safety of the customers..

An additional evaluation goal concerning EPP evolving from the ruling requiring this evaluation (RESCUE App. for Rehearing of Res E3515) was to assess the pilot program for effectiveness and improvements.

Understanding Goals

Understanding Goals Among Implementation Staff – When asked to state the primary program goal, all interviewed staff responsible for any element of the program implementation stated one or both of the two primary program goals. Most stated assuring customer health and safety first. The fact that all program implementers understood the

overall program goals is a primary indicator that the program has been well disseminated and launched in a focused manner. It means that all players understand the central purpose of the work that they are performing every day.

The clear understanding of the CAS program goals is probably also a result of the fact that the goals have not changed since the program inception. This was confirmed by all staff interviews. Consistency of message is a very important factor in successful program implementation.

All implementation staff were also asked whether they considered the program goals as realistic. Most interpreted this question as asking about the participation targets. All but one respondent answered that the goals were realistic. One respondent indicated initial skepticism, but now believes that the goals were realistic. One voiced concern about whether the level of CAS staffing was sufficient to keep the program on track. The person who felt that the goals were unrealistic pointed to the late program start for some contractors as the reason for the concern.

Overall the program implementation team has been given clear and consistent goals, understands the goals, and believes the goals are achievable. All of these are good indicators of program success.

Achievement of Goals

Health and Safety– Two indicators were used to determine whether the CAS Testing program is achieving its goal of assuring the health and safety of its low income weatherization customers. The first is the rate of pre-installation failures and the rate of post-installation failures. The second is the assessment of all of the program staff as to whether it was achieving the goal.

The rate of pre-installation CAS Testing failures from the CIP/CAS database is 24%[1]. This indicates that serious problems of gas appliance safety exist in the low income community. The incidence of post-installation CAS test failure is 0.5% (37 out of 7400). This differential indicates that the CAS test is achieving its goal of assuring the health and safety of the low income weatherization participants.

Implementation staff assessment of goals achievement was based on two questions: “As operated how well did the CAS program meet the goal of assuring health and safety?” and “Based on your knowledge, what are other ways to check for CO and other combustion products within a home?”.

In response to the direct question as to how well the program met the health and safety goal all respondents but one answered “very well” or “well”. The one respondent who answered “not so well” went on to indicate that the “CAS [was] only done when [appliance] pilot is on, and users shut off pilot after the CAS leaves…”. This same respondent later recommended that the program should include CO detectors in the

[1] During the interviews most staff reported approximately 40% failure rates, all quoting the percent previously communicated to them by PG&E. The 24% value reflects the most recent value based on the CIP database at the time of the report.

program, not as a replacement for the CAS testing, but as a supplement to assure longer term safety.

In response to the second question as to other ways to check for CO in the home, this group of knowledgeable people could not recommend a better method. Several suggested that the program install CO alarms in the homes as a means of assuring healthful conditions in the homes over time. Contrary to some suggestions, the installation of CO detectors would not protect customers against potentially dangerous situations arising from turning off pilot lights. CO detectors do not warn of the presence of unburned gas in the house.

Thus the CAS test as administered appears to be substantially assuring the safety of the low income weatherization participants from the dangers of CO gas accumulation due to faulty appliance operation.

Validity of the CAS as a Pilot Program – The evaluation asked the implementation contractors "As operated, how well has CAS met goals for use as a pilot program?". Of the five responses, two indicated "not very well" and three indicated "well". However, four of the five went on to identify areas where it was not working or where it could be improved. Finding these issues is, of course, exactly the purpose of a pilot program. Overall, we believe that these results, along with the analysis of the implementation of the program presented later, indicate that the current CAS program is serving its purpose as a "pilot" for any CAS efforts that may be fielded in 1999.

Program Participation Goals – The CAS program had the potential to significantly hinder PG&E's contractors' ability to achieve the participation goal of 33,500 participants from March to December 1998.[2] These goals are further subdivided as illustrated in Exhibit 4.1.

Exhibit 4.1
Distribution of Participation Target Ranges

Housing Category	Target Range
Single-Family Homes	44-68%
Mobile Homes	6-16%
Multi-Family Housing	30-37%

Interviews with PG&E general office staff indicated that progress as of mid-August was on track with last years performance. They fully anticipate that the program will achieve the target by the end of 1998.

Despite general agreement that the goals are realistic, the contractors are not as sure as the General Office (GO) staff that the current program, including the CAS Testing, will be able to achieve the targeted number of completes. This appears to be due to limited

[2] PG&E has an overall goal of 38,835 low income participants from January through December 1998. This includes EPP participants completed from January though March 1998 under the previous years program.

experience with the current program. When asked "As operated, how well has CAS met goals for participation levels?", three of the contractors indicated that they were still "building backlog" in order to get into full production. The contractors that had more experience felt more positive about the final outcome and the ability of the process to achieve the goals.

As with the health and safety goals, the fact that the program features have been held fairly constant help in delivering a consistent message and keeping the program on track. While three of twelve responses indicated that program features had been changed when asked "Were features and/or procedures revised once CAS was underway?", follow on questions indicated that the changes were actually minor procedural changes and not program feature changes.

Ancillary Goals –Interviewees identified two other "goals" that they believed were being pursued. These goals were stated as:

- Pre-approval of measures and assuring that the contractors get paid. The CAS testing process has allowed PG&E to implement "pre-approval" of measures that the contractors can install. This allows the contractors to install the measures with a clear indication that they will get paid for all of the measures that they install. Several interviewees indicated that this is a big advantage, and that they would like to be sure that this feature of the program is kept. Two interviewees indicated that this part of the program was going well to very well.
- Completing the CAS tests on the same day. One interviewee indicated they thought that there had been a goal to complete the CAS test on the same day. They did not know whether this goal was being met or not.

Overall, the evaluation team concludes that the program goals have been clearly stated and communicated, that the goals are perceived as realistic and achievable, and that the program features have been consistent during the time the program has been offered. All of these features contribute toward program success.

4.2.1 Energy Partners Program Marketing

As part of the process evaluation, Equipoise assessed the marketing of the EPP. The assessment attempted to determine any affect that the CAS Testing program had on EPP marketing success. This was done by giving the marketers of the EPP opportunities to identify positive and negative elements of the marketing effort. The questions asked about the marketing approach, most and least effective marketing methods, whether changes had been made to marketing efforts, and what features of the program were most influential and detrimental to participation. The following general findings were derived from the assessment of the EPP marketing assessment:

Marketing Approach – By far the most widely applied EPP marketing approach is door-to-door recruitment in targeted low income areas. The targeted door-to-door recruitment is supplemented by referrals from PG&E's Smarter Energy Line and other bill complaint referrals. While less favored, some contractors use mail and telemarketing recruitment in specialized situations.

Most/Least Effective Marketing Methods – The most effective marketing approach was almost universally agreed to be door-to-door in person recruitment in targeted low income areas. The least effective method was most succinctly identified as anything other than door-to-door. Telemarketing and advertising were also mentioned as ineffective.

Features Most Influential in Inducing Participation – The feature that was identified most often as being influential in inducing customers to participate was free measures and services. (Seven of the eight staff interviewed identified the fact that the program was free as a main factor in participation.) CAS testing was identified as important by two interviewees. Individual measures (showerheads, refrigerators, attic insulation, minor home repair) were also identified as factors in getting people to participate.

Features that Tended to Discourage Participation – The two most common features identified by the interviewees that discourage customers from participating are (1) they do not believe that it is free, and (2) the number of visits and time that has to be invested by the customer. The second point is the one that impinges on the CAS Testing Program evaluation. The staff interviewed stated that as the program is currently structured the program has a minimum of five to nine customer contacts and as many as 10 separate steps. The CAS inspection process increases the number of visits. As currently structured, a common contact sequence might go as follows:

1. Initial recruitment (in-person door-to-door), attempt to set up appointment with CAS.
2. CAS Inspector shows up to do CAS test. Test passes go to step 8 below. Test fails, GSR appointment requested, and a second CAS test is scheduled if necessary (does not involve the customer).
3. GSR shows up, inspects and possibly adjusts equipment. Equipment not adjustable results in two possible requirements: (a) equipment left operating, repair by private party required, (b) equipment “red-tagged”, shut off, gas disconnected, repair required by private party.
4. Equipment repair by private party.
5. CAS tester requested by customer (does not involve customer).
6. CAS tester inspects and passes the home.
7. Schedule the EPP repairs to the home.
8. Install weatherization measures by EPP contractor. This may occur over several days as the contractors typically employ specialized crews to perform components of the weatherization process.
9. Post installation inspection by contractor staff.
10. Post installation inspection by CIP/EPP inspector.

