

RCA Verification Program for New Air Conditioners

**New Program Proposal Prepared for the
California Public Utilities Commission**

**2004-2005 Energy Efficiency Program Selection
SDG&E Service Area**

Confirmation Number

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I. Program Overview

A. Program Concept

The Refrigerant Charge and Airflow (RCA) Verification Program for new air conditioners provides in-field training and upstream incentives to air conditioning contractors in the Pacific Gas and Electric (SDG&E) service territory. The program will address lost opportunities for energy and peak demand savings by verifying proper RCA at 8,000 residential and 4,000 small commercial sites.¹ The program complements the statewide high efficiency air conditioner rebate program by verifying RCA for new units. The program will also work with manufacturers to transform the market so that verification becomes standard practice for all new air conditioners. The program will attempt to convince manufacturers to offer longer warranties for verified RCA installations. The program will coordinate with professional organizations such as the American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) on standards for RCA verification services. The program will also work with government agencies to promote verification of new air conditioners in codes, standards, and labels (i.e., Federal Trade Commission yellow label). The program uses innovative computer diagnostic software that quickly determines whether or not there is a problem, and then provides expert recommendations for quickly correcting problems to verify proper RCA. The program provides several innovative and cost effective communication methods to verify technician supplied measurement results through: 1) web-enabled personal digital assistant (PDA); 2) cell-phone telephony; 3) web-enabled cell phone; 4) web-enabled PC notebook; or 5) toll-free telephone support with an EPA-certified technician. The program offers multiple communication methods to make it easy for technicians to verify proper RCA for new air conditioners. The program will inspect a random sample of RCA verified jobs using EPA certified technicians for quality assurance purposes and to guarantee that the program delivers energy and peak demand savings. The program will provide verification certificates and educational materials to all participating customers.

B. Program Rationale

The RCA Verification Program should be evaluated as a hardware/incentive program. The program rationale is based on the following problems with new air conditioner installations.

1. Approximately 441,000 split-system air conditioning units are sold in California each year. Roughly 370,000 are retrofit and 88% are standard 10 SEER.² Approximately 50 to 65 percent of units are installed with improper RCA wasting 52 GWh/year and 68 MW.^{3,4}

¹ Several studies have shown that approximately 50-67% of new air conditioners have improper refrigerant charge and airflow causing systems to operate less efficiently than the FTC yellow label (see *Assessment of HVAC Installations in New Air Conditioners in SCE's Service Territory*, M. Blasnik, Electric Power Research Institute (EPRI), 1995).

² See *California Residential Efficiency Market Share Tracking: First-year Interim Report*, prepared for Southern California Edison, prepared by Regional Economic Research, Inc., San Diego, CA. October 2000.

³ *National Energy Savings Potential from Addressing HVAC Installation Problems*, Chris Neme, Vermont Energy Investment Corporation, prepared for US Environmental Protection Agency, March 1998.

⁴ Energy and peak demand savings are based on the 2001 DEER Update Study, page 193, Basic HVAC Diagnostic Testing and Repair, prepared by XENERGY, Inc., prepared for the California Energy Commission, Contract 300-99-008, August 2001.

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2. No dedicated RCA verification service exists in California for new air conditioners. Without a dedicated RCA verification program, the probability is very low that new air conditioners will operate at their rated efficiency. This represents a lost opportunity for the statewide high efficiency air conditioner rebate program since it does not include RCA verification.
3. “Truth in advertising” is important to consumers and manufacturers who assume that new units are installed properly and perform as advertised. Unfortunately, many new air conditioners do not perform as advertised making consumers question the American Refrigeration Institute (ARI) ratings and FTC yellow label Seasonal Energy Efficiency Rating (SEER).
4. Department of Energy (DOE) air conditioner standards and Environmental Protection Agency (EPA) Energy Star air conditioners do not include requirements for RCA verification.
5. The CHEERS organization has no formal training classes to teach HERS raters how to verify proper RCA.⁵ CHEERS assumes that Thermostatic Expansion Valves (TXVs) will correct for improper RCA.⁶
6. The California Energy Commission (CEC) AB970 Title 24 New Residential Building Standards include alternative component packages for air conditioners requiring either verification of proper RCA or a thermostatic expansion valve (TXV). Most new home builders choose to install TXVs rather verifying proper RCA. RMA studied this issue in a recently completed EM&V study of a new residential air conditioner rebate program that required TXVs.⁷ Field measurements of participant and non-participant air conditioners were made to determine in-situ efficiency before and after correcting RCA (see **Tables 1** and **2**). Participants in the study had FTC yellow label SEER values that were 21 percent better than non-participants (i.e., 13.5 SEER for participants versus 11.1 SEER for non-participants). However, the average measured efficiency for participants was only 6 percent better due to improper RCA (based on average pre-EER of 10.6 for participants and 10.0 for non-participants). After correcting RCA the efficiency difference between participants and non-participants increased to 19 percent.⁸ Findings from this study indicate that TXV units are subject to efficiency losses due to improper RCA. RMA measured 47 air conditioners this summer at mobile homes and found similar results (see **Figures 1** and **2**).⁹

The RCA Verification Program addresses these problems by offering a simple, effective, and proven RCA verification system for new air conditioners. The program will complement the

⁵ June 12, 2002 E-mail communication from Tom Hamilton of CHEERS: “At this point CHEERS will not schedule any training sessions for training Raters to complete the RCA.”

⁶ June 12, 2002 E-mail from Douglas Beaman, CHEERS Trainer, to Tom Hamilton: “I firmly believe that contractors will continue to use TXV's instead of RCA in most cases. This is a non-issue. Until there is greater demand for RCA verifications, CHEERS approach to this issue is the appropriate position.”

⁷ *Measurement and Verification Report for NCPA SB5X New Residential Air Conditioner Rebate Programs*, prepared by Robert Mowris & Associates, prepared for the Northern California Power Agency, September 2003.

⁸ Based on average post-EER of 12.4 for participants and 10.4 for non-participants.

⁹ *EM&V Mobile Home Inspection Report for PG&E, SCE and CPUC Representatives*, prepared by Robert Mowris & Associates, prepared for American Synergy Corporation and CAL-UCONS, September 2003.

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statewide air conditioner rebate program by offering RCA verification to ensure that all rebated units have proper charge and airflow.

Table 1. EM&V Results for Participants with and without Proper RCA

Site	Tons	Cfm	Rated SEER	Pre-EER	Post-EER	Factory Charge (oz)	Charge Adjust +/- oz.	Percent Over or Under	Notes
1	4	1,250	14	11.2	13.1	140	56	40%	TXV, R410A
2	3	872	13	9.9	12.1	100	-18.3	-18%	TXV
3	5	1,745	12	10.4	10.4	114	Refused	Refused	TXV, R410A
4	4	1,360	14	11.6	11.6	170	Refused	Refused	TXV
5	3.5	1,190	13	10.9	11.8	100	16	16%	TXV, R410A
6	2.5	910	14	8.3	11.8	96	-75	-78%	TXV, R410A
7	5	1,460	13	10.8	11.7	176	6.8	11%	TXV
8	4	1,304	14	n/a	n/a	162	162	100%	TXV
9	4	1,350	14	11.1	14.6	170	26.1	15%	TXV
10	5	1,451	14	9.8	12.3	200	17.2	9%	TXV
11	3	1,050	14	9	12.3	150	51.3	34%	TXV
12	5	1,175	14	12.9	12.9	200	Okay	0%	TXV
13	3.5	1,050	14	n/a	n/a	170	Okay	0%	TXV
14	5	1,495	12	11.5	11.5	166	Okay	0%	TXV
Average	4	1,262	13.5	10.5	12.4	151		27%	

Table 2. EM&V Results for Non-Participants with and without Proper RCA

Site	tons	Cfm	Rated SEER	Pre-EER	Post-EER	Factory Charge (oz)	Charge Adjust +/- oz.	Percent Over or Under Charge	Notes
15	3	975	12	9.9	9.9	130	Okay	0%	Non-TXV
16	4	1,606	12	12.0	12.0	117	Okay	0%	Non-TXV
17	5	1,475	14	12.2	12.2	96	Okay	0%	Non-TXV
19	3.5	953	10	9.6	10	130	-9	7%	Non-TXV
20	4	1070	10	9.3	9.3	82	Okay	0%	Non-TXV
21	4	1175	10	8.5	9.9	112	42	38%	Non-TXV
22	5	1540	10	8.6	9.8	158	-24.4	15%	Non-TXV
Average	4.1	1,256	11.1	10.0	10.4	112		10%	

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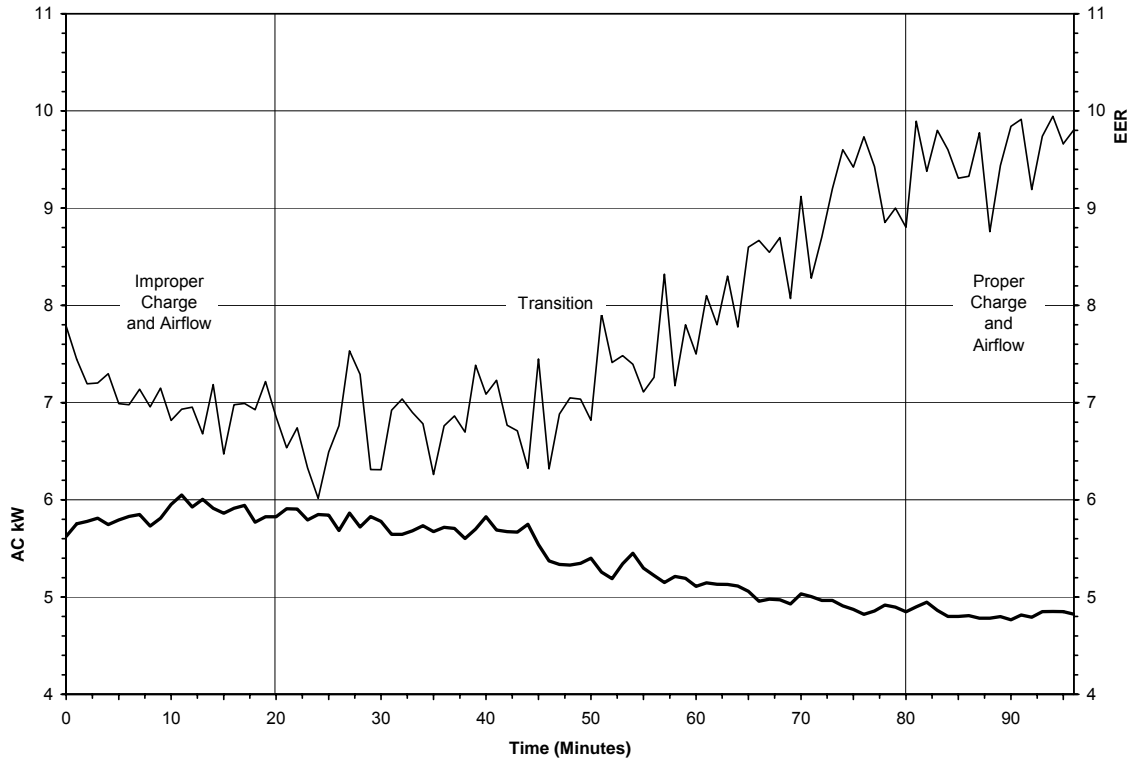


Figure 1. EM&V Measurements of Proper RCA for TXV AC Unit

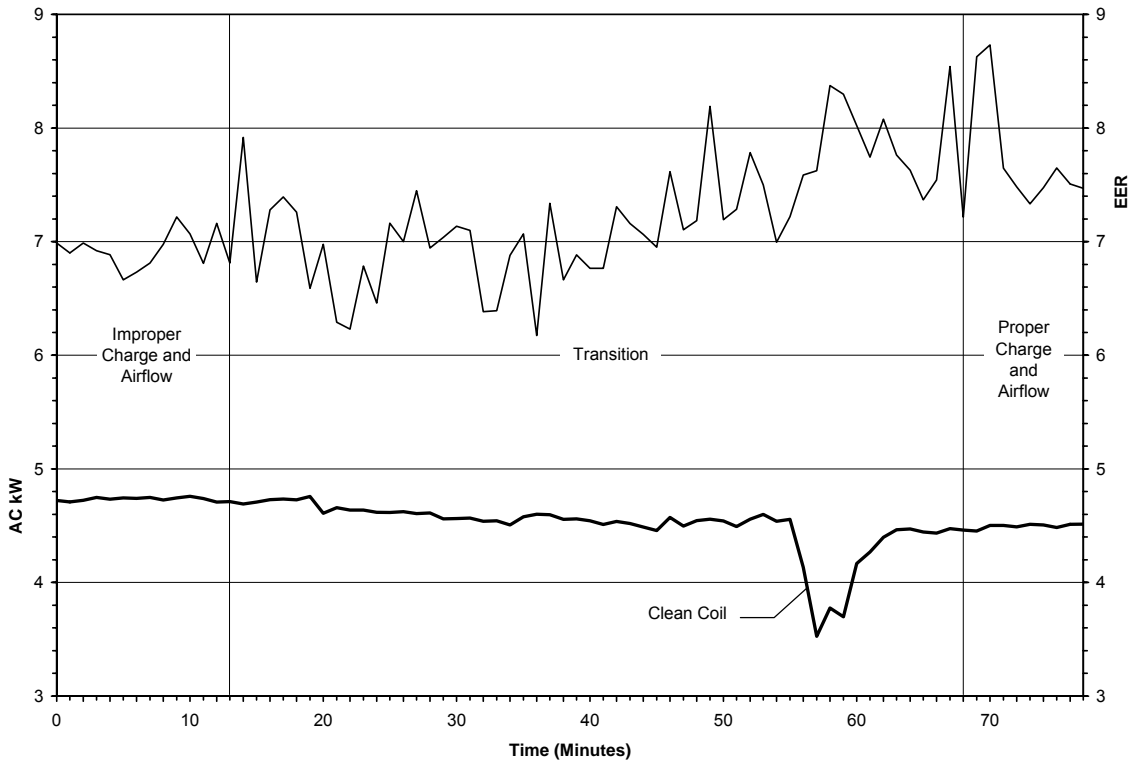


Figure 2. EM&V Measurements of Proper RCA for non-TXV AC Unit

B.1 Cost-Effectiveness

The attached workbook demonstrates that the proposed RCA verification program is indeed cost effective **with a TRC of 2.64 and a participant test of 14.23.**

B.2 Long-term Energy Savings

The attached workbook demonstrates that the proposed program will provide annual energy savings of 5,678,200 kWh/yr and long-term electricity savings of 85,173,000 kWh.

