PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
SAN FRANCISCO, CA 94102-3298

October 10, 2003 Agenda ID #2868

**TO:** PARTIES OF RECORD IN RULEMAKING 01-08-027

**RE:** NOTICE OF AVAILABILITY OF DRAFT DECISION ON PHASE 4 STANDARDIZATION RESULTS FOR LOW-INCOME ENERGY EFFICIENCY MEASURE COST-EFFECTIVENESS AND NATURAL GAS APPLIANCE TESTING

Consistent with Rule 2.3(b) of the Commission's Rules of Practice and Procedure, I am issuing this Notice of Availability of the above-referenced draft decision. The draft decision was issued by Administrative Law Judge (ALJ) Gottstein on October 10, 2003. An Internet link to this document was sent via e-mail to all the parties on the service list who provided an e-mail address to the Commission. An electronic copy of this document can be viewed and downloaded at the Commission's Website (www.cpuc.ca.gov). A hard copy of this document can be obtained by contacting the Commission's Central Files Office [(415) 703-2045].

When the Commission acts on the draft decision, it may adopt all or part of it as written, amend or modify it, or set it aside and prepare its own decision. Only when the Commission acts does the decision become binding on the parties.

Parties to the proceeding may file comments on the draft decision as provided in Article 19 of the Commission's "Rules of Practice and Procedure." These rules are accessible on the Commission's website at http://www.cpuc.ca.gov. Pursuant to Rule 77.3 opening comments shall not exceed 15 pages.

Consistent with the service procedures in this proceeding, parties should send comments in electronic form to those appearances and the state service list that provided an electronic mail address to the Commission, including ALJ Meg Gottstein at meg@cpuc.ca.gov. Service by U.S. mail is optional, except that hard copies should be served separately on ALJ Gottstein, and for that purpose I suggest hand delivery, overnight mail or other expeditious methods of service. In addition, if there is no electronic address available, the electronic mail is returned to the sender, or the recipient informs the sender of an inability to open the document, the sender shall

immediately arrange for alternate service (regular U.S. mail shall be the default, unless another means – such as overnight delivery is mutually agreed upon). The current service list for this proceeding is available on the Commission's Web page, www.cpuc.ca.gov.

/s/ ANGELA K. MINKIN
Angela K. Minkin, Chief
Administrative Law Judge

ANG:tcg

Attachment

ALJ / MEG / tcg **DRAFT** Agenda ID #2868
Quasi-legislative

Decision **DRAFT DECISION OF ALJ GOTTSTEIN** (Mailed 10 / 10 / 2003)

**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA**

| | |
|---|---|
| Order Instituting Rulemaking on the Commission's Proposed Policies and Programs Governing Low-Income Assistance Programs. | Rulemaking 01-08-027 (Issued August 23, 2001) |

# INTERIM OPINION: PHASE 4 STANDARDIZATION RESULTS FOR LOW-INCOME ENERGY EFFICIENCY MEASURE COST-EFFECTIVENESS AND NATURAL GAS APPLIANCE TESTING

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# INTERIM OPINION: PHASE 4 STANDARDIZATION RESULTS FOR LOW-INCOME ENERGY EFFICIENCY MEASURE COST-EFFECTIVENESS AND NATURAL GAS APPLIANCE TESTING

## 1. Summary[1]

By today's decision we address the recommendations contained in two Phase 4 Standardization Reports on the Low-Income Energy Efficiency (LIEE) program submitted in this proceeding.[2] One report addresses the issue of which measures should continue to be offered under the program, based on the results of cost-effectiveness evaluations that include consideration of non-energy benefits. The other addresses carbon monoxide (CO) testing under the program, based on the results of an extensive study of CO levels present in low-income homes in California. The report recommendations apply to the LIEE programs administered by Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), Southern California Edison Company (SCE) and Southern California Gas Company (SoCalGas), collectively referred to as "the utilities," "Joint Utilities," or "investor-owned utilities" (IOUs) in this decision.

The reports were prepared by the Standardization Team (also referred to as "the Team"), at the Commission's direction. The Team is comprised of the utilities and project consultants, with coordination assistance from the Commission's Energy Division. Public workshops were held during the

[1] Attachment 1 explains each acronym or other abbreviation that appears in this decision.

[2] *Low-Income Energy Efficiency Program Measure Cost Effectiveness Study Final Report,* June 2, 2003. *Low Income Energy Efficiency Standardization Project: Final Phase 4 Report on Natural Gas Appliance Testing Study Results,* May 5, 2003. (NGAT Final Report.)

development of both reports. No comments or protests were filed in response to the Team's final recommendations.

We find that the Standardization Team has applied the cost-effectiveness guidelines adopted by the Commission in Decision (D.) 02-08-034 consistently, and reasonably. In those instances where the Standardization Team recommends retaining measures that do not meet the specific cost-effectiveness thresholds established by those guidelines, the Team has offered persuasive reasons for doing so based on policy or program considerations. We adopt the Standardization Team's recommendations as summarized below. These changes will be in effect for PY2004 and beyond, until further order by the Commission.