The CAS inspection process, as currently fielded, composes one to five of the eleven steps in the process (steps 2 through 6). (The most common number of CAS visits required is one visit, since 60% of all dwellings pass on the first test. Additionally only 20% of the dwellings are post inspected.) As a result it has been identified as the largest factor in discouraging participation. Thus, it is not surprising that several of the contractors

commented that they avoided saying how many contacts or visits would be required in their initial recruitment efforts so they would not lose customers.

In summary, the most widely applied and successful marketing approach is door-to-door solicitation in targeted low income areas. The free services is the feature that most influences people to participate and the high number of contacts is the feature the most discourages participation. The high number of contacts is a direct result of the inclusion of the CAS testing program component.

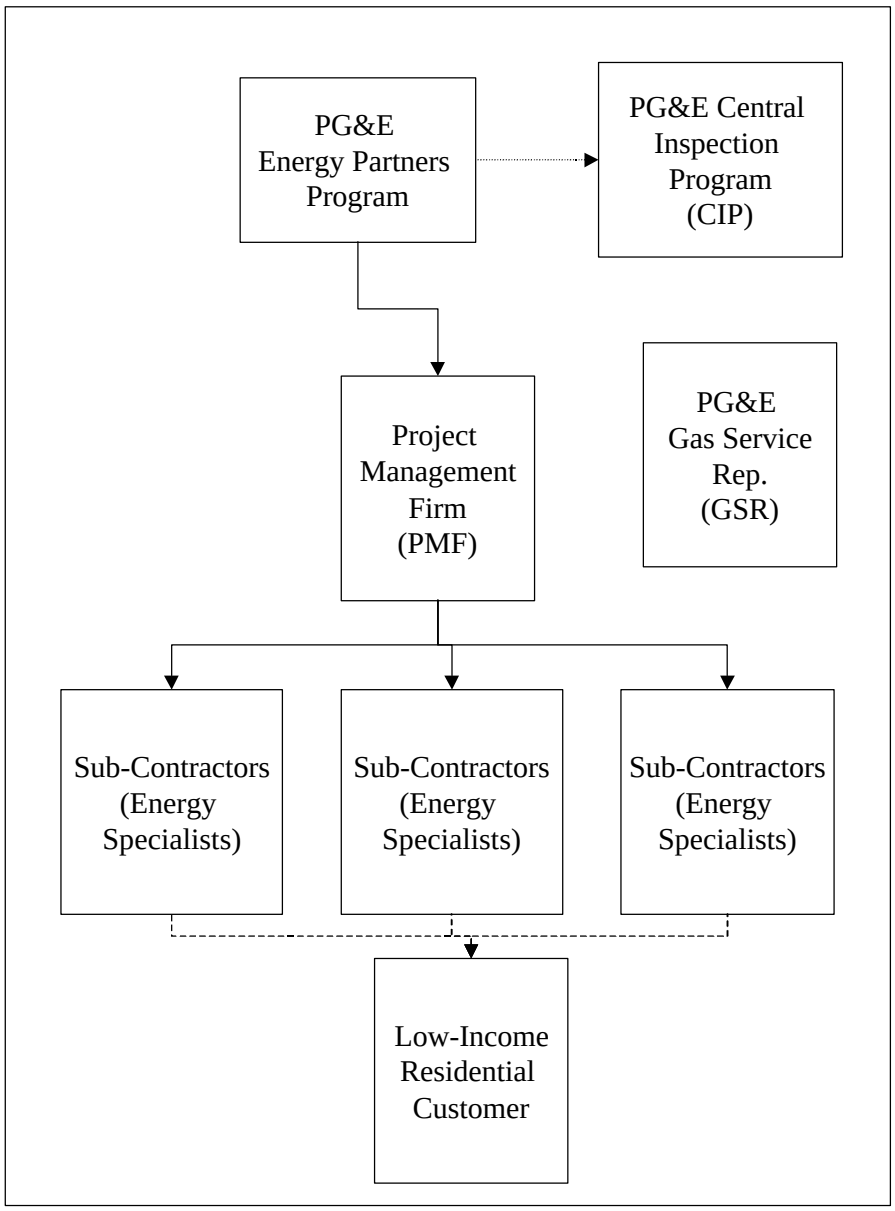
4.2.2 CAS Testing Program Implementation/Operation

The discussion in this section is split into two parts. First, we present an overview of our understanding of how the EPP/CAS programs operate. This is followed by an analysis of the issues raised by the EPP and CAS staff interviews.

EPP/CAS Program Contractual and Reporting Structure

The contractual structure of the EPP and the CAS varies from the reporting structure. Exhibit 4.2 indicates the contractual structure. One issue that is rapidly apparent from Exhibit 4.2 is that the Project Management Firm (PMF) has no direct contractual line of authority to either CIP (who conducts the CAS testing) or the GSRs. The program was set up this way intentionally based on the belief that it was not a good idea to let the contractor (who has a profit motive) also be responsible for safety testing which can inhibit their ability to make sales. The issue of the reporting structure for GSRs was never really an issue since GSRs are PG&E employees and were already serving an existing function within PG&E.

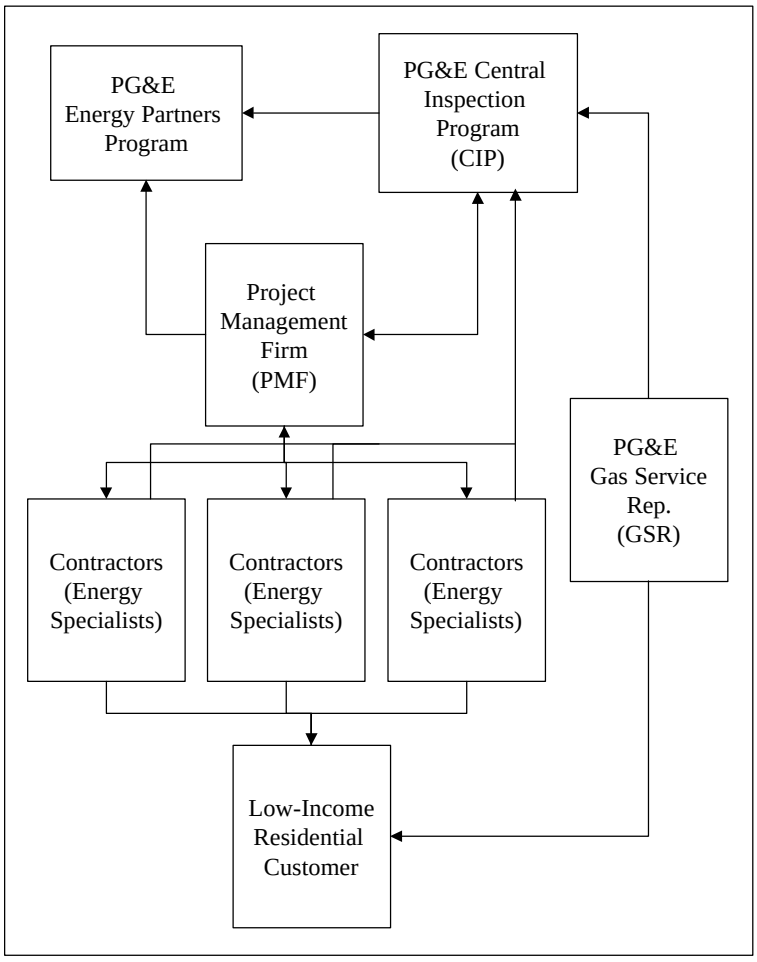
Exhibit 4.2
Contractual Structure



There is no actual contract between the EPP and CIP arms of PG&E. CIP commitments to perform work are laid out in the document titled "PG&E Central Inspection Program Policies and Procedures, Combustion Appliance Safety Testing and Energy Efficiency Measure Inspection" dated February 11, 1998 and revised June 8, 1998 (Attached in Appendix C). The arrow represents a commitment of the two sections of PG&E to work together to complete the needed components of the programs. The GSR entity is shown with no contractual agreements since it operates independently of either the EPP or CIP. An implied contract is indicated between the energy specialists and the customer.