B.3 Electric Peak Demand Savings

The program focuses on improving peak performance of new air conditioners that contribute most to summer peak demand. Estimated peak demand savings for the program are 5,796 kW.

B.4 Equity

The program addresses equity concerns by targeting hard-to-reach underserved residential and small commercial customers who do not normally participate in the statewide AC rebate programs due to the extra cost and hassle associated with buying a higher efficiency unit.

B.5 Ability to Overcome Market Barriers

The RCA program addresses the following market barriers faced by contractors and customers.

1. Higher start-up expense for high-efficiency measures relative to standard-efficiency measures
 - The cost of verifying RCA for a new air conditioner at time of installation is significantly less than correcting RCA later on. The program provides a \$70 upstream incentive for the RCA verification service. Similar RCA verification program incentives for retrofit RCA tune-ups are 2 times higher (due to the higher cost for retrofit RCA). The RCA Verification Program provides lower incentives due to the fact that technicians are already at the site with their equipment installing the new air conditioner (i.e., no extra time for travel or setup). The cost for retrofit RCA is higher due to marketing, travel, setup and problems encountered with older units.
2. Lack of consumer information about energy efficiency benefits
 - Most customers who purchase a new air conditioner mistakenly assume that it is installed properly and will perform at its rated efficiency. The fact that 50 to 65 percent of units are not installed properly indicates lack of consumer information about the importance of RCA verification and benefits. The program will provide educational information along with the RCA verification certificate to participating customers. Educational information will also describe the benefits of duct sealing and other statewide and local energy efficiency programs.
3. Lack of financing for energy efficiency improvements
 - The upstream contractor incentive and allows the RCA Verification Program to reach customers who cannot take advantage of programs that require large capital investments.

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4. Split incentives (between owners/landlords and tenants)
 - Many small commercial customers are tenants and pay their utility bill, but they do not make the decision regarding whether or not their air conditioner has proper RCA. The low cost of RCA Verification means that thousands of small commercial customers will participant and benefit from proper RCA.
5. Lack of a viable and competitive set of providers of energy efficiency services in the market
 - RMA will recruit contractors across the service area in order to develop a comprehensive list of contractors for customers to choose from.
 - There is only one provider of RCA verification services in California at the present time. If this program is funded, RMA will become the second provider. Our focus on new air conditioners is unique and specifically designed to not compete directly with other local programs that focus on the retrofit market. The RCA Verification Program is unique in terms of providing both RCA verification and working with manufactures and government agencies so that RCA verification becomes standard practice.
6. Barriers to the entry of new energy efficiency service providers
 - No dedicated RCA verification service exists in California for new air conditioners. Without a dedicated RCA verification program the probability is very low that new air conditioners will operate at their rated efficiency. This represents a huge lost opportunity due to the large number of new air conditioners that are installed each year in California without RCA verification. Many statewide and local programs would benefit from the RCA verification program including the statewide high efficiency air conditioner rebate program. Manufacturers and many government agencies are unaware that RCA is a major problem, and some government agencies have created barriers to RCA verification services by incorrectly assuming that TXVs correct for improper RCA. This program aims to transform the market for RCA verification by introducing a low-cost high-quality verification service that focuses on new air conditioners where the cost to verify RCA is lowest.
7. Lack of availability of high-efficiency products
 - The program provides marketing and educational materials to customers about the importance of new air conditioner RCA verification.
 - The program provides technicians with in-field training, incentives, and state-of-the-art software technology to help contractors verify RCA for new air conditioners.
 - The program offers several communication methods to verify RCA results through: 1) web-enabled PDAs; 2) cell-phone telephony; 3) web-enabled cell phones; 4) web-enabled PC notebooks; or 5) telephone support with an EPA-certified technician.
 - The program will work with manufacturers to transform the market so that verification becomes standard practice for all new air conditioners by convincing manufacturers to offer longer warranties for verified RCA installations.
 - The program will coordinates with professional organizations such as the American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) on standards for RCA verification services.
 - The program will work with government agencies to promote verification of new air conditioners in codes, standards, and labels (i.e., FTC yellow label).

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The RCA Verification Program addresses all these important market barriers to provide customers with new air conditioners that perform as advertised.

B.6 Innovation

The RCA verification program is innovative by providing understandable in-field training, incentives, and state-of-the-art software technology to help contractors verify RCA for new air conditioners. The program offers innovative communication methods to verify RCA results through: 1) web-enabled PDAs; 2) cell-phone telephony; 3) web-enabled cell phones; 4) web-enabled PC notebooks; or 5) telephone support with an EPA-certified technician. Multiple communication methods make it easier for technicians to perform RCA verification. The easy-to-use PDA software is an industry first in terms of putting technology into technician's hands and empowering them to be able to quickly check RCA without using complicated cardboard calculators.

B.7 Coordinating with Programs Run by Other Entities

The program will complement and coordinate with the statewide air conditioner rebate program by providing a verification system to ensure that savings are achieved. We intend to work closely with SDG&E to help make sure that all rebated high efficiency air conditioners receive RCA verification. We intend to help the statewide Energy Star residential new construction program wherever possible by offering RCA verification services to air conditioners installed in new homes. We will also coordinate with other local programs that offer RCA measures and offer assistance in terms of making sure that their RCA measures are properly verified.

C. Program Objectives

This program objective is to enroll and train 100 licensed heating, ventilation, and air conditioning (HVAC) contractors to use the RCA system to verify proper installation of new air conditioning units. Modest contractor incentives of \$40 for verified AC units will ensure participation to reach 8,000 new residential AC units and 4,000 new small commercial AC units. The program will target underserved and hard-to-reach residential and small commercial customers in the SDG&E service area who typically would not participate in the statewide AC rebate program due to the extra cost of obtaining a high efficiency SEER 12+ unit. Program objectives for 2004-2005 are summarized in **Table 3**.

Table 3. RCA Verification Program Objectives

Description	Objective
HVAC Technicians Trained and Using the RCA Verification System	100 Technicians
Residential Customers with Verified New AC Units	8,000 Units
Small Commercial Customers with Verified New AC Units	4,000 Units
Peak Demand Savings	5,796 kW
Annual kWh Savings	5,678,200
Lifecycle kWh Savings	85,173,000
Total Resource Cost Test	2.64
Participant Test	14.23

II. Program Process

A. Program Implementation

The program implementation plan includes ten elements.

1. **The RCA web-enabled database verification system** will be deployed within three months of signing the contract. RCA verification PDA, PC, and voice telephone systems are already functional and field testing and training these will begin immediately upon signing the contract.
2. **Marketing materials** will be designed to motivate AC contractors to enroll in the program. Advertisements will be placed in trade journals and newsletters. Telephone marketing and faxes will be combined with door-to-door marketing which is very effective with HVAC contractors. Advertising brochures with our 800-number and internet website (www.RCAverification.com) will be placed on the sales counters of wholesale distributors to advertise the program.
3. **The program will train 100 technicians to use the RCA verification system** to verify proper charge and airflow and how to verify proper refrigerant charge and airflow using the RCA verification software system. Technicians will learn how to verify RCA measurements through: 1) web-enabled PDA; 2) cell phone telephony; 3) web-enabled cell phone; 4) web-enabled PC; or telephone support with an EPA-certified technician. Two-day training sessions will include ½ day of classroom training and 1½ days of field training. Training will ensure that technicians fully understand how to use the RCA verification system. Included in the training are clearly defined procedures regarding calibrating pressure and temperature measurement equipment, digital scales for weighing refrigerant, recovery equipment, leak detection equipment, and proper use of the RCA software. Contractors are provided with expert advice on the proper procedures to follow from the RCA verification expert-system software (or EPA-certified technician). Immediately after receiving RCA verification the contractor will install a weatherproof sticker on the condensing unit indicating that the air conditioner is “RCA Verified.” The technician also provides the customer with a customer satisfaction survey and energy education pamphlet that documents results of the verification. The pamphlet is designed to slip into the air conditioner warranty packet.
4. **Upstream rebates** of \$40 per job will be paid to contractors for verified jobs. Rebates will be paid on a monthly basis using the RCA database fulfillment system and our certified public accounting subcontractor Barry Goldstein.
5. **Advertising to residential and small commercial customers** will stimulate demand for RCA among AC dealers and distributors.
6. **The program will work with manufacturers** to help them understand the widespread problems associated with efficiency degradation due to improper charge and airflow. This effort will focus on convincing manufacturers to offer a longer warranty for RCA-verified installations compared to non-verified installations.
7. **The program will coordinate with the CEC** to consider requiring RCA verification in future Title 24 Residential Building Codes for air conditioners in the alternative compliance packages for new buildings.

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8. **The program will coordinate with US-DOE and the Federal Trade Commission (FTC)** to consider changing the yellow label on new air conditioners to include information regarding RCA verification. The program will also coordinate with the Environmental Protection Agency (EPA) to include RCA verification in future Energy Star labeled air conditioning programs.
9. **The program will coordinate with the statewide rebate program** by working with SDG&E, SCE, and PG&E to demonstrate the RCA verification system and discuss how RCA can complement the statewide AC rebate program. We intend to work closely with SDG&E to make sure that all rebated AC units receive RCA verification. *Bill Grimm, Manager Small Business Express Efficiency, has already expressed interest in RCA Verification for new air conditioners that receive rebates from the SCE Express Efficiency Program.*
10. **The program focuses exclusively on new air conditioners and transforming the market for RCA verification.** The IOU statewide programs focus on rebates for new high efficiency AC equipment, but don't currently require RCA verification (although it is being considered). Other local programs target RCA verification for existing AC units rather than new units, and only offer telephone operator verification services. The RCA verification program offers lower incentives than other programs due to the fact that contractors are already at the sites with their equipment installing new AC units (i.e., lower incremental measure cost). The RCA-verification market transformation plan is also different than other programs. RCA will work with manufacturers to offer longer warranties for RCA-verified units and also work with government agencies to promote verification. No other program is doing this.

B. Marketing Plan

The marketing plan will target four upstream market actors.

1. AC contractors who will implement the verification services;
2. Wholesale distributors to advertise the service and enroll contractors;
3. Manufacturers of air conditioners; and
4. Government agencies to institutionalize verification of proper charge and airflow on the FTC yellow label and to revise current codes and standards to institutionalize verification of proper charge and airflow in all new buildings.

Marketing plans will be coordinated with SDG&E, SCE, and PG&E and non-utilities to provide information about all CPUC programs that can benefit the residential and small commercial customers that are served by the program. Each of these marketing plans are discussed below.

Marketing to AC contractors will focus on enrolling them into the program. Advertisements will be placed in trade journals and newsletters. Telephone marketing and faxes will be combined with door-to-door marketing which is effective with HVAC contractors. Contractor marketing will include equipment incentives for web-enabled PDAs to assist contractors with reporting verification results to RCA. Advertising materials will provide the following information.

- How the verification system will result in fewer call backs saving contractors money.

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- Increased customer satisfaction.
- Referrals to RCA enrolled contractors that will lead to increased sales.
- RCA label to indicate that air conditioners installed by participating contractors are independently verified to have proper charge and airflow (i.e., truth in advertising regarding the SEER rating).
- How RCA contractors will gain a competitive advantage by verifying proper charge and airflow.

Marketing to wholesale distributors will focus on placing contractor enrollment brochures on sales counters to advertise our 800-number and internet website (www.RCAverification.com). Point-of-purchase contractor marketing brochures will be designed and printed to place on distributor sales counters. The marketing brochures will explain the RCA verification, increased quality, customer satisfaction, and competitive business advantages of verifying proper charge and airflow. Wholesale distributors will appreciate the RCA service since contractors who enroll will have fewer compressor failures.

Upstream marketing to manufacturers will focus on how proper charge and airflow avoids premature compressor failure and “truth in advertising” of the SEER ratings. Excessive refrigerant charge can cause premature compressor failure due to non-compressible liquid refrigerant entering suction line of the compressor. Insufficient refrigerant can cause premature compressor failure due to the compressor operating at elevated temperatures. Low airflow can result in icing of the evaporator coil and premature compressor failure. All of these installation problems are of concern to manufacturers since they might have to cover the cost of premature failure of compressors within the warranty period. Marketing to manufacturers will be aimed at them covering the cost of the independent verification services as a way to provide their normal 5-year compressor warranty. Without proper verification, manufacturers might only provide a 90-day warranty on the compressor. For manufacturers the warranty issue is a major concern since the cost to replace a premature compressor failure is considerable.

Upstream marketing to government agencies such as US-DOE and the Federal Trade Commission (FTC) will focus on changing the yellow label on new air conditioners to include information regarding verification of proper charge and airflow. Upstream marketing to the Environmental Protection Agency (EPA) will be aimed at including verification of proper charge and airflow in future Energy Star labeled air conditioning programs. Upstream marketing to the CEC will focus on revising Title 24 to require proper charge and airflow verification on all new residential and small commercial buildings irrespective of whether or not they have a TXV. Since roughly 70,000 new air conditioners are installed in new construction each year in California the lost opportunity for savings is roughly 8.3 GWh and 10 MW. This is enough electricity to power 5 to 10,000 new homes.

C. Customer Enrollment

The customer enrollment strategy is to offer upstream incentives to HVAC contractors to install new air conditioners that are verified as having proper charge and airflow. The following enrollment process will be used.

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1. Recruit successful contractors who sell and install a large number of new air conditioners and who have good reputation in the targeted service areas. This will be accomplished by working through large wholesale distributors who have already expressed interest in the RCA verification program.¹⁰
2. Participating contractors will sign a letter of agreement to abide by the RCA verification installation standards which include in-field checking of a random sample of jobs by EPA-certified air conditioning technicians in order to verify energy and peak demand savings. In addition, the RCA verification database checks all verified data to look for potential problems associated with reported measurements. Technicians found to be reporting incorrect information will be required to correct any problems or they will be decertified from the program.
3. Most customers assume that new air conditioners are properly installed. The program will develop marketing materials to educate residential and small commercial to make sure that their new air conditioner is verified to perform as advertised.