Exhibit 4.3 indicates the reporting structure.

Exhibit 4.3
Reporting Structure

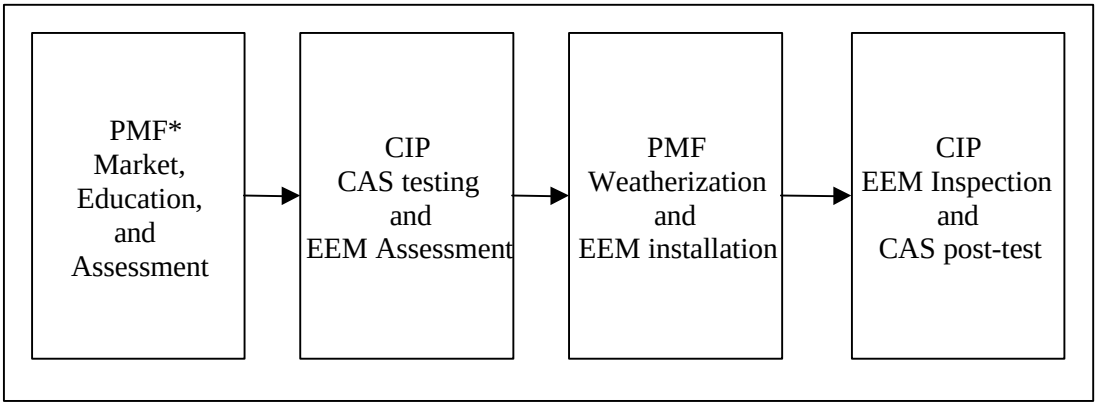


As a quick glance indicates, there is much more interaction between the entities than illustrated in Exhibit 4.2. A review of Exhibits 4.1 and 4.2 illustrates that while CIP plays a crucial role in the program implementation, neither EPP nor the prime or subcontractors have any direct route to influence CIP budgets or performance. Independent of the actual performance of CIP on the project, this is far from an ideal organizational structure.

EPP/CAS Program Operation

While CAS Testing is a component of EPP, it is run by the CIP. CIP contract employees are trained by the Stockton Training Center (STC) in CAS testing and energy efficiency measures (EEM) inspection. The CIP testers are integrated into the flow of the EPP as shown in the overview in Exhibit 4.4.

Exhibit 4.4
Installation Flow - Overview



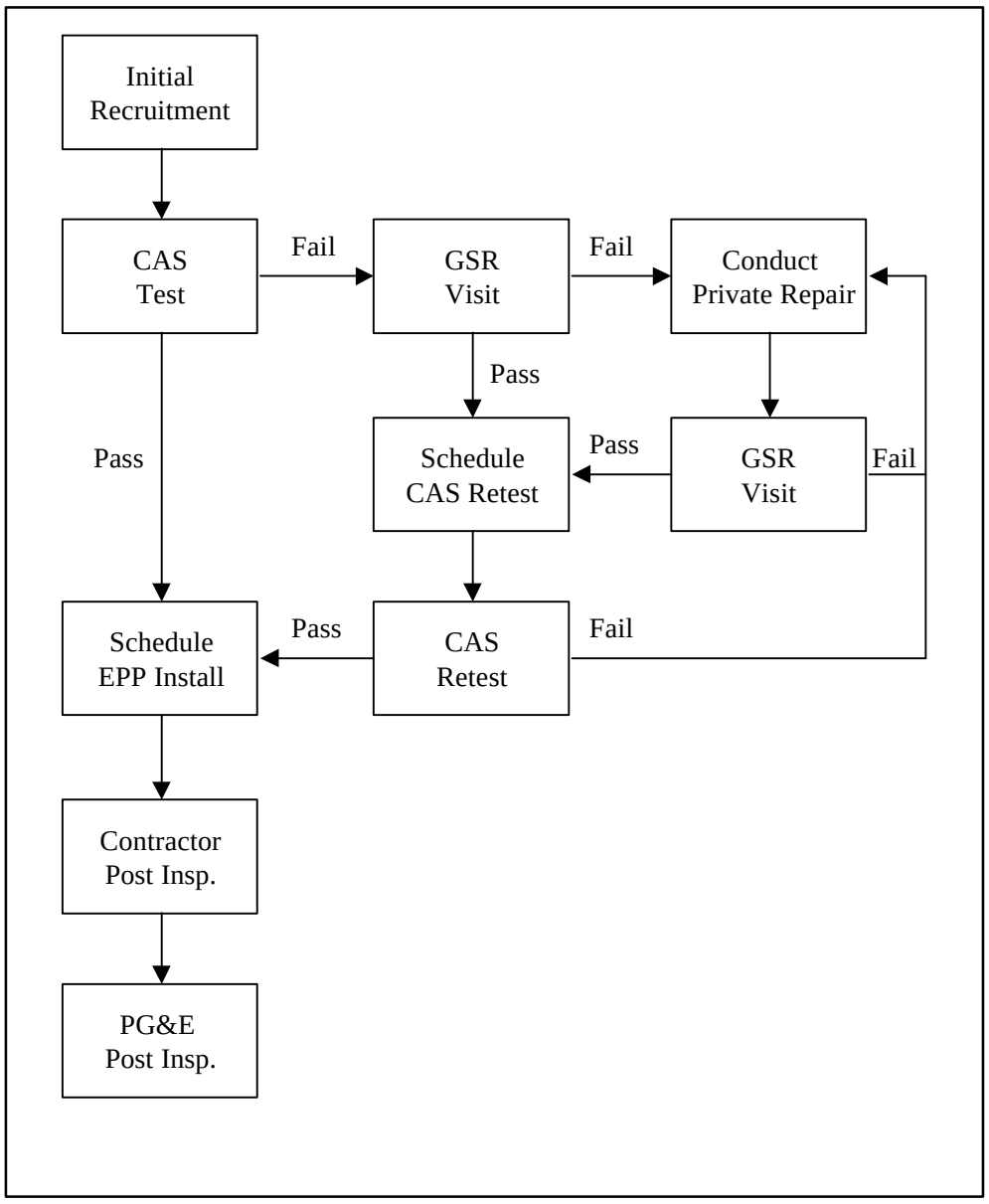
*PMF = Project Management Firm

Only those homes which are potential candidates for the weatherization infiltration measures have a CAS test performed. However, as it turns out, 98% of the homes are candidates. Only 20% of the homes with infiltration measures installed are slated for a post-installation CAS test. The purpose of the post-installation CAS test is to assure, on a random basis, that the newly weatherized homes have been safely weatherized, have safe CO levels, and that appliances that required attention have been properly adjusted or repaired.

CIP has written extensive detailed descriptions of the policies and procedures for the CAS inspection program and the CAS testing procedure. These are included for reference in Appendices C and D. The following summarizes those documents and the interviews of EPP/CAS program implementation staff.

Exhibit 4.5 presents a more task-specific typical installation/inspection flow diagram for the EPP/CAS program. As has been stated earlier, this process can easily involve five or more contacts for customers who fail the CAS test. It is important to remember that 98% of the homes qualify for weatherization measures, meaning 98% receive a CAS test. Of this 98%, approximately 24% fail the CAS test on the first try.

Exhibit 4.5
General Installation Inspection Flow Diagram



Each of the steps depicted in Exhibit 4.5 can be summarized as follows:

1. *Initial Recruitment*. Most contractors identify potential low-income neighborhoods and recruit via in-person door-to-door solicitation. Often, once they begin working a neighborhood the word spreads and occupants become more receptive to recruitment. When a customer agrees to participate, the contractor's Energy Specialist (ES) inspects the home, identifies potential measures, establishes that the home meets the income criteria of the program, discusses with the customer ways that they can save energy, and verifies that the equipment to be inspected is operating and that the pilot light is lit. If the pilot lights are not working, the ES tells the occupants that either they need to get them lit (either themselves or by their landlord) or the ES can arrange for a

GSR to come and light them. The occupant can then call and inform the contractor when the pilot lights are lit. If the pilot lights are working, then the ES calls the CAS appointment telephone number (using the customers phone) to arrange a mutually acceptable time for the CAS inspection (see below).

The fact that the pilot light is lit is crucial to the smooth flow of the program. If the pilot light is not lit when the CAS tester arrives, then the CAS test cannot be done. Since the CAS testers are not allowed to light pilot lights, they then tell the customer that they have to get them lit or arrange for a GSR to light them. They have then wasted a trip. When the pilots are lit, the CAS tester then comes back. To try to assure that the pilot lights are working, the ESs ask very specific questions (like "if we turn on the stove will the burner light up so you can cook") or some actually say they are turning on the appliance themselves to check.

2. *Scheduling CAS Test*. At the end of the inspection and customer education the ES calls the CIP/CAS telephone scheduler. If an appointment cannot be scheduled (e.g., long hold times or off hours recruitment), the ESs fill out the section on the customer application form (Appendix B) identifying three times that the customer intends to be home. These applications forms are then faxed in by the contractors daily. CIP dispatch then inputs the faxed tag into the CIP data base and PG&E calls the customer to schedule an appointment. If there is no answer, the CAS tester then simply goes to the home during one of these three times. The customer is often not home. This results in a reported "Can't Get In" (CGI). CIP makes three attempts to contact the customer. First they show up, if the customer is not home they leave a card and attempt to contact the customer by telephone (if the customer has a phone), then they make two more attempts to conduct the CAS test. If after three attempts they cannot get in they leave a card telling the customer that they will only have the non-infiltration measures installed, and giving them options to change this. The total percentage of customer that this happens to is reported by CIP to be seven percent. If CIP/CAS cannot perform the test for any reason within 10 business days of the recruitment, then, according to the contract they are supposed tell the contractor within 5 business days that they are allowed to install non-infiltration measures only.
3. *CAS Test*. If the customer is not home when the CAS tester show up to do the CAS test, this results in a "Can't Get In", or CGI, being reported. CIP then attempts to contact the customer by phone to set up another time. If the customer does not have a phone, a second and a third trip is performed to the site by CIP before labeling the site as a CGI. If the customer does have a phone, they are called and an appointment time is scheduled. If they are again gone when the CAS tester shows up, the site is labeled CGI. If the customer is home, the CAS test is completed and results in a pass or fail. If the test passes then the next step is to schedule the EPP installation (step 9 below).
4. *CAS Test Fails*. If the test fails, then a GSR visit is scheduled. If levels of CO in the home are at dangerous levels or natural gas is smelled, then a GSR is called in immediately.
5. *GSR Visit*. A GSR arrives, inspects and possibly adjusts equipment. If equipment cannot be adjusted then there are two possible results: (a) the equipment is left

operating, and the customer is told that they (or their landlord) need to have it repaired by private party; or (b) the equipment is "red-tagged", shut off, and gas disconnected by the GSR because it is dangerous to the customer The customer is then informed that they (or their landlord) need to have the equipment repaired by a private party. The customer is given, if appropriate, contacts at community assistance agencies that can assist them in getting the appliance repaired. CIP follows up routinely on "red-tagged" equipment cases to see if it has been repaired and to try to assist in making sure they know what they have to do and where to go to get assistance.

6. *Equipment Repaired*. In this step the customer or the landlord arranges for or completes the repair or replacement of the malfunctioning equipment.
7. *Request CAS Retest*. When the equipment is repaired, the customer calls the EPP contractor to say that the equipment has been repaired and is now ready to be retested. An appointment is set up to complete the CAS retest.
8. *CAS Retest*. CAS tester retests the home, resulting in a pass or fail. If the home fails, then the customer is either told what needs to be done by the CAS tester or a GSR is called in again, returning to step 4 above. A pass result is reported to CIP who reports it back to the contractor.
9. *Schedule the EPP Installation*. Once the EPP contractor is informed that the home has passed the CAS test, the installation of the EPP EEMs is scheduled. (As will be discussed later, if the process of achieving a CAS pass takes longer than 10 business days, then the contractor is allowed to go ahead and install all of the appropriate Non-infiltration Measures (NIM) and move on to other installations. So in some cases this may be a moot point.)
10. *Install Measures*. The contractors, for cost reasons, will usually wait until CAS approval or NIM status is confirmed to go ahead with installation. They can then install the weatherization measures at the same time that they install any non-infiltration measures.
11. *Contractor Post Installation Inspection*. The contractors perform a post-installation inspection to assure that all work has been performed properly and to conduct a second set of educational discussions with the customer. These discussions help the customer understand both the installed measures and how to save energy in general.
12. *CIP Post Installation Inspection.* CIP performs post installation inspections on 20% of all measures and 100% of attic insulation measures. Post installation CAS tests are performed on 20% of all weatherization sites.

Implementation/Operational Issues

Based on the preceding overview of program operation, and to a smaller degree upon the customer telephone survey, the evaluation team identified the following several discussion areas.

It is worth restating that the interviews included general office EPP/CAS staff, CIP/CAS staff, Prime contractor staff including Energy Specialists, all subcontractor managers, the prime contractor for the 1996 EPP program, and PG&E Stockton Training Center staff

responsible for training CAS inspectors. Several of the subcontractors had worked on previous EPP contracts and conducted similar programs for the State of California Community Services Department (CSD). Some of the contractors currently perform CAS tests under the CSD programs. Their CAS testers are trained by the PG&E Stockton Training Center.

Smoothness of CAS Delivery. While it has its operational issues (discussed below), the CAS Testing Program appears to be fairly well planned and implemented. The following facts and interview responses support and expand on this statement:

- Plans. Extensive and well documented plans exist (see Appendices C and D). The contractors are aware of these plans.
- Implementation. When asked "How well does the CAS implementation match the original design?" five of the seven interviewees stated very well or well. Three of these respondents were contractors.
- Consistency. When asked "Were features and/or procedures revised once CAS was underway?" three quarters of the respondents indicated that no changes had been made. The respondents who indicated that changes were made identified minor adjustments that would be expected in the implementation of most programs.
- Staffing and Scheduling. While CAS staffing appears to be adequate, on the "average" it is perceived by the contractors to be inadequate to meet the highly variable demands of the implementation as designed. According to the contractors, staff shortages result in inconvenience to the customer, limiting delivery of measures to the customers, and wasting of contractor time and energy. When asked "Is enough (field, office, management) staff available to implement CAS as designed?" all PG&E staff (GO, CIP, STC) stated that there was adequate staff. PG&E staff expanded on these answers by indicating that there should be "…enough based on historical data, but demand changed…" and that it is "…more an issue of coordination than manpower…", indicating recognition of some shortfalls. Unfortunately, this question was only asked of PG&E staff, and not of contractor staff. However, in response to other questions the contractors indicated that shortages of telephone scheduling staff and region specific availability of CAS staff are or have been a severe problem.

  Contractors commented on three telephone scheduling issues: (a) long hold times; (b) lack of availability of service in off hours when much of the recruiting is done; and (c) lack of foreign language service.

  - Long Hold Times. Routine hold times of 3 to 20 minutes were reported by contractors. CIP reported average hold times of less than 5 minutes. The hold times are an issue because the ES completes the call at the end of the 30 to 45 minute home inspection (when the customer is impatient anyway), the ES is tying up the customer's phone, and the ES needs to get on to other homes.
  - CAS Hours of Operation. CAS only offers telephone scheduling and CAS testing from 8 a.m. to 5 p.m., Monday through Friday. Much of the EPP recruiting is done in the evenings and on weekends in order to find the customer at home. Applications for customers recruited during off hours record three times when the

customer will be available and then are faxed to CIP the next morning. (It should be noted that PG&E reports recent staffing changes allowing after hours operations that may make this a moot point.)

- Foreign Language Service. Contractors report that CAS scheduling telephone service does not offer foreign language service (other than possibly Spanish). PG&E states that they do use the AT&T foreign language service. (CIP states that this has not been an issue for appointment scheduling.) If the service is not available it limits the ability to coordinate schedules. The low income community has many foreign speaking inhabitants. In addition, when CAS Testers go to the sites, they only carry English versions of their written information.

The issue of scheduling appointments is very important. If, for any reason, an appointment is not scheduled, there is a higher probability that the CAS test will not be performed in time for the customer to get the weatherization measures. When the CAS test cannot be conducted the contractors install only the non-infiltration measures, which means that the customers get less from the program than they should have received. Contractors stated clearly that it was not economically viable under the program structure to then go back at a later date and install the infiltration measures, although a couple indicated that they did so on a case-by-case basis.