D. Materials

An overview of the RCA verification system is shown in **Figure 3**. The figure shows almost all of the procedures for procuring, delivering, and performing RCA verification on new air conditioners for residential and commercial customers. RCA measurements are recorded by the technician and relayed to the RCA Verification Web Server over the internet using one of five methods: 1) web-enabled PDAs; 2) cell-phone telephony; 3) web-enabled cell phones; 4) web-enabled PC notebooks; or 5) telephone support with an EPA-certified technician. If the AC technician enters the data into the web-enabled PDA, then the data is either stored or relayed to our Web Server in real time depending on cell phone coverage. An example of how the RCA verification software works on the PDA is provided in **Figure 4** for airflow, **Figure 5** for superheat (non-TXV), and **Figure 6** for subcooling (TXV). Screen space on the PDA is limited so acronyms are used as labels. “TS” is an acronym for Temperature Split. Selecting TS opens the airflow verification screen. “SH” is an acronym for SuperHeat. Selecting SH opens the superheat verification screen used to check refrigerant charge for non-TXV systems. “SC” is an acronym for SubCooling. Selecting SC opens the subcooling screen used to check refrigerant charge for TXV systems. “Type” is a pull-down menu used to select refrigerant R22 or R410A. The PDA displays refrigerant type in the upper left corner.

¹⁰ Personal communication with John Staples, President of US Air Conditioning , with 14 distributors in Northern California and 23 distributors in Southern California.

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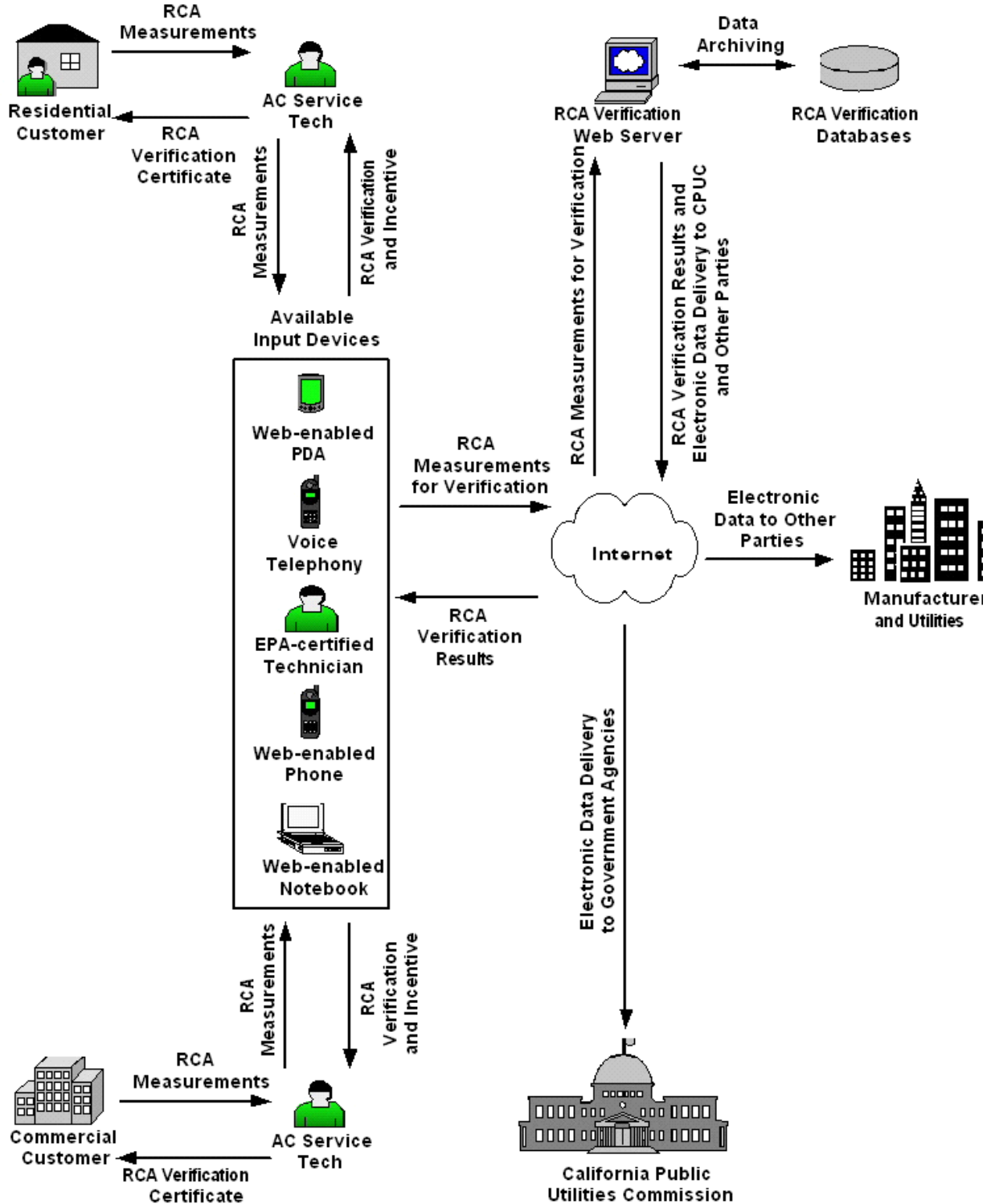
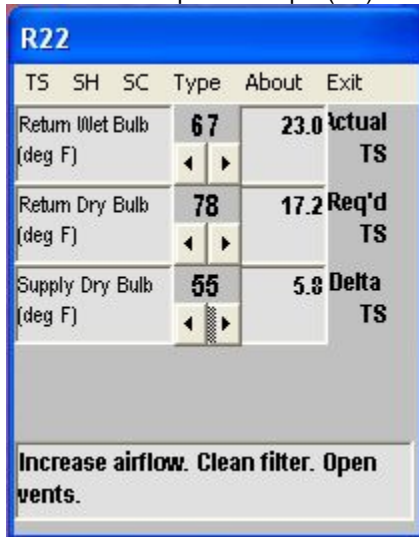


Figure 3. Overview of RCA Verification System

RCA Verification Program for New Air Conditioners

Pre-Airflow Temperature Split (TS)



Post-Airflow Verification

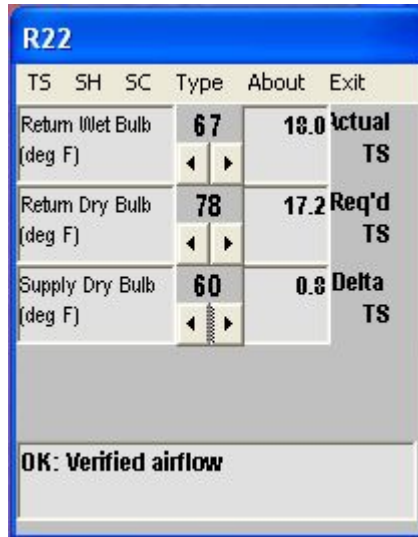
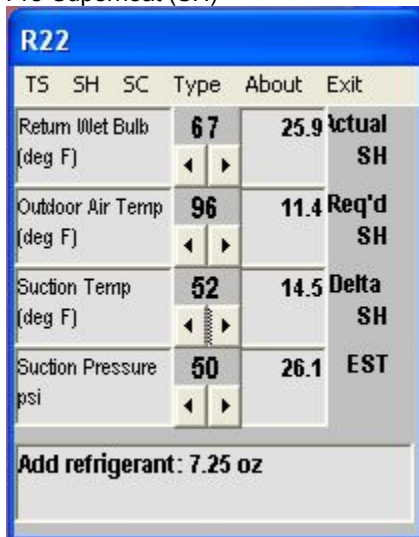


Figure 4. RCA Verification for Airflow

Pre-Superheat (SH)



Post-Superheat Verification

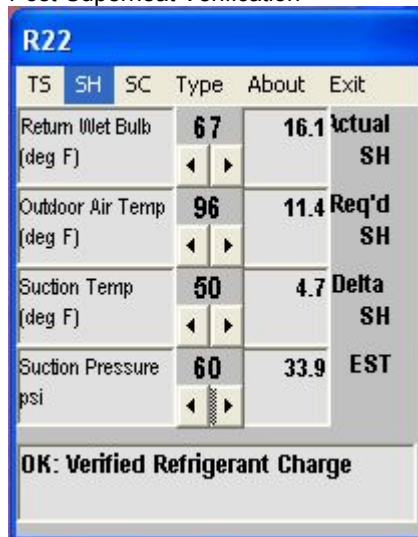
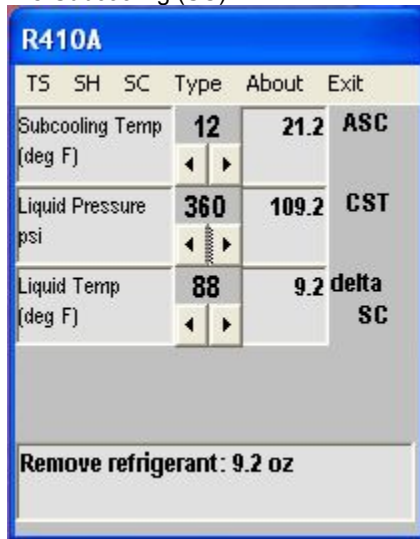


Figure 5. RCA Verification for Superheat

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Pre-Subcooling (SC)



Post-Subcooling Verification

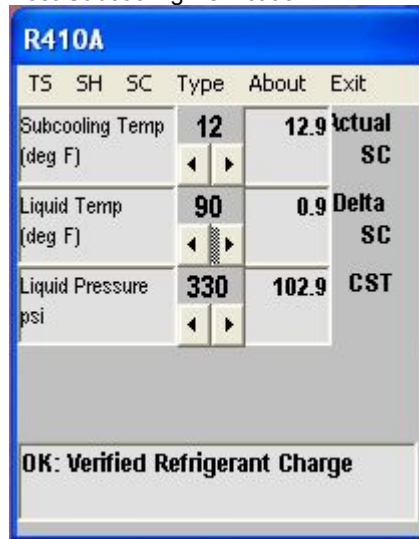


Figure 6. RCA Verification for Subcooling

The web-enabled PC notebook application allows for more information to be displayed as shown in **Figure 7**. The market transformation plan is offer several methods for verification to determine which works best based on contractor feedback and field verification results.

RCA[®] Verification

Customer: _____ Address: _____ City: _____ ZIP: _____
 Phone: _____ Technician: _____ Date: _____

Enter data into yellow highlighted cells.

HVAC System	Manufacturer	Model Number	Capacity	Factory Charge	Multiplier	Est. Airflow	Meas. Airflow
AC or HP	Bryant	593C	4 tons	100 oz	x 340 =	1,360 cfm	1,400 cfm
Furnace			60 kBtu		x 18.5 =	1,110 cfm	

R22	1
R410A	

Airflow Temp-Split	1. Return WB Temp.	2. Return DB Temp.	3. Supply DB Temp.	4. Actual Temp-Split	5. Required Temp-Split	6. ΔTS (within ±3°F)	Recommend	Airflow Adjustment (check boxes that apply)			
								New Filter	Fix Ducts		
Pre	67	78	55	23	17	5.8	Increase Airflow	Open Vents	x	Clean Coils	x
Post	67	78	60	18	17	0.8	ok	Fan Speed		Schrader Caps	x

Superheat non-TXV	1. Return WB	2. Outdoor Air	3. Req'd SH	4. Suction Pres.	5. Suction Temp.	6. Evap. Sat.	7. Act. SH=#5-#6	8. ΔSH=#7-#3 (within ±5°F)	Technician Add/Remove Refrigerant	Recommend Add/Remove Refrigerant
Post	67	96	11	60 psi	50	34	16	5		ok

Subcooling TXV	1. Required SC (Mfr Data or 10°F)	2. Liquid Line Pressure (psi)	3. Condenser Saturation	4. Liquid Line Temp. (°F)	5. Actual SC = #3 #4	6. ΔSC=#5-#1 (within ±3°F)	Technician Add/Remove Refrigerant	Recommend Add/Remove Refrigerant
Post	10	230 psi	111	99	12	2		ok

Figure 7. RCA Verification Software for PC-Notebooks

RCA Verification Program for New Air Conditioners

The cell-phone telephony system is a VoiceXML application architecture that uses an internet Web-server to run the application logic. The server will contain a database or it will interface to an external database or transaction server. The VoiceXML interpreter acts as a client to the application server. The interpreter understands VoiceXML dialogs and controls speech and telephony resources. These resources include ASR, TTS, audio play and record functions, as well as a telephone network interface. A TCP/IP-based packet network connects the application server and telephony server via HTTP. The Public Switched Telephone Network (PSTN) is used so that any telephone can connect to the network through the RCA Verification toll-free 800 number. Call 877-436-1590 to listen to a demonstration VoiceXML application for verifying refrigerant superheat.

The RCA verification system uses expert software and a web-enabled database to collect RCA measurements from the technician, evaluate the measurements for errors, report expert recommendations, and verify the final results. If users provide incorrect or nonsensical values the software will check the inputs and provide appropriate responses such as “wetbulb temperature cannot be greater than drybulb temperature” or “suction temperature cannot be lower than evaporator saturation temperature (EST).” These expert checking procedures eliminate the guess work and make the verification process easier and more accurate. All data is error checked and stored in the verification database. Verified jobs are double-checked in the field by EPA-certified technicians to maintain quality control and reliability in the energy and peak demand savings.

The procedure for verifying RCA is as follows.