Staffing of the CAS inspectors is also an issue with contractors. Several contractors indicated that they were being delayed by lack of availability of CAS results. One contractor even claimed to have been completely shut down at one point. However, it is worth noting that when queried as to the overall turn around time "from first notification of a need for a CAS inspection to the go ahead for weatherization" the contractors most commonly reported less than 10 business days . The contractors and CIP disagree on the size of the issue. The contractors perceive it as a large issue, while CIP perceives it as a small issue caused by fluctuations in the work load. The CIP database reports show that only 7.4% of the CAS candidates resulted in "Can't Get In" final dispositions.

It should be noted that this could be a communication issue. The most commonly identified problems are communication and data flow. CIP claims that virtually all of CAS tests that are not CGIs are completed within the 10 business day limit and communicated to the prime contractor within the agreed overall 15 business day limit. There is a history of computer communication difficulty between CIP and the prime contractor, and the prime contractor and between the subcontractors, which limits the evaluation team's capability to determine exactly where the delays occur.

- Inspection Times. The inspection times and the elapsed time from site recruitment to the go ahead for weatherization are discussed below.

  - Time to complete pre- or post-installation CAS test is about 40 minutes. This estimate was essentially confirmed by responses to question 1 of the Customer Survey

  - Time from first notification of a need for a CAS inspection to the go ahead for weatherization for CAS inspection with no repair necessary is estimated by the

contractors to be 3 to 15 days depending on work load. The most commonly reported time is estimated at 8 to 10 days.

- Time from first notification of a need for a CAS inspection to the go ahead for weatherization for CAS inspection when an appliance adjustment is necessary is estimated by the contractors to be 5 to 20 days depending on work load. The most commonly reported time is estimated to be 10 days. In general, the customers responses indicated shorter times for equipment adjustment, with 58% indicating one day or less and 69% indicating one week or less. The difference could potentially be the time it takes to enter data and notify the contractors to proceed with installation.
- Contractors did not know how long it took if an appliance repair was necessary. This is because, according to the contractors, most situations where an appliance repair is necessary result in installation of non-infiltration measures only. This is because either (a) the customers do not/cannot get the appliance repaired, or (b) it passes the 10 day time limit in which CIP is required to get back to the contractor. Either situation results in the contractor installing non-infiltration measures only and moving on to other jobs. To put this in perspective, CIP estimates that 4% of the recruited participants require equipment repair.

Overall the on-site inspection time is in line with planned and expected values. The turn-around times for CAS results with no repair necessary and for sites requiring appliance adjustments reflect previously mentioned person-power issues and information transfer issues (discussed further under Section 4.2.5, Tracking System Operation and Effectiveness).

Issue Resolution/Responsiveness. The evaluation attempted to assess how well the program could respond to external and internal stimulus for change.

- To assess the ability to respond to external stimulus we asked program implementation staff the question “Is there a procedure to handle CAS related customer comments and complaints?” and “How well do you think the system works?”. All organizations stated that there was a system, and PG&E staff and the contractors with the most experience operating under the 1998 program indicated that it worked very well. The contractors with the least experience under the program gave responses from “don’t know” to “somewhat well”.
- To assess the ability to respond to internal stimulus we asked program implementation staff the question “Are the PG&E, CAS, and subcontractor field staff responsive to requests for information and/or procedural changes?”. This question elicited the full range of possible responses because it was too broadly couched. This was followed up with three questions: “Is there a means for field staff to make suggestions for CAS improvements?”; “If yes, were these suggestions ever carried out?”; and “Did feedback from the field affect CAS implementation?”. This question was only asked of GO and CIP staff. However, all organizations were asked “In general, how effectively are problems with CAS implementation solved?”. The responses to these questions show that all organizations agreed that the monthly contractor meetings enhance communication and airing of issues. However, PG&E staff and contractor staff

disagreed on how effectively CAS implementation problems were solved. PG&E GO and CIP staff felt that implementation problems were solved quickly and effectively, while the contractor staff universally gave responses at the "somewhat", "not very", "not at all" end of the scale.

- This discrepancy in opinion on the problem solving capability is probably best exemplified by two comments made to the open-ended request for other suggestions made at the end of each interview. Two contractor interviewees responded similarly, "All need to work together closer, in a more cooperative manner. Feels that they don't have any way to get system changed. Cooperation would do a lot to get the program better." and "Typical of any new program. Every program they start is hard. Come along way. Turned out better than expected. Sitting down together as a group to problem solve would result in a better process. The program was imposed on the contractors". Both of these comments indicate that the contractors feel powerless and not included in the process.

In short, the CAS program has a working system for handling customer complaints (confirmed by high customer satisfaction rate) but is not responsive to suggested changes from contractors implementing the program.

Program Effects on Customers. The program has achieved some very clear results in the following areas.

- Customer Satisfaction. When queried, 80% of EPP and contractor staff indicated that they felt that the customers were satisfied to very satisfied with the CAS test. Their response is reported to be based on responses from customers. This is confirmed by the 94% customer satisfaction reported by customers in the telephone survey that is discussed in Section 4.3, Customer Satisfaction.
- Customer Safety. According to program implementation staff, a feeling of increased security and safety is the primary benefit that customers gain from program participation . Many were surprised at the high CAS failure rate. They admitted that they had been skeptical about the necessity for CAS testing prior to program implementation but now felt that the service was necessary.
- It is interesting to note that the response from the customer survey contradicts the opinion of the program staff. When asked why they were satisfied with the CAS test 95% indicated that it was because it meant that they could "get their house made warmer", while only 22% indicated that it was because "their house felt safer after testing.". This is somewhat offset by a later customer response where 70% indicated that they had learned how to make their houses safer.
- Reasons for CAS Failure. It is generally agreed that about 40% of the houses tested fail the CAS test the first time and that the most common reason is "not enough combustion air".
- Hardship, Appliance Adjustments. All program implementation staff felt that failures that require appliance adjustment do not represent a hardship to the customers. Customers also reported low levels of hardship due to appliance adjustment with 93%

of those responding to the question indicating no hardship and 3% indicating that it was a hardship.

- Hardship, Appliance Repair. Contrary to appliance adjustment, the program implementation staff felt that failures that require appliance repair did represent a hardship to the customers. In this case, a limited number of customers responses (only eight people responded to this question) showed 100% indicating no hardship.[3]

  While customers are directed to community help organizations in order to get help with the repair, in many cases the customers are just not able to get the equipment repaired at all. Sometimes landlords refuse to effect repairs. At least two of the interviewees stated that they wished that they could do more to assure that the customers get equipment repaired and are put back in service. One stated that they felt that PG&E should supply repair and replacement service for critical items.

Overall the CAS program has high customer satisfaction and supplies the customers with an enhanced feeling of safety. While appliance adjustments are not perceived to cause customers hardship, customers with failures requiring appliance repair are perceived to be caused hardship.

4.2.4 Alternative to CAS Testing

As part of the process evaluation we asked all interviewees whether "Based on your knowledge, what are other ways to check for CO and other combustive products within a home?". This was followed up with questions inquiring whether this would increase the risk and whether that risk level would still be safe for the customers. They were then asked about the pros and cons of these alternatives.

While several people listed CO alarms and CO strips as alternatives, all but one person agreed that they were not an alternative to current CAS testing. Most respondents felt that the CO alarm would be a good improvement for the current program. They contend that by installing CO alarms, PG&E is supplying the customers with a way that extends safety testing of the home beyond the narrow period around the CAS test. While acknowledging the recognized shortcomings of the CO alarms (false alarms, battery failure, and potential misplacement), they felt that including the alarm would be a net improvement for customer safety.

Several of the respondents volunteered that they had been skeptical about the requirement for the CAS test at the beginning of the program, but given the percent of sites that fail they believe it is a necessary part of the program.

4.2.5 Tracking System Operation and Effectiveness

To assess the effectiveness of the program tracking system we did a first order assessment of the data in the CIP tracking system and interviewed all program managers to assess

[3] It should be noted that the low response rate to this question fits well with the program statistics. CIP reports that 4% of the CAS population requires equipment repair due to "red tags" (i.e., equipment shut off and disconnected because it is dangerous). From a non stratified random sample with 204 customers responding eight indicated that they had had equipment turned off because of the test.

what kind of access they had to information, how they used it, and what additional reports would be of value.

CIP Tracking System

The evaluation team requested and received a retrieval of a wide range of fields from the CIP database. These data were manipulated and confirmed the total number of applicants reported by CIP for the period. The evaluation team did not conduct an audit of the paper files (or a sample) to confirm correct data entry of the number of events per applicant.

The tracking system is a Microsoft Access relational database. At face value it appears soundly constructed and fields that would be expected to be populated are populated with data. Rudimentary data retrievals from the data set produced rational results. The database appears capable of producing the reports necessary to support the program.

Data Source Flow

The input data for the tracking system comes from (1) the EPP contractors doing the installation, (2) the CIP inspection schedulers, and (3) the CIP inspectors. The contractors either call the CIP dispatch and schedule an appointment or send in the scheduling information via fax. The fax is sent if the contractors are working outside of the CIP hours of operation (M-F, 8 AM-5 PM). The CAS test is scheduled, all data concerning attempted or actual customer contacts are entered into the database as they occur. After the CAS test is completed all information regarding the CAS pass/fail is recorded by the CIP inspectors. Once completed, information is sent back electronically to the Project Management Firm (PMF or prime contractor) to be passed through to the subcontractors indicating that the site has passed or failed the CAS test. The CAS information is sent to the PMF twice a week and the PMF sends out the information to the subcontractors twice a week. The information from the PMF to the subcontractors has been sent in both electronic and hardcopy form. When there are electronic data communication difficulties, the subcontractors are faxed slips of paper which indicate the information on each site.

Data Dissemination

The evaluation team interviewed all of the program implementation staff on what information they got from the CAS tracking system and how they used it. The results of these interviews can be summarized as follows[4]:

- CIP and GO staff receive status reports (see Appendix A) and feel well informed. Some GO staff would like direct access to the tracking system.
- The prime contractor receives CIP tracking system reports on request. The subcontractor report receives no tracking information directly from CIP or indirectly through the prime contractor

[4] Readers who review the Tracking System questions 1 through 7 should be cautioned that responses about data availability are confusing because the respondents often say that they are satisfied with the information they get, referring to information that they get from internal systems, while the question is intended to elicit satisfaction with CIP information flow.

- Contractors all have their own system for tracking progress. While they would like more comprehensive tracking data from CIP they feel that their own tracking systems meet most of their needs.
- The contractors receive information twice a week from CIP identifying the sites that have passed CAS inspection and can now go ahead with installation. The contractors would like this information more frequently (daily if possible).
- The one piece of information that the contractors cannot get from their own system, which they want to get on a regular basis from CIP, is the status of all applications that have pending CAS test/approval. Since applications are often faxed in, the contractors have no double-check to be sure the application was actually received and is making its way through the system. When CAS results are slow in coming back, the contractors have no idea whether they were never received, have been mislaid, are waiting repairs, are having trouble passing the CAS test, etc. Having this type of status report would help contractors plan their work better.

System Compatibility

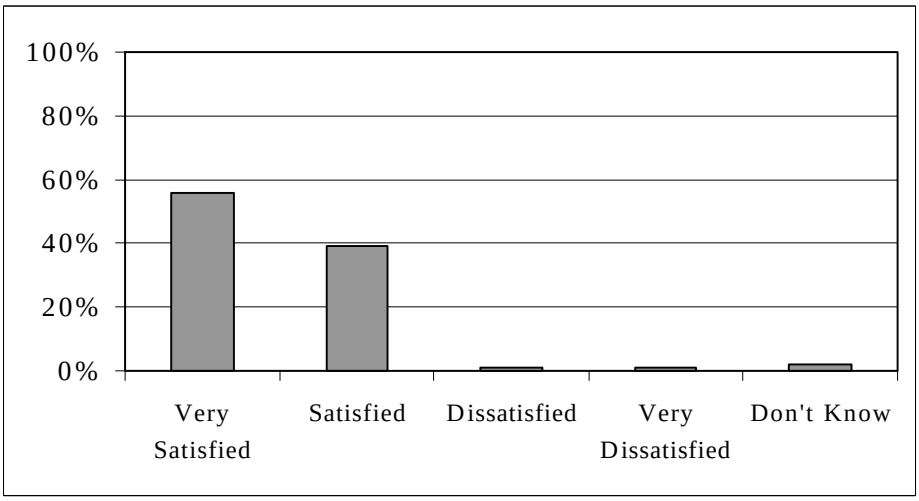
Both CIP and the prime contractor are aware of data transfer difficulties and incompatibility between the database system used by the prime contractor and the one used by CIP. These database difficulties have complicated data and report transfer between the CIP and the contractors.

4.3 Customer Satisfaction

The second evaluation goal was to determine customer satisfaction with the CAS pilot program. The customer satisfaction telephone survey was designed to determine customer response to four areas: 1) satisfaction, 2) hardship due to CAS, 3) value to customer, and 4) training effectiveness. The results of these four areas are discussed below.

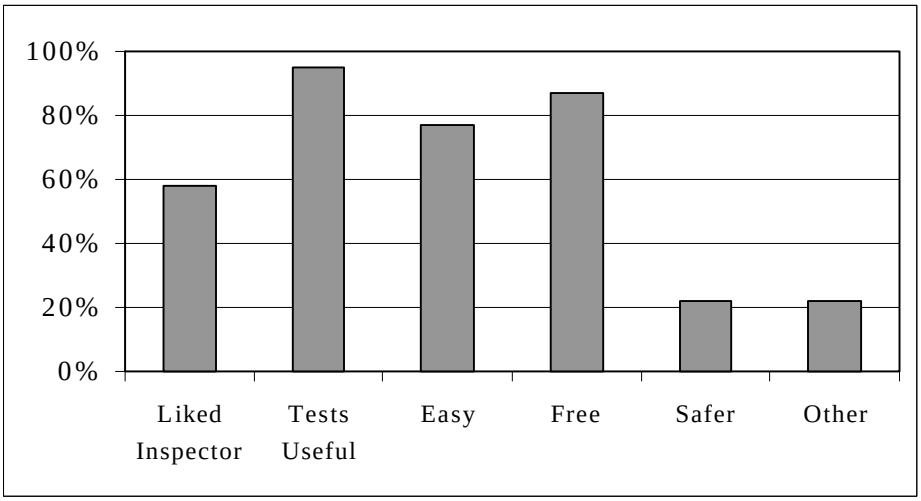
The customers were overwhelmingly satisfied with the CAS testing. **Exhibit** indicates that only 2% of the customers surveyed were dissatisfied, while 56% were very satisfied.

Exhibit 4.6
Customer Satisfaction



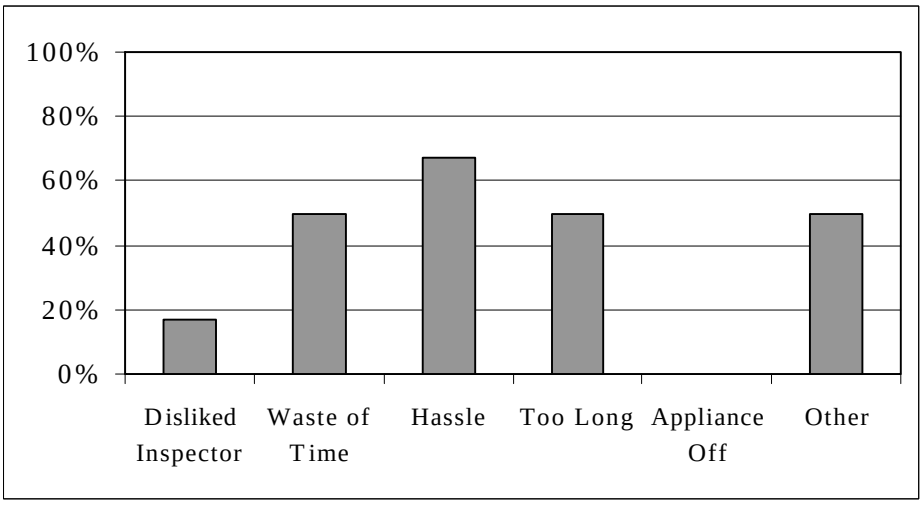
As shown in Exhibit 4.7, customers tended to like the inspector and found the tests useful. The majority of customers (77%) found the CAS test easy to have done. The other responses often reiterated that the customer felt the CAS inspector was doing a good job. There were a few other responses which stated they were satisfied specifically because of the carbon monoxide testing and safety.

Exhibit 4.7
Reasons Why Satisfied



For those few customers who were dissatisfied with the CAS test (six responses representing 2%), the biggest reason was because it was a hassle. None of the dissatisfaction was due to an appliance being turned off. Exhibit 4.8 indicates why the customers were dissatisfied.