1. Once the new air conditioner is installed, the technician makes sure that it has been running for at least 10 minutes before taking the first set of RCA measurements.
2. The technician records their initial set of RCA measurements and either enters these into the PDA (which stores the data for e-mailing) or uses one of the other methods of entering and verifying the data. The data is checked by the software and if the measurements indicate a problem, the software will provide an appropriate recommendation.
3. The software verifies proper airflow; and either superheat (for non-TXV systems); or subcooling (for TXV systems).
 - Airflow is checked to see if the actual return drybulb minus supply drybulb (i.e., temperature split or TS) is within $\pm 3^{\circ}\text{F}$ of the required temperature split. The required TS is based on the measured return wetbulb/drybulb temperatures.
 - For non-TXV systems, the superheat (SH) is checked to see if the actual SH is within $\pm 5^{\circ}\text{F}$ of the required SH. Actual SH is the difference between the suction line temperature and the evaporator saturation temperature. Evaporator saturation temperature is based on the suction line pressure. The required SH is based on the measured return wetbulb and outdoor condenser entering air drybulb temperatures.
 - For TXV systems, the Subcooling (SC) is checked to see if the actual SC is within $\pm 3^{\circ}\text{F}$ of the required SC. The required SC is assumed to be 10F unless data is available from the manufacturer. Actual SC is the difference between the condenser saturation temperature and the liquid line temperature.

RCA Verification Program for New Air Conditioners

4. If the first set of measurements doesn't pass, then the software will wait five minutes before accepting further data. This important step ensures that the technician doesn't enter additional measurements before the air conditioner can respond to changes in refrigerant charge and reach equilibrium.
5. When the air conditioner charge and airflow are correct, the software will indicate that the RCA is verified. The beginning and end point data entries are stored in the database as a record of the RCA verification along with the customer ID number, size, make, and model of the air conditioner.
6. The average time to complete the entire verification procedure is approximately 10 to 30 minutes, but the actual time required for the software to check the data is less than 1 second.
7. Each technician is trained to check if Schrader valve caps with "O" ring seals are installed on both the high and low pressure fittings. If no caps are present, then the technician must install Schrader caps to prevent leaks and realize the full 15-year effective useful lifetime.
8. Data is recorded for each job that is verified and a weatherproof sticker is placed on the air conditioner to indicate that it is "RCA Verified." The technician provides the customer with a customer satisfaction survey and energy education pamphlet that documents results of the verification. The pamphlet is designed to slip into the air conditioner warranty packet.

Contractors are required to provide participating technicians with the following equipment.

- Mercury sling-psychrometer to accurately measure wetbulb/drybulb temperatures;
- Multi-point digital thermometer and Type-K pipe-clamp thermocouple sensor;
- At least four accurate and durable Type-K thermocouples.
- Digital Refrigerant Charging Scale.
- A compound refrigerant gauge that reads pressure and saturation temperatures.
- Schrader valve cores and a Schrader valve core replacement tool.
- Brass Schrader valve caps with integral "O" rings must be installed on the high and low pressure refrigerant valves for every job that receives RCA verification to prevent leaks. This is important since over time air conditioner vibration can cause refrigerant leaks and efficiency loss.

RMA will verify that all participating technicians have purchased the required equipment. Training will include proper methods to calibrate equipment and proper timing between calibrations. Besides two full days of in-field training each participating technician will receive the following:

- PDA loaded with the RCA Verification software; and
- Program educational binder containing policies and procedures and results from EM&V studies and marketing information to help them market the program.

E. Payment of Incentives

Payment of incentives will be based on verified jobs that are reported in the database. RMA will invoice SDG&E for all RCA-verified jobs entered into the database for the previous month. The invoice will include the contractor “financial incentive” of \$40 per job plus the “installation service cost” of \$30 per job to cover the cost of RMA providing the RCA verification service. Payment of incentives to contractors will be made after RMA receives payment.

F. Staff and Subcontractor Responsibilities

This section describes the staff and subcontractor responsibilities and structure of prime contractor and subcontractors. The program staffing structure is shown in **Figure 8**.

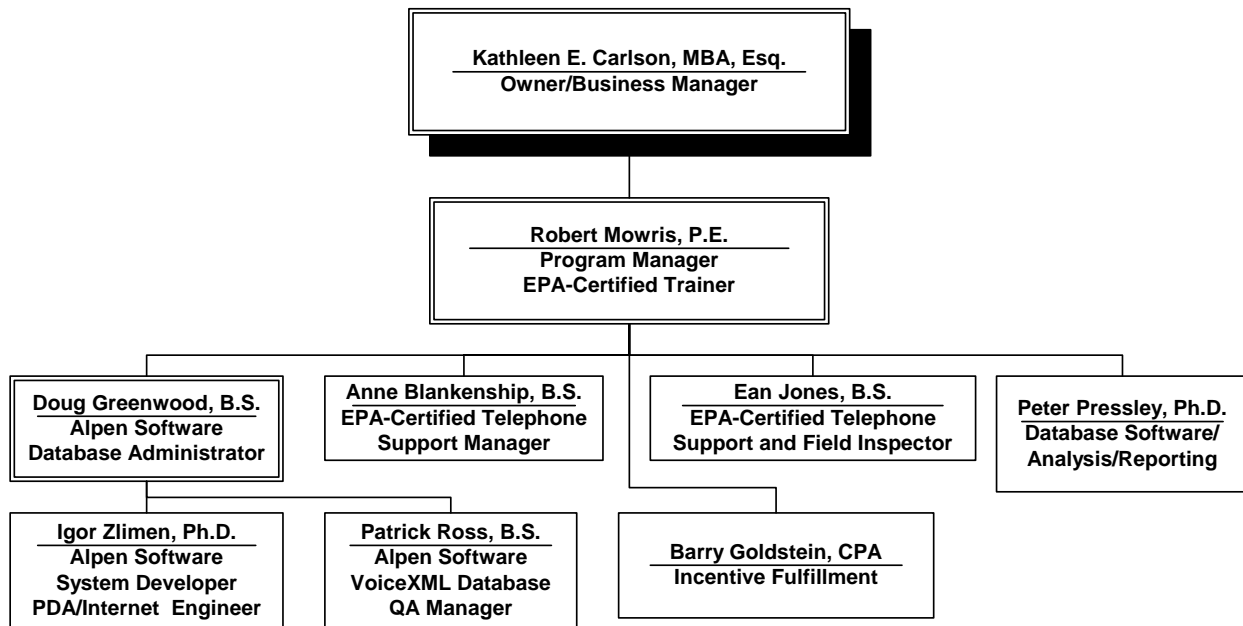


Figure 8. Program Staffing Structure

Role of RMA

RMA is the primary contractor for the project responsible for day-to-day program management, design, development, contractor training, implementation, and reporting.

Role of Alpen Software

Alpen Software is responsible for management, design, development and operation of the RCA verification application and database software.

Role of Barry Goldstein, CPA

The Accounting Office of Barry Goldstein, CPA will provide incentive fulfillment services for the program. Mr. Goldstein has more than 17 years of experience as a certified public accountant and provides automated accounting services to many companies in California.

G. Work Plan and Timeline for Program Implementation

This section provides the detailed work plan, schedule, key dates, and important milestones. The project schedule is shown in **Figure 9**. Where applicable, all linkages and/or interactions between tasks are clearly identified so that interactions between tasks and the effects of changing scope and timing of each task can be visualized and tracked. Key dates and milestones for the Study are shown in **Table 4**. Staff positions, responsibilities, and the percent of time each staff person is projected to be devoted to the project are provided in **Table 5** (also see attached workbook).

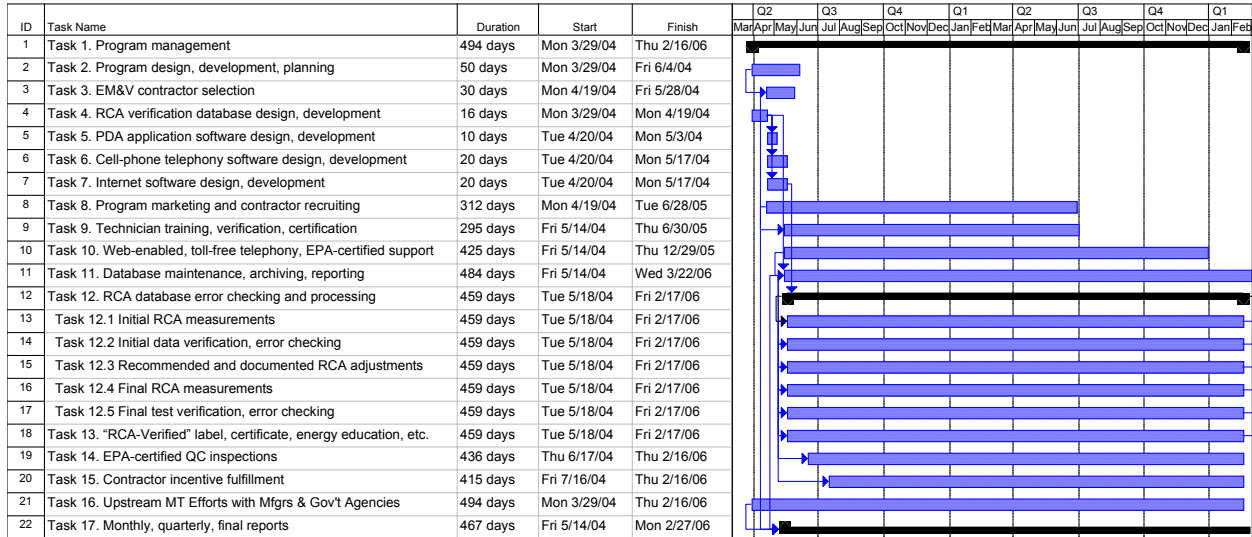


Figure 9. Project Timeline

Table 4. Key Dates and Milestones for the Study

Task Description	Duration	Start Date	Finish Date	Milestone
Task 1. Program management	494d	Mon 3/29/04	Thu 2/16/06	Completed project
Task 2. Program design, development, planning	50d	Mon 3/29/04	Fri 6/4/04	Final program design
Task 3. EM&V contractor selection	30d	Mon 4/19/04	Fri 5/28/04	Select EM&V Contractor
Task 4. RCA verification database design, develop	16d	Mon 3/29/04	Mon 4/19/04	Functional RCA database
Task 5. PDA application software design, develop	10d	Tue 4/20/04	Mon 5/3/04	Functional PDA with database
Task 6. Cell-phone telephony software design, develop	20d	Tue 4/20/04	Mon 5/17/04	Functional cell-phone telephony
Task 7. Internet software design, develop, implement	20d	Tue 4/20/04	Mon 5/17/04	Functional internet website
Task 8. Program marketing and contractor recruiting	312d	Mon 4/19/04	Tue 6/28/05	Recruit 100 contractors
Task 9. Technician training, verification, certification	295d	Fri 5/14/04	Thu 6/30/05	Train 100 technicians
Task 10. Toll-free web-enabled EPA-certified support	425d	Fri 5/14/04	Thu 12/29/05	100 satisfied technicians
Task 11. Database maintenance, archiving, reporting	484d	Tue 4/20/04	Fri 2/24/06	Functional database reporting
Task 12. RCA database error checking and processing	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 12.1 Initial RCA measurements	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 12.2 Initial data verification, error checking	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 12.3 Recommended RCA adjustments documented	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 12.4 Final RCA measurements	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 12.5 Final test verification, error checking	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 13. "RCA-Verified" label, certificate, energy education	459d	Tue 5/18/04	Fri 2/17/06	12,000 RCA verifications
Task 14. EPA-certified QC inspections	436d	Mon 6/17/04	Thu 2/16/06	600 EPA-certified Inspections
Task 15. Contractor incentive fulfillment	415d	Fri 7/16/04	Thu 2/16/06	12,000 rebate checks issued
Task 16. Upstream MT Efforts with Mfgs & Gov't Agencies	494d	Mon 3/29/04	Thu 2/16/06	Longer warranty, Awareness
Task 17. Monthly, quarterly, final reports	467d	Wed 5/5/04	Thu 2/16/06	24 reports due 21 st of month

Table 5. Staff Positions, Responsibilities, and Percent of Time Devoted to Program

Position Title	Staff Name	Primary Responsibilities	% of Time Devoted to Program
Owner of Business	Kathleen E. Carlson, MBA, Esq.	Program Management, Contracts	8%
Principal	Robert Mowris, P.E.	Program Manager, Designer, Engineer, Lead Trainer,	70%
Associate Consultant	Anne Blankenship, B.S.	EPA-Certified Telephone Support Manager, Trainer, Field Inspector	80%
Associate Consultant	Ean Jones, B.S.	EPA-Certified Telephone Support, Trainer, Field Inspector	80%
Consultant	Peter Pressley, Ph.D.	Database Software, Analysis, Reporting	15%
Consultant	Douglas Greenwood, B.S.	Alpen Software, Database Administrator	15%
Consultant	Igor Zilmen, Ph.D.	Alpen Software, System Developer, PDA/Internet Engineer	12%
Consultant	Patrick Ross	Alpen Software, VoiceXML Database, QA Manager	9%
CPA	Barry E. Goldstein, CPA	Incentive Fulfillment Services	8%

III. Customer Description

A. Customer Description

The program will target hard-to-reach residential and small commercial customers by enrolling HVAC contractors who install new air conditioners for these customers. The customer size corresponds to roughly one-quarter of the new split-system air conditioners that are sold in California each year or approximately 110,000 residential and small commercial customers. The program will serve 10 percent of these customers (i.e., 12,000 RCA verifications out of 110,000 new air conditioners installed without RCA verification). The program will work with local contractors with existing customers in the targeted communities to serve hard-to-reach customers who cannot afford to install a high efficiency air conditioner, but, nevertheless, deserve a verified unit with proper refrigerant charge and airflow.

A.1 Residential Hard-to-Reach Customers

RMA will target and recruit HVAC contractors who serve communities where the primary language is non-English. Our cell-phone telephony system will include Spanish and other languages to be determined based on market research with contractors. We will also have Spanish-speaking EPA-certified technicians available to provide person-to-person telephone verification. We will also recruit and train contractors who serve senior communities such as mobile homes and multi-family apartments. We have been providing training and EM&V services to contractors who serve these communities for the past five years, and we intend to continue serving these communities with the RCA verification program. We plan to market the program to rural contractors who normally do not participate in energy efficiency programs. We have performed EM&V services for more 9,000 mobile homes this past year and are in the process of verifying RCA on 100% of 1,240 mobile homes during the next three months.