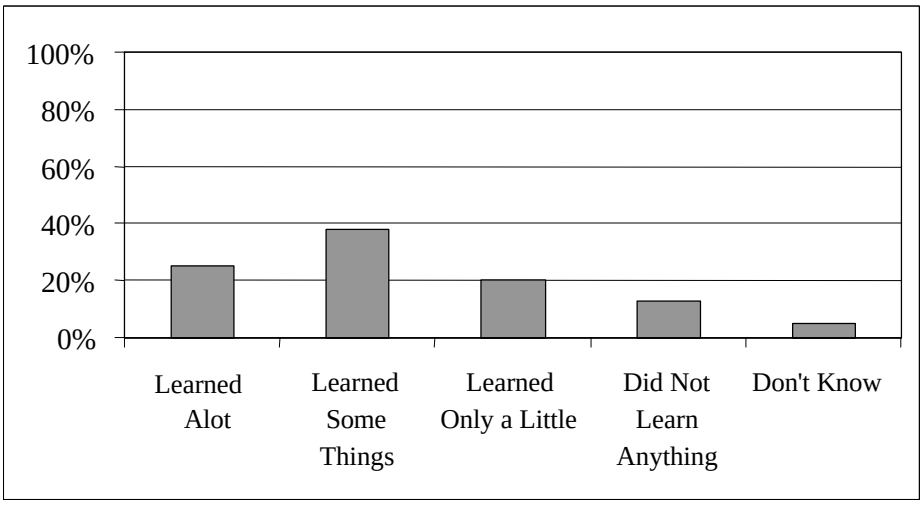
Exhibit 4.8
Why Customer Dissatisfied



Most of the customers had an appliance that required adjustment (66%), while only a few (4%) had an appliance that was turned off due to the CAS test. However, only a small number of customers felt that the adjustment was a hardship (3%). Possibly, this was because over half (58%) were able to resolve the adjustment in one day or less. The customers who felt it was a hardship had adjustments completed anywhere from one day to over two weeks. None of those customers with an appliance turned off felt it was a hardship to complete the appliance repair. This may have been due to the fact that, for 75% of those with an appliance turned off (six of the eight), the inspector had explained to them why it was being shut down and most understood that the appliance was unsafe.

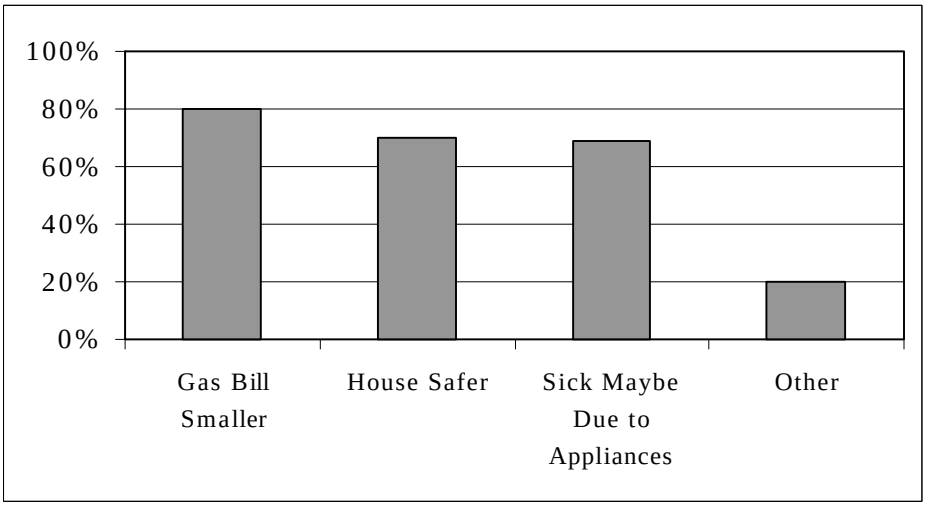
Questions which determined if the customer learned anything from the inspection were used to determine if the customer gained any value from the testing. Only 13% of the customers felt that they learned nothing. As Exhibit 4.9 indicates, most customers learned many or some things.

Exhibit 4.9
Value to Customer



Of those customers who learned something from the inspectors, they learned most about how to reduce their gas bill. Exhibit 4.10 shows the topics in which the customers felt they learned something. The range of "Other" responses goes from cleaning the refrigerator to the fact that the stove grill gives off gases. The customers appeared to lump all the information gathered from the CAS testers as well as the energy-efficiency measure inspectors into one learning experience.

Exhibit 4.10
What Customers Learned



The last area, training effectiveness, indicated that almost all the customers felt that the inspector was knowledgeable (96.6%). A single response (0.5%) indicated that the trainer was not knowledgeable and the remaining 2.9% of customers had no opinion. The positive response to the inspector's knowledge was reiterated in the "Other" responses on the satisfaction question.

4.4 CAS Auditor Training Effectiveness

The last evaluation goal was to determine the effectiveness of the CAS auditor training. The PG&E Stockton Training Center has been training auditors for the State of California to perform CAS tests since 1991. John Proctor, of Proctor Engineering Group (PEG) performed the first CAS training in 1990-91. The PG&E lead trainer was taught by John Proctor to enable the STC to take over the CAS training. Since then, the STC trainers attend training sessions which present the latest information on weatherization and affordable housing in addition to interactions with specialists in the field. When PG&E decided to incorporate the CAS portion into the EPP, the STC was consulted in the design of the CAS test. To date, the STC has trained all of the CIP CAS testers and hundreds of CAS testers for the State.

The training session lasts for four eight-hour days and consists of approximately 60% classroom and 40% laboratory time. The classroom time included hands-on demonstrations in addition to straight lecture. They are taught how to operate the various pieces of equipment used within the CAS test as well as policy and procedures. To test their learning, the lab is set up with known problems on functioning equipment which the potential tester must find.

Once through with the STC training, the CAS testers are followed into the field by team leads. The team leads go to every first time CAS test by a new tester and may go to more if they feel that the new tester requires a bit more instruction and follow-up. After the original “ride-alongs”, CIP performs quality audits on all inspectors annually. At least two CAS tests per tester are chosen and the CIP team leads inspect the test to assure that it was properly performed. If there are consistent issues on specific items, the team leads discuss this with the STC to determine if this should be presented differently during the training session. Additionally, the STC hands out a written feed-back form to the trainees at the end of the training session. This and interactions with the team leads, forms the basis for evaluation of the training session by the STC.

The training is seen to be very effective among those who know what is being presented. However, most of the contractors had no opinion one way or the other on this issue. One contractor felt that some of the testers don’t have the experience that is required to handle customers and that their crews know more about how to do the work than the PG&E inspector. (The caveat must be presented here that this last comment was most likely directed towards the EEM measures and not the actual CAS test.) The customers felt that the inspectors were very knowledgeable and were quite satisfied with the test. This speaks well for the effectiveness of the training of the CAS testers.

5 FINDINGS AND PROGRAM DESIGN OPTIONS

5.1 Findings

The overall findings of the CAS Testing process evaluation are presented in Exhibit 5.1. This exhibit presents a broad-brush summary of the finding from the structured interviews and the telephone survey. These summary findings are discussed in more detail in Section 4. The summary findings are presented in Exhibit 5.1 by program actor (EPP general office, CIP, prime contractor, subcontractor, Stockton Training Center, and Customer) in order to make it easier to identify where opinions diverge and how they might effect the flow of the program. A "rating scale" of IIIII to I has been used to allow quick visual identification of differences. In this case "IIIII" indicates that that aspect of the program works very well or is very effective. Similarly "I" indicates that it is not working at all or is very ineffective.