A.2 Commercial Hard-to-Reach Customers

RMA will target and recruit HVAC contractors who serve small commercial buildings where the primary language is non-English. This past summer we provided EM&V services to hard-to-reach small commercial programs in non-English speaking communities (i.e., Vietnamese and Spanish). This experience has been helpful in helping us understand how target contractors who serve these customers. Many small commercial buildings replace their units in an emergency and having relationships with contractors who serve these buildings will help our program to deliver RCA-verified new air conditioners for these customers.

B. Customer Eligibility

The types of customers who will be entitled to participate in the program include any residential and small commercial customers installing a new air conditioner. The goal is to reach the HVAC contractors with the largest sales volume since these contractors will reach the largest number of residential and small commercial customers. However, for equity considerations, the program will also reach out to minority and small business contractors to serve hard-to-reach customers as described above.

C. Customer Complaint Resolution

The procedures for responding to customer questions or complaints regarding, and for resolving program performance disputes with program participants or customers are as follows. RMA will maintain an experienced customer service department to respond to customer complaints within 24 hours. RMA believes in treating customers fairly and promptly in order to resolve customer complaints in a timely manner. Customers will be provided with our toll-free customer service telephone number and personal service from our trusted customer service associates Anne Blankenship and Ean Jones who are both experienced EPA certified technicians.

D. Geographic Area

The geographic area served by the program includes the hot Central Valley, Southern San Francisco Bay Area, and Napa Valley regions which are represented by Sacramento, Fresno, San Jose, and Napa. These regions have large peak cooling loads and would benefit most from the air conditioner efficiency improvements available from RCA verification services.

IV. Measure and Activity Description

A. Energy Savings Assumptions

The program coincident peak demand reduction (kW) and electric energy savings (kWh) for residential and commercial RCA verification measures are based on the following assumptions (the program has zero gas savings).

A.1 Residential RCA Verification Energy Savings Assumptions

The 2001 DEER Update Study refers to RCA verification as “Basic HVAC Diagnostic.” The 2001 DEER Update Study baseline is a degraded AC unit and the measure is proper RCA.¹¹ The program targets the geographic areas of SDG&E including Inland San Diego County, and Coastal San Diego which are represented by El Cajon and San Diego forecast climate zones 10, and 13.¹² The baseline and measure savings assumptions are provided in **Table 6**. Average savings for residential RCA verification are as follows.

- **Coincident Peak Demand Reduction: 0.585 kW**
- **Electric Energy Savings: 394 kWh/yr**

Table 6. Residential RCA Baseline Assumptions and Measure Savings

City	CEC Forecast Zone (from DEER)	UEC (kWh/yr)	UEC (kW)	kWh Savings	kW Savings
San Diego	13	1,574	2.800	296	0.570
El Cajon	10	2,395	2.800	493	0.600
Average		1,985	2.800	394	0.585

A.2 Commercial RCA Verification Energy Savings Assumptions

The DEER 2001 Update Study doesn’t provide coincident peak demand or energy savings for commercial RCA verification. Energy savings for commercial RCA verification are based on average savings of 17% and an applicability factor of 57.5%.¹³ The applicability factor accounts for 50 to 65 percent of sites that do not have proper RCA. Baseline Energy Use Intensities (EUIs) are based on studies for small commercial buildings.¹⁴ The program targets commercial

¹¹ Energy and peak demand savings are based on the 2001 DEER Update Study, page 193, Basic HVAC Diagnostic Testing and Repair, prepared by XENERGY, Inc., prepared for the California Energy Commission, Contract 300-99-008, August 2001.

¹² The CEC climate zones are El Cajon (10), and San Diego (7).

¹³ Average savings of 17% and applicability factor of 57.5% are based on the following studies. *National Energy Savings Potential from Addressing HVAC Installation Problems*, Chris Neme, Vermont Energy Investment Corporation, prepared for US Environmental Protection Agency, March 1998. *Assessment of HVAC Installations in New Air Conditioners in SCE’s Service Territory*, Blasnik, M., EPRI, 1995; *Enhancing the Performance of HVAC and Distribution Systems in Residential New Construction*, Hammarlund, J., Proceedings of 1992 ACEEE Summer Study on Energy Efficiency in Buildings, Volume 2, pp. 85-87; *The Effect of Reduced Evaporator Air Flow on the Performance of a Residential Central Air Conditioner*, Palani, M., O’Neal, D., Haberl, J., The Eighth Symposium on Improving Building Systems in Hot and Humid Climates, 1992; *Impact of Evaporator Coil Air Flow in Residential Air Conditioning Systems*, Parker, D., FSEC-PF-321-97; *The Effect of Refrigerant Charge, Duct Leakage, and Evaporator Air Flow on the High Temperature Performance of Air Conditioners and Heat Pumps*, Rodriguez, A., EPRI, 1995.

¹⁴ *Filing of San Diego Gas & Electric Requesting Approval of Proposed Energy Efficiency Programs and Budgets as Part of the 2002 Energy Efficiency Program Selection Process Required by Rulemaking 01-08-028*, December 14, 2001; *California Energy Demand: 1995-2015*, P300-95-008, California Energy Commission, 1516 Ninth Street, Sacramento, CA 95814, 1995 ; *Southern California Edison Energy Efficiency Potential Study*, prepared for Southern California Edison Company, prepared by XENERGY, 1992; *Proposal of Southern California Edison Company for Administration of 2002 Energy Efficiency Programs Required by Rulemaking 01-08-028*, and SCE C-E Tables.xls, December 16, 2001.

RCA Verification Program for New Air Conditioners

customers in all geographic areas of SDG&E. The baseline and measure savings assumptions are provided in **Table 7**. Average savings for commercial RCA verification are as follows.

- **Coincident Peak Demand Reduction: 0.458 kW**
- **Electric Energy Savings: 807 kWh/yr**

Table 7. Commercial RCA Baseline Assumptions and Measure Savings

Building	CEC Forecast Zone	EUI (kWh/ft ²)	Baseline (W/sf)	UEC	kW	kWh Savings	kW Savings
Retail	All	5.65	3.480	8,475	5.220	828	0.390
Small Office	All	3.95	4.181	5,925	6.272	579	0.469
Restaurant	All	6.92	4.581	10,380	6.872	1,015	0.514
Average		5.51	4.08	8,260	6.121	807	0.458

B. Deviations in Standard Cost-Effectiveness Values

The program net-to-gross ratio, estimated useful life, and incremental measure cost are based on the following rationale.

1. **Net-to-Gross Ratio: 0.89.** The program uses the published NTGR of 0.89 from the CPUC *Energy Efficiency Policy Manual* (Table 4.2, page 19, chapter 4 of the CPUC EEPM)
2. **Estimated Measure Life: 15 years.** This is equivalent to the EUL for “Air Conditioners – High Efficiency” (see Table 4.1, page 17, chapter 4 of the CPUC EEPM). The CPUC EEPM does not list an effective useful lifetime for RCA verification. Other programs have used 8 years and 10 years for proper RCA in retrofit applications assuming that the measure lasts as long as the remaining lifetime of an older air conditioner. The rationale for using a 15-year EUL is based on the fact that the air conditioner is new and will last 15 years. The program also requires installation of two secondary brass Schrader valve caps (on liquid and suction lines) to prevent refrigerant from leaking out of the unit once it is properly charged.
3. **Incremental Measure Cost: \$70 per RCA verification.** The 2001 DEER Update Study provides a measure cost of \$123 per unit for Basic HVAC Diagnostic (same as RCA verification), but this cost is only for retrofit applications. The 2001 DEER Update study does not provide a cost for new air conditioner RCA verification installations. The measure cost for new installations is unavailable. The cost for RCA verification includes the cost to motivate technicians to participate and the cost to provide the verification service (i.e., data collection, database management, reporting, and inspections for quality control). This innovative program is proposing an incremental cost that includes financial incentives of \$40 per unit and “installation service cost” of \$30 to provide the RCA verification service.

C. Rebate Amounts

Rebate amounts are specified for two measures in the attached workbook and shown in **Table 8**.

Table 8. Rebate Amount for RCA Verification Program

Qty.	Measure	Qty	Financial Incentives to Contractor	Direct Installation Service Cost	Total Rebates
1	≤ 5 ton Proper Charge/Airflow (Res)	8,000	\$40	\$30	\$560,000
2	≤ 5 ton Proper Charge/Airflow (Comm)	4,000	\$40	\$30	\$280,000

The rebate amounts have two elements.

1. “Financial incentives” to contractors to properly collect RCA measurements and receive RCA verification by reporting data over web-enabled devices, cell phone telephony, or person-to-person to an RMA EPA-certified technician.¹⁵
2. “Installation service costs” are provided to RMA to provide the RCA verification service.¹⁶

The financial incentives to contractors are based on market research and costs for contractors to perform the service. The direct installation service cost is for RMA to provide the RCA verification service and on a per unit basis includes the following costs.

1. Field verification on a random sample of RCA-verified jobs. The field verification is part of the direct installation service cost for quality assurance purposes and to guarantee that the service delivers energy and peak demand savings.
2. Web-enabled RCA verification service which includes collecting and verifying RCA measurements from participating contractors through web-enabled devices, cell phone telephony, or person-to-person with our EPA-certified technicians.
3. Send RCA verification certificates and AC energy education material to customers.
4. Archive and report the data to contractors, utilities, CPUC and other parties (i.e., manufacturers).

The rebate amounts are based on market research data obtained from wholesale distributors and AC technicians. The rebate amount of \$40 to contractors is adequate since technicians are already at the site with their equipment installing the new air conditioner (i.e., no extra time for travel or setup). The cost for retrofit AC diagnostic tune-ups is 2 times higher due to marketing, travel, setup and problems encountered with older units.

¹⁵ See Column G, “2 – MeasurableEEActivities” spreadsheet in the “RMA 20042005proposalworkbookv03.xls.” workbook

¹⁶ See Column H, “2 – MeasurableEEActivities” spreadsheet in the “RMA 20042005proposalworkbookv03.xls.” workbook

D. Activity Descriptions

The following program activities are not expected to produce measurable energy savings.

1. Customer Education regarding maintaining efficient AC operation (i.e., changing filters, keeping air vents open, cleaning condenser, etc.).
2. Working with manufacturers to discuss the widespread problems associated with efficiency degradation due to improper charge and airflow. The focus of this effort will be to convince manufacturers to offer a longer warranty for RCA installations compared to non-RCA installations.
3. Coordination with CEC Title 24 codes and standards programs to require RCA verification on new air conditioners for new buildings
4. Coordination with US-DOE regarding future efficiency standards for new air conditioners to require RCA verification
5. Coordination with US-EPA regarding Energy Star labels for new air conditioners to require RCA verification
6. Coordination with Federal Trade Commission regarding yellow label for new air conditioners to include RCA verification

V. Goals

The program has quantitative and qualitative goals. Quantitative goals include enrolling and training 100 licensed HVAC contractors to use the RCA system to verify proper charge and airflow for 8,000 new residential AC units and 4,000 new small commercial AC units. Quantitative peak demand and energy savings goals are 5,796 kW, 5,678,200 Wh/yr and 85,173,000 lifecycle kWh (see **Table 9**). The total resource cost test is 2.64 and the participant test is 14.23.

Qualitative goals include working with manufacturers to only provide their 5-year warranty for verified ac units and offer a significantly lower 90-day warranty for non-verified units. Qualitative goals also include working with government agencies to institutionalize independent verification of proper charge and airflow. The CEC would be lobbied to revise the Title 24 standards to require verification of proper charge and airflow on all new air conditioners installed in new construction. The US-DOE and FTC would be lobbied to include verification of proper charge and airflow on the yellow label for new air conditioners. The EPA would be lobbied to include verification of proper charge and airflow in future Energy Star air conditioner programs. Quantitative and qualitative goals of the program are summarized in **Table 9**.

Qualitative goals will be based on contacting and establishing a working relationship with at least two manufacturers and each of the respective government agencies. We cannot guarantee that these market actors will adopt verification requirements within the two-year time frame of the program.

Table 9. Summary of Quantitative and Qualitative Program Goals

Description	Goal
Technicians trained to use RCA verification system	100 Technicians
Residential RCA verified new AC units	8,000 Units
Small commercial RCA verified new AC units	4,000 Units
Peak demand savings	5,796 kW
Annual kWh savings	5,678,200
Lifecycle kWh savings	85,173,000
Total Resource Cost test	2.64
Participant Test	14.23
Manufacturers	5-year warranty for RCA verified units only
CEC	Require RCA verification
US-DOE and FTC Yellow Label	Yellow label SEER only valid for verified units
US EPA	Include verification in Energy Star

VI. Evaluation, Measurement and Verification (EM&V)

This section provides the EM&V plan, list of two potential EM&V contractors, and their qualifications and evidence that the contractors can objectively evaluate the program success.

A. EM&V Plan

The EM&V approach will consist of both a process and an impact evaluation. The evaluation will be conducted throughout the program period and consists of the following elements. Eight tasks will be undertaken by the study. The eight tasks are briefly summarized as follows.

Task 1. EM&V Plan

The EM&V Plan will contain a detailed description of all activities required to complete the study.

Task 2. Tracking Database

The tracking database will provide a complete listing of verification sites and on-site measurements. RMA will provide data from their program tracking database for evaluation purposes.

Task 3. Sample Design

A statistical sample design will be used to select a sample of customers or projects from the participant populations. Samples will be selected to obtain a reasonable level of precision and accuracy required by the CPUC Energy Efficiency Policy Manual (EPPM).

Task 4. Process Surveys

Process surveys will be used to evaluate what works, what doesn't work, and customer satisfaction. Process surveys will also obtain suggestions for improvement in the program's services and procedures. Market research and saturation data will be used to assess whether or not there is a continuing need for the program.

Task 5. On-Site EM&V Inspections

On-site EM&V inspections and measurements will be used to assess energy and peak demand savings. Site visits will be also be used to verify that measures are properly installed. Sites in the statistical sample will include spot and short-term measurements.

Task 6. Statistical Analyses

Statistical analyses will be used to extrapolate measurements of baseline and measure assumptions from the sample level to the program population. Ex post energy and peak demand savings for each measure will be determined using IPMVP Option A, partially measured retrofit isolation, and stipulated values. Statistical analyses will be used to extrapolate energy and peak demand savings at the sample level to the program level. This task will include an assessment of the relative precision of program-level energy and peak demand savings. Analysis of process evaluation telephone survey data will include a summary of what works, what doesn't work, and customer satisfaction. Market assessments will also be performed to evaluate whether or not there is a continuing need for the program

Task 7. Progress, Draft, and Final Reports

Progress, draft, and final reports will include a description of the study methodology and all deliverables as per the CPUC EEPM. The reports will provide results of the impact evaluation including gross and net energy and peak demand savings for each measure and the program as well as results.

Task 8. Project Management

Project management includes management of all personnel required to complete the study, consistent and timely communication, issue resolution, and periodic reporting.

The program savings verification will be based on field verification, field measurements, and the RCA verification database.

B. List of Potential EM&V Contractors

The following two EM&V contractors are recommended as potential EM&V contractors.

1. Ridge & Associates

Richard S. Ridge, President
3022 Thompson Avenue
Alameda, CA 94501
Voice: (510) 865-6011
Cell: (510) 510-910-4349
FAX (510) 865-1057
E-Mail: RSRIDGE@COMCAST.NET

Ridge & Associates has no conflict of interest in providing EM&V services to RMA. Ridge & Associates is entirely independent and has no business relationship with RMA and no professional interest in the program that is proposed. Ridge & associates is not aware of any reason why the CPUC might not select Ridge & Associates to provide EM&V services for RMA. We have no outstanding state tax liens, present or former bankruptcy, pending civil or criminal litigation or other proceedings, license suspensions or other similar actions, or criminal convictions.

Ridge & Associates has more than 20 years of experience conducting a wide variety of EM&V studies of residential, nonresidential, and agricultural energy efficiency and

conservation programs. Our evaluations have always withstood the scrutiny of the CPUC allowing clients to justify their energy savings claims. In 1992, Rick represented Edison in developing the *Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management (DSM) Programs* that set forth guidelines for evaluating DSM programs. During 1993, he also chaired the Statistical and Engineering Modeling Subcommittee that reported to the California Demand-Side Management Measurement Advisory Committee (CADMAC). After founding Ridge & Associates in 1993, Rick led the team of experts that developed an *Evaluation of Statistical and Engineering Models for Estimating Gross Energy Impacts* and the *Quality Assurance Guidelines for Statistical and Engineering Models*, both of which were published by the Association of Energy Services Professionals. In 2001, Dr. Ridge conducted a meta-analysis of over 190 DSM evaluations conducted in California by the four investor-owned utilities from 1993 through 1998. The main focus of this effort was to explore historical trends in net-to-gross ratios and to examine any systematic bias in estimates of net-to-gross ratios associated with the various methods. He has continued to focus on process and impact evaluations of large-scale residential and non-residential DSM programs and to provide consulting support to such clients as Southern California Edison, the Pacific Gas & Electric Company, the California Measurement Advisory Committee (CALMAC), San Diego Gas and Electric, the Southern California Gas Company, Kauai Electric, the Oregon Energy Trust, the Korea Energy Economics Institute, the New York State Energy Research and Development Authority, and the University of California.

2. **Itron, Inc.**

Mr. Alan Fields, Vice President of Consulting & Analysis
Consulting and Analysis Division
11236 El Camino Real, San Diego, California 92130
Tel: 858-481-0081
Fax: 858-481-7550
E-mail: www.RER.com

Itron, Inc. has no conflict of interest in providing EM&V services to RMA. Itron is entirely independent and has no business relationship with RMA and no professional interest in the program that is proposed. Itron is not aware of any reason why the CPUC might not select Itron to provide EM&V services for RMA. We have no outstanding state tax liens, present or former bankruptcy, pending civil or criminal litigation or other proceedings, license suspensions or other similar actions, or criminal convictions.

Itron, Inc. (previously RER, Inc.) has been recognized for years as one of the leading firms in the country in the evaluation of energy efficiency programs. Established in 1979 in San Diego, Itron has been evaluating energy efficiency programs since 1982. We have conducted numerous program evaluations, market assessments, market effects studies, and assessments of cost-effectiveness. We have been at the forefront of the development and implementation of modeling approaches like the realization rate approach and efficiency modeling. Our past and present clients in the area of energy efficiency include all of the California utilities, the California Energy Commission, the California Public Utilities Commission, and numerous other major utilities from around the country. The Consulting and Analysis group of Itron

has its main office in San Diego and regional offices in Boston, Massachusetts and Vancouver, Washington. We offer an experienced team of professionals in the areas of market assessment and program EM&V. Many of our staff have been with the company for at least five years, and some have been in the energy industry for over a decade. We offer a wide range of disciplinary backgrounds including economics, engineering, statistics, and computer programming. Itron has extensive experience in providing EM&V services for energy efficiency programs for utilities and government energy agencies. These evaluations have spanned the full range of programs, from residential energy efficient lighting to industrial load curtailment programs. We have also encompassed both detailed process evaluations and statistical impact and market effects assessments.

VII. Description of Implementer's Qualifications

Robert Mowris & Associates (RMA) is the primary implementer and program manager. Subcontractor, Alpen Software, will develop the RCA verification system, web server and database. The Accounting Offices of Barry Goldstein, CPA will provide incentive fulfillment services for the program. Mr. Goldstein's office is located at 5767 Broadway, Suite #3, Oakland, CA 94618, (510) 658-5050. Qualifications are provided below for the Robert Mowris & Associates (RMA) and Alpen Software. Resumes are attached at the end of this section.

A. Qualifications of RMA Primary Implementer

Robert Mowris & Associates has a proven record in California for developing and implementing innovative upstream energy efficiency programs. We designed the Upstream High Efficiency Gas Water Heater Program and Time-of-Sale Home Inspection Programs in 1998. We assisted with the design of the Residential Contractor Program and provided training to more than 500 HVAC technicians over a two year period on proper charge and airflow. We designed and implemented the TXV upstream incentive pilot program that delivered 1,400 TXVs and trained 60 technicians and salespersons on proper charge and airflow.¹⁷ We also designed and performed EM&V for the Mobile Home Peak Load Reduction Third Party Initiative for SDG&E. RMA has more than 15 years of experience with energy-efficiency program design, administration, implementation, market assessment, measurement, evaluation, and verification. RMA has performed more than 2,500 detailed energy-efficiency evaluations of residential, commercial and industrial programs and projects. We have provided energy consulting services to SCE, SCG, the California Board for Energy Efficiency (CBEE), PG&E, SMUD, SQAMD, MID, TID, TDPUD, Lodi Electric, Roseville Electric, Silicon Valley Power, City of Lompoc, City of Gridley, City of Biggs, Healdsburg, Alameda, Lassen MUD, Ukiah, Palo Alto, Port of Oakland, Redding, Alameda, Plumas Sierra Rural Electric Cooperative, US EPA, US DOE, ACEEE, NRDC, Sierra Club, Rainforest Action Network, Hawaii Energy Coalition, Lawrence Berkeley National Laboratory, and many corporate clients.

RMA designed and developed the RCA verification software to assist with EM&V verification. Scott Price, Lead Technician and Quality Control Manager for American Synergy Corporation is

¹⁷ RMA designed and implemented the 2001 TXV Incentives program as a subcontractor to the Local Government Commission with funding from SCE under the auspices of the California Public Utilities Commission.

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currently field testing the RCA verification software on 1,240 mobile homes in Southern California. Here is what Scott had to say about the RCA software.

“The RCA verification program is very useful and accurate in determining the correct charge and airflow of air conditioning systems. In using it and applying it in my quality control efforts I have found it makes my job easier. This program can and will eliminate human data entry errors. I really like the availability to enter the numbers myself and to also have the option to call in when a PDA or Laptop computer is not accessible. In closing this program, when applied correctly, will help ASC technicians and me be more accurate in doing our work.” - Scott Price, ASC QC Manager

Past Projects for Robert Mowris & Associates

The following is a partial list of past projects for RMA.

Project: EM&V for the Mobile Home Energy Savings Local Program

Client: American Synergy Corporation and CAL-UCONS

Duration: 2003-04

Contact: Steve Shallenberger, President (888) 988-2896, cell: (909) 288-4651

Description: Performed detailed EM&V verification inspections for duct test/seal, AC diagnostic, blower door guided infiltration reduction, programmable thermostats, showerhead, aerators, CFLs, water heater blankets, pipe insulation, and energy education. Designed and performed participant and non-participant surveys. Designed statistical random sample sizes for each measure at the 90% confidence interval. Performed measurements of duct leakage, infiltration, air conditioner capacity, air flow, enthalpy, and energy efficiency ratio (EER) to develop calibrated eQuest simulations of measure savings. Provided an evaluation of the program process, quality control, and tracking database.

Project: EM&V for the Small Commercial Mobile Energy Fitness Local Program

Client: ADM, Inc.

Contact: Safdar Chaudry, Program Manager (916) 363-8383

Duration: 2003-04

Description: Performed EM&V verification inspections for retail, restaurant, and office participants. Measured a random sample of pre- and post-retrofit air conditioner performance. Designed and performed participant and non-participant surveys including an assessment of recommended measures based on the MEC reports. Provided an evaluation of the program process, quality control, and tracking database.

Project: EM&V for the Small Nonresidential Energy Fitness Local Program

Client: RHA, Inc.

Contact: Jim O'Bannon (530) 898-1323

Duration: 2003-04

Description: Performed EM&V verification inspections for retail, restaurant, and office participants. Measured a random sample of pre- and post-retrofit lighting fixture Wattages using true RMS electric power data loggers. Measured hours of operation using light loggers and participant interviews. Designed and performed participant and non-participant surveys including an assessment of recommended measures based on the Energy Fitness reports. Provided an evaluation of the program process, quality control, and tracking database.

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Project: **EM&V for the Small Commercial Energy Efficiency & Market Transformation Local Program**

Client: Energx Controls, Inc.

Contact: Tim Krause, Program Manager (714) 826-4426

Duration: 2003-04

Description: Performed EM&V verification inspections for small commercial boilers. Designed and performed participant and non-participant surveys including verification of boilers. Provided an evaluation of the program process, quality control, and tracking database.

Project: **EM&V for 37 Residential and Nonresidential Peak Load Reduction Local Programs**

Client: Northern California Power Agency

Contact: John Berlin, Program Manager (916) 781-4272

Duration: 2002-04

Description: EM&V of 37 residential, nonresidential and industrial peak load reduction local energy efficiency programs for 18 public utilities, municipal utilities, and rural electric cooperatives. Developed and implemented EM&V plans, Microsoft Access tracking database, sample designs, site visits, data collection, telephone surveys, engineering and/or statistical analysis of gross and net savings according to the *International Performance Measurement and Verification Protocols*.

Project: **Residential Contractor Program (RCP) and Standard Performance Contract Program (RSPC)**

Client: Southern California Gas Company

Contact: Wayne Tanaka, Program Administrator (805) 492-6405, cell: (805) 490-0173

Duration: 1999 and 2000

Description: Developed curriculum, managed training, hired trainers and provided bi-weekly RCA training to HVAC technicians for two years. Developed field verification and inspections and assisted with design, measure selection, rebates, and implementation for the RCP. Developed the standards manual, training curriculum, tests, certificates, database, contractor sales/marketing materials, and recruiting plan.

Project: **California Energy Efficiency Policies and Program Priorities**

Client: California Board for Energy Efficiency and Southern California Edison Company

Duration: 6/98 – 10/98

Contact: Richard Ridge, Ph.D. (510) 865-6011

Description: Reviewed 200 residential, nonresidential, and new construction energy efficiency programs in California and other States, and made recommendations regarding best practices.

Project: **Residential Standard Performance Contract Programs (M&V)**

Client: SoCalGas, SCE, and PG&E

Duration: 11/97 – 1999

Contact: Melissa Cuaycong (SoCalGas), Dave Bruder (SCE), and Marty Chetaitus (PG&E)

Description: Developed installation, measurement, and verification protocols and energy savings for insulation, windows, duct sealing, infiltration reduction, air conditioner, heat pump, furnace, water heater measures, pool pumps and CFLs.

RMA Key Personnel

Robert Mowris, P.E., EPA-Certified Universal Refrigerant Technician

Robert Mowris, principal consultant, will provide overall project management for the program. Mr. Mowris has 15 years of energy engineering experience and 8 years of experience with energy-efficiency program design, administration, market assessment, measurement, verification and standard performance contract programs. Mr. Mowris is a nationally recognized expert in the energy efficiency field. Robert worked with the Local Government Commission (LGC) in 2001 to implement a successful upstream TXV program and also provided training to HVAC contractors on proper refrigerant charge and airflow. Mr. Mowris designed the Southern California Residential Contractor Program training materials and managed and delivered all aspects of RCP contractor training on refrigerant charge and airflow from 1999 through 2000. Mr. Mowris is an EPA-certified Universal Refrigerant Technician, a CHEERS Analyst, CHEERS Rater, and registered trainer and proctor for the ESCO Institute on refrigerant charge and HVAC Excellence. He is a member of the Desert Chapter of the Building Industry Association and worked with several builders in 2001 to train AC contractors on RCA for the EPA Energy Star New Homes program. He has provided classroom and hands-on training to HVAC dealers and technicians at the Southern California Air Conditioning Distributors Carrier Training Center. Mr. Mowris is the principal consultant/engineer working with Northern California Power Agency on measurement and verification of SB5X energy efficiency programs for 18 municipal utilities. Mr. Mowris has performed more than 2,500 energy-efficiency evaluations of residential, commercial and industrial projects. Mr. Mowris has provided energy consulting services including program design, implementation or evaluation services to Southern California Edison Company (SCE), Southern California Gas Company (SCG), Pacific Gas and Electric Company (PG&E), the California Board for Energy Efficiency (CBEE), SMUD, SQAMD, US EPA, US DOE, ACEEE, NRDC, Sierra Club, Rainforest Action Network, Hawaii Energy Coalition, Lawrence Berkeley National Laboratory, and many other corporate clients. Mr. Mowris earned a Master of Science degree in Civil & Architectural Engineering specializing in Building Energy Engineering from the University of Colorado-Boulder and Bachelor of Science degrees in Mechanical Engineering and Education from the University of Wisconsin-Madison (highest honors). He was a member of the engineering staff at Hughes Aircraft Company, Eastman Kodak Company and Accudyne Corporation. He is a member of the American Society of Heating, Refrigeration, and Air Conditioning Engineers, a senior member of the Association of Energy Engineers, a member of the American Society of Mechanical Engineers, and a member of the Illuminating Engineering Society of America. Mr. Mowris has authored or co-authored more than 20 published papers on DSM policy, program design, evaluation and forecasting.