Exhibit 5.1
Subjective Summary of Overall Evaluation Findings

Category	EPP	CIP	Prime	Sub	STC	Customer
Understanding CAS Goals						
Understanding of CAS Goals	IIIII	IIIII	IIIII	IIIII	IIIII	NA
How Well Has CAS Met Goals	IIIII	IIIII	III	IIII	NA	NA
EPP Marketing						
Most Effective Method	Targeted Door to Door				NA	NA
Influential Features	Free Measures, CAS Testing				NA	NA
Discouraging Features	Number of Visits, Don't believe it's free				NA	NA
Program Implementation						
Smoothness of CAS Delivery	IIIII	IIII	II	II	NA	NA
Issue Resolution / Responsiveness	IIII	IIII	II	II	NA	NA
Delivers Customer Safety	IIIII	IIIII	IIIII	IIIII	IIIII	IIII
Hardship from Identified Repairs	Yes				NA	No (Limited sample)
Tracking System						
Operation and Accessibility	III	II	I	I	NA	NA
Awareness of Field Status	IIIII	IIIII	II	II	NA	NA
Customer Satisfaction						
Customer Satisfaction with CAS	IIII	IIIII	III	IIII	NA	IIIII
CAS Auditor Training						
How Well Trained	IIIII	IIIII	Don't know	Don't know	IIIII	IIIII

IIIII = Works Very Well , I = Does Not Work at All

The following findings are grouped by evaluation category.

Overall

- The program is well designed and fielded.
- The program features have been held constant during the time the program has been offered and are uniformly understood by all program implementers.

Customer Satisfaction

- Many customers stated that they learned how to make their house safer (70%) and how appliances can make their family feel sick (69%). A relatively small percentage (22%) of those who were satisfied felt that it was due to their house feeling safer after the testing.
- Most implementation staff consider customer satisfaction high. The customer survey corroborated this by showing that 95% of the customers were either very satisfied (56%) or satisfied (39%).
- Most people felt they learned something. The customers appeared to lump all the information gathered from the CAS testers as well as the energy-efficiency measure inspectors into one learning experience.

Administrative Process

Understanding CAS Goals

- All parties participating in the program implementation clearly stated an understanding of one of the CAS programs two main program goals, assuring customer safety and protecting PG&E from potential liability. Most stated assuring safety as the primary goal.
- All implementers agreed that the CAS program was achieving its goals. The contractors implementing the program expressed concern about the longevity of the safety since conditions change very soon after the inspector leaves.

EPP Marketing

- The marketing of the EPP appears highly developed. The program appears on target to deliver the required number and distribution of participants.
- The most effective marketing tactic is door-to-door solicitation in targeted low income areas.
- The features most likely to get people to participate are free measures and the assurance that the customers receive from having their home tested.
- The number of visits required to complete the process and disbelief that they are getting something for free are the two most quoted reasons inhibiting participation.

Program Implementation

- EPP/CIP/Contractor organizational structure appears to limit ability to effect changes in the program.
- While the program is achieving its goals, there are some operational issues. These are the reasons for the discrepancy between PG&E staff and contractor staff ranking of "smoothness of delivery" and "problem resolution".
  - CIP staffing and hours of operation appear to adversely affect the CAS implementation. This could also be a communication issue.
  - The CAS program has a working system for handling customer complaints but does not appear responsive to suggested changes from contractors implementing the program.
- All parties agree that the CAS Testing program is assuring customer health and safety.
- None of the parties felt that there was any equal or better alternative to CAS Testing. Some expressed concern about the long term benefit of CAS testing and recommended CO detectors as an extension to the program.
- While all parties agreed that CAS failures resulting in appliance adjustments caused minimum hardship for the customer, there was also agreement that CAS failures resulting in "red tagging" imposed a considerable hardship on the customer. However, in the customer survey, an extremely small sample of eight people who had equipment disconnected, reported that they suffered no hardship.[5]

Tracking System

- Operational issues and inaccessibility of the tracking system are recognized, to differing degrees, by all implementers.
- Information flows up from the subcontractors, but not back down to them in a useful format or timely fashion.
- Database incompatibility causes problems in data flow.

CAS Training Effectiveness

- The CAS auditors are felt to be very well trained by the PG&E staff. However, neither the prime nor subcontractors could comment on the level of CAS training.
- The vast majority of customers (97%) thought that the inspectors seemed knowledgeable about their job.
- Team leader accompaniment of CAS testers during initial visits is felt to be key to tester competency.

5.1 Program Design Options

Equipoise presents two scenarios for program changes. In the first scenario we suggest that PG&E change the actual structure of the program to allow the contractors to perform

[5] This sample is proportionate to the rate expected in the population for a sample of 204 participants.

the CAS testing. This is the preferred set scenario resulting from this evaluation. The second scenario provides suggestions which could improve the process if PG&E chooses to make no organizational structure changes.

5.1.1 Scenario One: Move Initial CAS Testing to Contractors

Many of the communication and scheduling issues evolved from the EPP decision to have PG&E control all phases of the CAS testing process. This was done because PG&E feels it is inappropriate that those conducting the installations should also be performing the CAS test. The evaluation determined that contractors perform both CAS testing and installations under the California state low-income weatherization program. These testers are trained at PG&E's Stockton Training Center and audited by a reliable independent consultant. We believe that a variation on this model would be appropriate for the PG&E program.

The proposed changes in structure are:

1. Give the contractors the responsibility of performing the pre-installation CAS testing. Each contractor must have their testers trained at the STC.
2. Have PG&E perform the quality assurance of the CAS testing by continuing its practice of accompanying all newly trained testers until they are assured that the tester is correctly applying the information taught. PG&E may want to consider spot checking the CAS tests to reinforce quality assurance.
3. PG&E should continue its practice of performing post-installation CAS tests. PG&E should reassess the percentage of sites required to satisfy their liability concerns under this scenario.

This scenario would have the following advantages and disadvantages:

Advantages.

1. Potentially reduce the number of customer contacts required to deliver the program, which could result in an increase in participation,
2. Likely to increase installation of infiltration measures by streamlining the testing process,
3. Improve installation contractor knowledge of customer job status allowing them to address issues inhibiting installation completion.

Disadvantages.

1. Would require an added visit by PG&E to "qualify" the measures for installation. This is a program feature universally desired by contractors,
2. The entity conducting the testing has a vested interest in test passing, potentially biasing the results,
3. Could decrease customer safety, unless the same high level of CAS program and administrative standards are employed. Increases PG&E's potential liability.

5.1.2 Scenario Two: Improve Current Process

We realize that PG&E may not be able to implement the first scenario for various reasons. Therefore, we present the following suggestions which could improve the process flow.

1. PG&E & contractors should reassess the current organizational structure to encourage greater responsiveness as issues are brought up.
2. PG&E should develop a list of desired reports and act on getting them in circulation. Specifically, a CAS aging report appears to be needed immediately.
3. Strive to develop accurate and timely reporting, (1) from PG&E to prime contractor and (2) from prime contractor to subcontractors.
4. PG&E should extend the hours of CIP dispatch operation[6]. This would facilitate person-to-person scheduling for all recruitment and increase the likelihood of completed CAS testing.
5. All data transfer should have some kind of data confirmation protocols whether information is passed electronically or by fax.
6. PG&E should require contractors to have the same database software and software version as CIP.
7. All contractor team leaders should accompany a CAS tester during at least one CAS test. This will allow them to give the energy specialists a better idea of what occurs during the CAS test so the ESs can better inform the customer.
8. PG&E should conduct an in-depth assessment of CIP dispatch response times (statistical variation and time of day). Conflicting information from CIP and the contractors needs resolution.
9. PG&E should assess extending the hours of CAS testing. This may decrease the number of CGI's currently experienced by the program.

5.1.3 5.2.3 Either Scenario

There are a few suggested changes which Equipoise makes for either scenario. These are:

1. PG&E should evaluate the viability of installing CO detectors as part of the Energy Partners Program, not as a replacement for CAS testing, but as an augmentation to further assure customer safety. While the CO detector has drawbacks, it may supply some additional safety as appliance conditions change.
2. PG&E should assess if the CAS testers could be allowed to light pilot lights and continue to be within union and safety guidelines for working with gas appliances.

This completes the evaluation report for the CAS Testing Pilot Program.

[6] This issue may already have been resolved through staffing changes.

1

APPENDICES

APPENDIX A
EXAMPLE CIP SUMMARY REPORT

Only Available in Paper Version,

See Hardcopy.

APPENDIX B
EXAMPLE CUSTOMER PAPERWORK

Only Available in Paper Version,

See Hardcopy.

APPENDIX C
PG&E CIP POLICIES AND PROCEDURES, COMBUSTION APPLIANCE SAFETY TEST AND ENERGY EFFCIENT MEASURE INSPECTION

Only Available in Paper Version,

See Hardcopy.

APPENDIX D
PG&E CIP POLICIES AND PROCEDURES, COMBUSTION APPLIANCE SAFETY TEST PROCEDURE

Only Available in Paper Version,

See Hardcopy.