Kathleen E. Carlson, MBA, Esq.

Kathleen E. Carlson, Principal Consultant/Attorney, will assist with project management tasks for RMA. Ms. Carlson has 15 years of energy efficiency experience and 17 years of legal experience with contracts, securities, banking, risk assessment, energy, and environmental law. Ms. Carlson has worked on a number of high-level energy and policy studies for the US Department of Energy, PG&E, Sierra Club, and Lawrence Berkeley National Laboratory. She is a former board member of the Save the San Francisco Bay Foundation. Ms. Carlson was a Senior Research Associate at Lawrence Berkeley Laboratory for three years, where she worked

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on energy and environmental policy. Ms. Carlson earned a Masters of Business Administration Degree from Golden Gate University, and a Masters Degree in Psychology from JFK University. She received her Bachelors Degree in Economics from UC Davis.

Peter Pressley, PhD

Peter Pressley, Ph.D., will be responsible for all database development tasks as well as program tracking tasks. Dr. Pressley has 25 years of computer experience and specializes in Microsoft Access relational databases, user interface development, and client-server network environments. He has been designing RMA's Microsoft Access databases for a number of years. He designed the Residential Contractor Program Training databases, Standard Performance Contract Program database, SDG&E Mobile Home TPI database, and the NCPA SB5X M&V database. He has been responsible for overseeing large database projects for utility and corporate clients. He is a software engineer with a Ph.D. research background, specializing in Microsoft Access, SQL, and 'C' programming, relational database design, user interface development, and client-server network environments. Mr. Pressley has twenty-five years of experience using computers for problem analysis; the last fifteen years dedicated to the development of software solutions for large and small businesses. Mr. Pressley earned a degree in computer technology from Control Data Institute and a Ph.D. in Zoology from University of California, Berkeley.

Anne Blankenship, B.S. EPA-Certified Universal Refrigerant Technician

Anne Blankenship will manage the RCA Verification telephone support system and perform telephone support for the program. Anne has performed numerous telephone services since joining RMA in 2001. She has performed more than 150 site visits where she has performed RCA verification services on split-system air conditioners. She has also performed electric power metering at residential, commercial, and industrial sites. She has successfully completed more than 1,000 EM&V telephone surveys. She is currently managing the implementation of customer in-person surveys and telephone surveys for 8 local programs. She is also managing the implementation of telephone surveys for 18 municipal utilities and 37 programs. Her expertise is designing and implementing customer friendly telephone support and telephone surveys aimed at understanding customer behavior and responding to technical questions regarding refrigerant charge and airflow. Ms. Blankenship performs database tracking of energy efficiency programs using Microsoft Access and analysis using Microsoft Excel. Ms. Blankenship earned a Bachelor of Science degree in Physics from Northern Arizona University in 2000 and graduated with honors.

Ean Jones, B.S. EPA-Certified Universal Refrigerant Technician

Ean Jones will co-manage the RCA Verification telephone support system and perform telephone support for the program. He will also manage RCA verification efforts in the field at customer sites. Ean has provided telephone support services for a number of projects since joining RMA in 2002. He has performed more than 200 site visits where he has performed RCA verification services on split-system air conditioners. He has also performed electric power metering at residential and small commercial sites. He has successfully completed more than 250 EM&V telephone surveys. He is currently co-managing the implementation of customer in-person surveys and telephone surveys for 8 local programs. Ean has performed EM&V field work for residential air conditioning sites, database tracking, analysis, and reporting. He has

four years of experience dealing with customer service issues. Mr. Jones earned a Bachelor of Science in Environmental Biology from Northern Arizona University in 2000 and graduated with honors.

B. Qualifications of Subcontractors

Alpen Software is the software, database, and information technology subcontractor, and Barry Goldstein is the incentive fulfillment subcontractor. Alpen Software is a full-service information technology (IT) services company. Alpen Software's team of experts provide voice application design and development services integrating Interactive Voice Response (IVR) and Text to Speech (TTS) technologies within new or existing systems and services. Alpen has designed **VoiceXML**, Internet based technology interfaces with existing telephony infrastructures to provide rich voice interfaces over the Internet using cell phone and PDA devices. Alpen Software's team of professionals understand design and development strategies required of this technology and furthermore, understand the obstacles and pitfalls that must be avoided when developing voice enabled applications. Imagine an Internet-based software system custom designed to meet your specific business requirements...an application that reflects the processes and workflow of your day to day operations. Known as system or software applications development, Alpen Software's team of engineers build systems that conform to precise specifications as described in the Systems Analysis and Design Lifecycle. Alpen Software are experts at systems integration. We provide and ensure cohesive information interchange across disparate software and hardware systems. Alpen Software understands the complexities of integration. By using the latest Internet standards for information interchange, we help companies improve efficiency by creating cohesive systems built on top of their existing software products.

Doug Greenwood, B.S., Alpen Software Principal

Douglas Greenwood, B.S., will be responsible for managing the design, development, and implementation of the RCA verification database software system. Mr. Greenwood has 20 years experience with information technology specializing in software application development, database design, and systems analysis and design. Doug is an expert in providing data integration, transformation, standards, communication, database design, systems analysis, web services, and web application development. Other specializations include web hosting, GPS/topographic map integration for the outdoor recreation industry. Technologies include XML, XSLT, VoiceXML, ASP.NET, and ADO.NET for data access. Databases include SQL 2000, JET 4.0. IDE's include Visual InterDev 6.0, Visual Studio.net. Mr. Greenwood earned a degree in physics, mathematics and computer science from Sonoma State University, Rohnert Park, California.

Igor Zlimen, Ph.D., Alpen Software Principal

Igor Zlimen, Ph.D., will be responsible for designing, developing, and implementing the RCA verification PDA and database software system. Mr. Zlimen has 22 years of software experience including designing and developing desktop applications and client and server web tools in Visual Basic. Igor is an expert in data collection, and model design and development. Igor hosts web servers for data collection and research. He develops server side DCOM objects, and designs and develops order entry and point of sale systems. He has designed and developed Visual Basic database browser applications to collect, analyze and report sales data, as well as built applications for the day-to-day maintenance of

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subscription programs and customer databases for the needs of the wine industry. He has built Visual Basic OLE servers on different database platforms to produce Excel workbooks as complex reports for performance analysis. He has developed data transfer tools and training applications. Mr. Zlimen earned a B.Sc. degree in physics from the University of Zagreb, Croatia in 1984, and a Ph.D., in Nuclear Physics from Rugier Boskovic Institute, Croatia in 1991.

Barry Goldstein, Certified Public Accountant

Barry Goldstein, CPA, will be responsible for providing incentive fulfillment services for the program. Mr. Goldstein has 17 years of public and government accounting experience, and 14 years experience with private and corporate accounting. He has provided accounting services for individuals, corporations, partnerships, and non-profit organizations. He provides bookkeeping services including incentive check disbursements, financial statement preparation, bank reconciliations, payroll accruals, accounts receivable tracking, set-up of general ledger/accounting system, implementation of accounting controls and general consulting. Mr. Goldstein earned a Bachelor of Science Degree in accounting from California State University in 1986.

C. Resumes

Resumes for the project are provided in this section for the following individuals.

1. Robert Mowris, P.E., RMA Principal Consultant
2. Kathleen E. Carlson, RMA Principal Consultant, Owner, Attorney
3. Peter Pressley, Ph.D.
4. Anne Blankenship, B.S.
5. Ean Jones, B.S.
6. Doug Greenwood, B.S.
7. Igor Zlimen, Ph.D.
8. Barry Goldstein, CPA

RCA Verification Program for New Air Conditioners

Robert Mowris, P.E.

PROGRAM MANAGER, EPA CERTIFIED TECHNICIAN

EDUCATION: M.S. Civil & Architectural Engineering, highest honors, Univ. of Colorado, 1986.
B.S. Mechanical Engineering with highest honors, University of Wisconsin, 1983.
B.S. Education with highest honors, University of Wisconsin, 1977.

PROFESSIONAL: Registered Professional Mechanical Engineer in California, # M26191
Certified C-HERS Analyst, HERS Rater, EPA Universal Refrigerant Technician

AFFILIATIONS: Member American Society of Heating Refrigeration and Air Conditioning Engineers, Member American Society of Mechanical Engineers, Senior Member Association of Energy Engineers, Member Illuminating Engineering Society

EXPERIENCE: Robert Mowris is an engineering consultant specializing in EM&V. He has a distinguished history of service. His areas of expertise include:

- EM&V of eight local energy efficiency programs.
- EM&V of 37 residential and nonresidential programs including City of Santa Clara, Turlock Irrigation District, Plumas Sierra REC, City of Lodi Electric Utility, Roseville Electric, City of Lompoc Electric Utility, City of Gridley Electric Utility, City of Biggs Electric Utility.
- EM&V of residential, nonresidential, new construction, and industrial energy efficiency programs.

Mr. Mowris' project and career experience includes the following:

- **Engineering Consultant, Robert Mowris and Associates, Orinda, California 1989-Present**
EM&V for Northern California Power Agency (NCPA) SB5X programs including residential, nonresidential, new construction, and industrial energy efficiency programs. Other M&E clients include government agencies, utilities, corporations, property owners, and environmental groups.
- **Senior Research Associate – Lawrence Berkeley Laboratory, Berkeley, California 1985-1989**
Research and development of energy efficiency and environmental policy and testimony to CEC, CPUC, US Congress and the National Academy of Sciences on the Implications of Greenhouse Warming.
- **Teaching Assistant – Civil Engineering Department, University of Colorado, Boulder, Colorado 1984-1985**
Taught Heating, Ventilating and Air Conditioning, Solar Energy Utilization, and Solar Energy Laboratory.
- **Member of Technical Staff – Radar Systems Group, Hughes Aircraft & Company, El Segundo, California 1983-1984**
Research and development of advanced manufacturing systems for aeronautical radar systems.
- **Engineering Quality Assurance – Eastman Kodak Company, Rochester, New York, Summer 1983**

Robert Mowris, P.E.

PROGRAM MANAGER, EPA CERTIFIED TECHNICIAN

**PUBLICATIONS:
(Partial List)**

Measure Incentives and Cost Effectiveness, for the California Residential Contractor Program, prepared for SoCalGas, SoCal Edison, SDG&E, and PG&E, Robert Mowris & Associates, 1999 and 2000.

California Energy Efficiency Policies and Program Priorities, prepared for California Board for Energy Efficiency and Southern California Edison Company, October 1998.

Deemed Energy Savings for Residential Standard Performance Contracting, prepared for Southern California Edison Company and PG&E, March 1998.

Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania, with S. Nadel, R. N. Elliott, J. DiCicco, H. Geller, American Council for an Energy-Efficient Economy (ACEEE), 1997.

Evaluation of First-Year Load Impacts of Southern California Gas Company's 1994 Energy Advantage Home Program, with Regional Economic Analysis, for Southern California Gas Company, February 1997.

Directory of Remote Monitoring and AMR Systems (database and state-of-the-art technical review), for Southern California Gas Company, Marketing Department, 555 W. Fifth St., Los Angeles, California, June 1997.

Energy Innovations: A Prosperous Path to a Clean Environment, technical analysis of buildings sectors (Chapter 5) with P. Miller, NRDC, and M. Duckworth, Tellus Institute. Published by Alliance to Save Energy, Union of Concerned Scientists, NRDC, ACEEE, and Tellus Institute, June 1997.

Impact Evaluation of PG&E's 1994 Industrial HVAC Program, with F. Powell, J. Register, and L. Clarke, pp. 6.111-119, Proceedings of the ACEEE 1996 Summer Study on Energy Efficiency in Buildings, ACEEE, 1001 Connecticut Avenue NW, Suite 801, Washington, DC 20036, August 1996.

Using the Long-term Industrial Energy Forecasting (LIEF) Model to Assess Industrial DSM Savings, with M. Ross, and R. Kent, Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings, ACEEE, 1001 Connecticut Avenue NW, Suite 801, Washington, DC 20036, August 1994.

DSM Strategies to Reduce Peak-Day Gas Loads in Antelope Valley and San Joaquin Valley, for Southern California Gas Company, Marketing Department, 555 W. Fifth St., Los Angeles, California, October 1995.

Data Collection of Gas and Electric Industrial Equipment Characteristics, for Southern California Gas Company, 555 W. Fifth St., Los Angeles, CA, 1994.

Conserved Energy Supply Curves with A. Rosenfeld, C. Atkinson, J. Koomey, A. Meier, L. Price, Contemporary Policy Issues: Economic Analysis for the Decision Maker, Vol. XI, No. 1, January 1993.

America's Energy Choices: Investing in a Strong Economy and a Clean Environment, analysis of buildings sector with P. Miller, NRDC. Published by Alliance to Save Energy, UCS, ACEEE, and NRDC, 1991.

Kathleen Carlson, MBA, Esq.

PRINCIPAL OWNER

EDUCATION: J.D. – University of Santa Clara, Santa Clara, CA, 1984.
M.A. Psychology with highest honors, JFK University, Orinda, CA 1990.

MBA, with highest honors, Golden Gate University, San Francisco, CA 1981.
B.A. Economics, University of California, Davis, CA 1980.

AFFILIATIONS: Member of the California Bar

EXPERIENCE: Ms. Carlson has 15 years of energy policy experience and 15 years of legal experience with contracts, securities, banking, risk assessment, energy, and environmental law. Ms. Carlson’s work is currently focused on energy and environmental work as the owner of RMA..

Ms. Carlson’s project and career experience includes the following:

- **Owner - Robert Mowris & Associates, Orinda, CA 1988-present**

Owns and manages RMA EM&V studies, develops business, writes proposals, writes reports, and performs analyses. Provides consulting services for energy policy, energy efficiency program design and administration, standard performance contracts, energy, environmental, and contract law.

- **Lawrence Berkeley National Laboratory, Berkeley, CA 1985-1988**

- Performed energy-related research including US appliance standards for the Department of Energy. Worked on liability issues related to indoor air quality for California Utilities.

- **Environmental Law Journal, San Francisco, CA 1983-1985**

- Performed environmental law research, writing, and related issues in the Western United States.

- **Fulbright & Jawarski, Washington, DC 1983**

Practiced securities and banking law.

Peter Pressley, Ph.D.

DATABASE SOFTWARE

- EDUCATION:** Ph.D., Zoology, University of California Berkeley, M.S. Zoology, University of British Columbia, B.A., Biology, University of California Berkeley, Computer Technology Degree, Control Data Institute
- SOFTWARE:** Operating systems: Windows; NT; DOS; UNIX; AIX; OS/2; VMS, Hardware systems: IBM PCs, RISC System/6000; Sun; DEC VAX; DG Avion. Programming languages: Visual Basic for Applications; C; C++; SQL; Bourne and C Shells; Ingres 4GL. Database systems: MS Access; SQL Server; Ingres; Sybase; Informix; Oracle; OS/2 DB; Btrieve. Windowing systems: MS Windows; OS/2 Presentation Manager; X Window System; Motif; SMS GUI
- EXPERIENCE:** Software engineer with a Ph.D. research background, specializing in Microsoft Access, SQL, and 'C' programming, relational database design, user interface development, and client-server network environments. Twenty-five years of experience using computers for problem analysis; the last fifteen years dedicated to the development of software solutions for large and small businesses. Recent projects include:
- **Access Database Programming Consultant – August 1993- Present**
Designed and developed the Residential Contractor Program Training databases, Standard Performance Contract Program database, SDG&E Mobile Home TPI database, and the NCPA SB5X M&V database. Mr. Pressley provides software solutions using Microsoft Access and Visual Basic for Applications in PC Local Area Networks.
 - **Computer Technology Center – June 1996-December 1998**
Designed and taught courses in Access, Visual Basic, and principles of modern computing.
 - **Netserve – July 1997-August 1998**
Consulted on WAN projects utilizing Cisco routers and ethernet switches. Performed system administration on Sun workstations, installing Oracle version 7 as an intranet server. Created Oracle databases used as database servers for PC clients utilizing ODBC connections.
 - **Power Engineers – February 1993-October 1995**
Consulting analyst for internal project and accounting systems running under UNIX and the Ingres database. Developed database system with Microsoft Access and SQL Server on NT. Created an internal Help Desk system using Access, Visual Basic, and Electronic Forms to manage help requests transmitted by E-Mail over a Novell Network.
 - **IBM Image Marketing – February 19903-January 1993**
Consulting analyst for the development of a client-server image processing system that runs on IBM RISC System/6000 and Sun workstation servers.

Anne Blankenship, B.S.

EPA-CERTIFIED TECHNICIAN

EDUCATION: B.S. Physiology, Northern Arizona University, 2000

- EXPERIENCE:** Anne Blankenship's EM&V experience includes the following:
- Field Metering of residential homes including mobile homes
 - Field Metering of Air Conditioners (EER, kW, kWh)
 - Designing EM&V customer surveys
 - Database tracking of energy efficiency programs
 - Implementing EM&V on-site and telephone process surveys
 - EM&V analysis and reports

Ms. Blankenship's project and career experience includes the following:

- **Consultant, Robert Mowris and Associates, Olympic Valley, California 2001-Present**

Field technician for residential and small commercial programs including AC EER, airflow, duct testing, lightning and auditing measurements. Other EM&V measurements include refrigerators, freezers, appliances, air conditioners, whole house fans, commercial geexchange heat pumps, roof-top packaged units, chillers, cooling towers, pumps, fans, and air handlers. Designed and implemented EM&V customer on-site and telephone surveys. EM&V analysis and reports, and database tracking and spreadsheet analysis of residential, commercial, and industrial energy efficiency projects and programs.

- **Recreation Supervisor– Benchmark Management, Olympic Valley, California 2000-2002**

Recreation department supervisor, performed cost/viability analysis to increase department's profits by 18%, organized large corporate activities, and managed a department of over 30 employees.

- **Undergraduate Research–Flagstaff, Arizona 1999-2001**

Three years experience working in an exercise physiology laboratory specializing in the kinesiology of respiration in elite cyclists. These included performing VO₂ max tests, creating complex abstracts, collecting data, data analysis, and presenting results at conferences.

- **Educational Coordinator, Pennsylvania 2000**

Planned and coordinated educational activities and supervised, and managed summer school camps and events including more than 100 young women and 14 counselors.

Ean Jones, B.S.

EPA-CERTIFIED TECHNICIAN

EDUCATION: B.S. Biology and Environmental Science, Northern Arizona University, 2000

EXPERIENCE: Ean Jones's EM&V experience includes the following:

- On-site EM&V inspections and measurements.
- Database tracking of energy efficiency programs
- Implementing EM&V on-site process surveys, metering, and verification
- EM&V analysis and reports

Mr. Jones's project and career experience includes the following:

- **Consultant, Robert Mowris and Associates, Olympic Valley, California 2001-Present**

Field technician for residential and small commercial programs including AC EER, airflow, duct testing, lightning and auditing measurements. EM&V inspections, testing, metering, analyses and reporting. Performed database tracking and spreadsheet analysis of residential, commercial, and industrial energy efficiency projects and programs.

- **Transportation Manager – Benchmark Management, Olympic Valley, California 2000-Present**

Transportation coordinator for a large resort management corporation. Performed cost/viability analysis and organized large corporate activities. Have managed a department of over 40 employees.

- **Undergraduate Research–Flagstaff, Arizona 1999-2001**

Three years experience working in an environmental biology laboratory specializing in energy conservation. I created complex abstracts, collected data, conducted data analysis, and presented my results at conferences.

- **Team Manager for the Aggressive Life Mountain Bike Racing Team-Big Bear, California 1997-2000**

Coordinated events, event registration, travel plans, on-site promotion for a team of 25 racers.

Doug Greenwood, Ph.D.

DATABASE AND VOICE XML SOFTWARE

- EDUCATION:** B.S. Physics, Mathematics, Sonoma State University, Sonoma, California, 1981
- AFFILIATIONS:** Organization for the Advancement of Structured Information Standards (<http://www.oasis-open.org>); Mortgage Industry Standards Maintenance Organization (<http://www.mismo.org>); Alliance for Advanced Transaction Technology (http://www.reipa.org/association/aartt_link.html)
- SOFTWARE:** Internet/Intranet: Microsoft's Active Platform (ASP technology, IIS 4/5), VBScript, JavaScript, DHTML, DOM; Development tools: Visual Studio IDE (InterDev). Integration tools include BizTalk Server 2000; Languages: ASP.NET (VB), Visual Basic 6.0, ECMAScript, VBScript, 4GL's: Speedware V5, V6.x, and V7.x; Powerhouse, and Transact SQL. 3GL's: FORTRAN; PL/I; Pascal; Basic-Plus (VAX); Database Systems: SQL Server 2000, Jet database engine, MySQL, Oracle 7.0 (OS/2), Turbo Image (MPE XL); Allbase G0.26 (MPE/XL); Rbase System V (DOS); XML Authoring Tools: XML Authority, XML Instance, XML Spy, XML Notepad
- EXPERIENCE:** Doug has twenty years of experience in the field of Information Technology, specialization in software application development, database design, and systems analysis and design. Mr. Greenwood's experience includes the following
- Internet/Intranet software application design and development
 - Design "N" tier frameworks using document/database layers
 - Integration of search engine technologies as data access methods (XML model)
 - XML DTD and Schema modeling and implementation
- Recent projects include:
- **Alpen Software, Principal – 2000 to Present**
Designed and developed data integration, transformation, standards, communication systems, database modeling and design, systems analysis and design, business process management, web services, and web application development. Other specializations include web hosting, GPS/topographic map integration for the outdoor recreation industry. Technologies include XML, XSLT, VoiceXML, ASP.NET, and ADO.NET for data access. Databases include SQL 2000, JET 4.0. IDE's include Visual InterDev 6.0.
 - **Greenwood Consulting – 1995-2000**
Database modeling for relational and network architectures; systems analysis and design for both mainframe and MS Windows environments; development and implementation of 4GL software applications; application performance assessment. Developed browser based Real Estate Listing Management System that using the XML document model for information search and retrieval. Clients and platforms include: *Unisource Corporation*, San Francisco, CA: Speedware 5.x, 7.x with Image on MPE XL (HP 3000/995); *Molecular Machines*, Sebastopol, CA: Microsoft Windows and NT client-server applications development utilizing the following tools: Access/Jet, SQL Server 6.5, Visual Basic 4.0, FoxPro 2.6, ODBC, and OLE Client/Server technology based application development.

Igor Zlimen, Ph.D.

DATABASE AND VOICE XML SOFTWARE

- EDUCATION:** Ph.D. in Nuclear Physics, Rugjer Boskovic Institute, Croatia, 1991
Post-doctoral fellow in Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California, 1991-1994
B.Sc. in Physics, University of Zagreb, Croatia, 1984
- SOFTWARE:** Designing VB applications as front end for SQL databases (Access, SQL Server, Oracle, Sybase, DB2, and SQL Anywhere); Implementing OLE, utilizing Windows APIs and interfacing MS Office applications
- EXPERIENCE:** Igor has twenty two years of software experience for many different applications including designing and developing desktop applications and client and server side web tools in Visual Basic.

Recent projects include:

- **Senior Systems Analyst, Alpen Software – 1994 to Present**
Managed data collection, model design and development in wine industry research. Hosted web servers for the data collection and research. Developed server side DCOM objects. Designed and developed order entry and point of sale system. Built application to follow different phases of wine production process. Designed and developed Visual Basic database browser applications to collect, analyze and report sales data, as well as built application for the day-to-day maintenance of subscription programs and customer databases for the needs of the wine industry. Built Visual Basic OLE servers on different database platforms to produce Excel workbooks as complex reports for the performance analysis. Developed data transfer tools and training applications.
- **Post Doctoral Fellow, Lawrence Berkeley Laboratory– 1991-1994**
Nuclear physics research and development of FORTRAN, BASIC and Visual Basic code for research data acquisition and analysis. Interfaced PC's and workstations with experimental electronic modules and developed software drivers.
- **Consultant– 1989-1991**
Developer of custom software applications for small companies (DOS and Novell LAN environment) to maintain warehouse databases, accounting, bookkeeping, form-printing and troubleshooting of the PC's and LAN's using Clipper and dBase. Installed software provided training and maintained equipment and applications.
- **Research Assistance, R. Boskovic Institute – 1984-1991**
Developed FORTRAN code for the simulation of experimental nuclear events and BASIC code for interface drivers.

Barry Goldstein, CPA.

INCENTIVE FULFILLMENT

EDUCATION: Bachelor of Science Accounting, California State University, September 1986
Post-doctoral fellow in Nuclear Science Division, Lawrence Berkeley Laboratory,
California Society of Certified Public Accountants Continuing Education:

EXPERIENCE: Barry has 17 years of public and government accounting experience, and 14 years experience with private and corporate accounting.

Professional experience includes:

▪ **Accounting Office of Barry Goldstein – 1989 to Present**

Individual, corporate, partnership, fiduciary and estate-planning and preparation, audits of corporations and non-profit organizations, bookkeeping services including financial statement preparation, check disbursements, bank reconciliations, payroll accruals, accounts receivable tracking, set-up of general ledger/accounting system, implementation of accounting controls and general consulting.

▪ **Revenue Agent, Internal Revenue Service – 1986- 1988**

Conducted over 75 business audits and received assignments conducting special investigations tracing large cash transactions and potential tax consequences.

▪ **Lecturer, Hastings School of Law**

Guest faculty expert at Hasting College of Law Expert Witness Workshop

VIII. Budget

The proposed budget summary for the program is shown in **Table 10**. The total budget is \$1,560,000 with \$420,000 for administration, \$40,000 for marketing/advertising, \$1,000,000 for direct implementation, \$80,000 for EM&V, and \$20,000 for financing costs. The potential performance award is \$107,800.

Table 10. Budget Summary Table

Description	Budget
Labor - Program Design, Development and Planning	\$46,000
Labor - Program/Project Management	\$175,000
Labor – Clerical	\$44,000
Payroll Tax - Administrative Labor	\$10,000
Conference Fees	\$2,000
Travel – Airfare	\$3,000
Travel – Lodging	\$5,000
Travel – Meals	\$2,500
Travel – Mileage	\$5,000
Labor - Conference Attendance	\$12,500
Overhead (General and Administrative) - Equipment – Computing	\$1,000
Overhead (General and Administrative) - Labor - Regulatory Reporting	\$24,000
Overhead (General and Administrative) - Subcontractor Labor - Information Technology	\$90,000
Total Administrative Costs	\$420,000
Marketing/Advertising/Outreach	
Advertisements / Media Promotions	\$20,000
Labor – Marketing	\$20,000
Total Marketing/Advertising/Outreach	\$40,000
Direct Implementation	
Financial Incentives to Contractors	\$480,000
Activity – Labor	
Labor - Curriculum Development	\$5,000
Labor - Customer Education and Training	\$80,000
Labor - Customer Equipment Testing and Diagnostics	\$30,000
Total Training Activities	\$115,000
Installation and Service Costs Subtotal	\$360,000
Rebate Processing and Inspection - Labor and Materials	
Labor - Rebate Processing	\$40,000
Rebate Applications	\$5,000
Total Rebate Processing and Applications	\$45,000
Total Direct Implementation	\$1,000,000
Evaluation, Measurement and Verification	
Labor - EM&V	\$74,000
Materials - EM&V	\$1,000
Travel - EM&V	\$5,000
Total EM&V	\$80,000
Financing Costs	\$20,000
Potential Performance Award	\$107,800
Total Budget	\$1,560,000