**TABLE A: Measures to Retain/Drop for PY2004 LIEE Program**

| Measure | |
|---|---|
| Non-Weather-Sensitive Measures | |
| Hard-wired CFL porch lights | Retain in all climate zones for single family homes, but drop for multi-family and mobile homes |
| Compact fluorescent lamps | Retain in all climate zones and residence types |
| Faucet aerators, | Retain in all climate zones and residence types |
| Low-flow showerheads, | Retain in all climate zones and residence types |
| High efficiency refrigerators | Retain in all climate zones and residence types |
| Water heater blankets | Retain in all climate zones and residence types |
| Water heater pipe wrap | Retain in all climate zones and residence types |
| High-efficiency water heaters | Drop from Program |
| Weather-Sensitive Measures | |
| Outlet gaskets | Retain in all climate zones and residence types |
| High efficiency central Acs | Drop in all climate zones and residence types |
| High efficiency room Acs | Retain in Climate Zones 11, 12, 13, 14, and 15 |
| Caulking | Retain in all climate zones and residence types |
| Ceiling Insulation | Retain in all climate zones and residence types |
| Duct testing and sealing | Drop in all climate zones and residence types |
| Evaporative cooler covers | Retain in all climate zones and residence types |
| Evaporative cooler maintenance | Drop in all climate zones and residence types |
| Evaporative coolers | Retain in Climate Zones 11 – 16 for single family and mobile homes; drop from Program for multi-family homes and in Climate Zones other than 11 – 16. |
| Furnace filters | Retain, but only as part of furnace repair or replacement |
| Gas furnace repairs | Retain in all climate zones and residence types |
| Gas furnace replacements | Retain in all climate zones and residence types |
| Minor home repairs | Retain in all climate zones and residence types |
| Setback Thermostats | Drop from Program except where required by code in conjunction with furnace repair or replacement |
| Weatherstripping attic doors | Retain in all climate zones and residence types |
| Weatherstripping doors | Retain in all climate zones and residence types |
| Whole house fans | Drop from Program |

As we stated in D.02-08-024, LIEE program measurement issues should be revisited periodically as time and resources permit. To this end, we request the utilities to submit additional information to explain the causes for the variability observed in some of their per measure cost data.

With regard to CO testing, we concur with all but two of the Standardization Team's recommendations. In particular, we agree that some type of CO testing is warranted for the LIEE program, even though the empirical data does not conclusively indicate that installing infiltration–reduction measures

will increase CO levels in the home. In terms of timing, we also agree with the Team's recommendation that CO testing be conducted only after weatherization. We concur with other recommendations made by the Team to improve CO testing based on the results of their study, including enhancements to visual inspections, the use of smoke tests as the standard procedure for draft testing, and changes to room ambient CO testing to include the operation of water heaters and kitchen appliances during the test, among others.

However, we do not adopt the recommendation that the decision to conduct flue tests or room ambient tests be left to the utility's discretion, as proposed by the Standardization Team for space and water heating.[3] As discussed in this decision, we find nothing in the study results to warrant the use of these tests in place of room ambient CO testing. Moreover, for the utility that elects to conduct flue tests, many of the customers' appliances will be "red-tagged" (disconnected) pending repair or replacement, even when CO levels in the room are well within safety thresholds and the appliance passes tests for adequate drafting. This is because there are far more test "fails" at the flue level, than in the room ambient air. Yet, the Standardization Team presents no empirical evidence or research to indicate whether, or to what degree, CO levels in the flue that exceed certain thresholds may present health problems in the future.

Instead, we direct all utilities to conduct room ambient CO tests as the standard procedure. If CO levels in a particular room (or rooms) are at or above

[3] With room ambient tests, CO levels are measured in the middle of the room or in the vicinity of a particular appliance (e.g., water heater). Flue tests are taken within the appliance itself at a point before room air mixes with combustion byproducts.

the 10 pounds per minute (ppm) action level, then the utility may (but is not required to) conduct flue tests as a diagnostic tool to identify the source(s) of the problem, as appropriate. This is the current manner in which SDG&E and SoCalGas utilize flue tests in combination with ambient tests in their CO testing procedures, and we adopt this approach for PG&E as well.

We also take issue with the Team's recommendation regarding the treatment of homes that contain a non-IOU fueled combustion appliance. Under this recommendation, the utility would no longer provide infiltration–reduction measures (such as caulking or weatherstripping) to low-income homes that use an IOU-fuel for space heating if the home also uses a non-IOU combustion fuel for one or more other end-use, such as water heating or cooking. For example, a home with electric space heat and electric cooking appliances would not receive infiltration-reduction measures under the LIEE program if it also uses a propane water heater.[4] At least for PG&E, the data available to date indicates that the impact of this policy would be significant in rural areas, where many electric customers do not have natural gas available for space heating. While we concur with the Team that the IOU ratepayers should not be responsible for conducting safety tests on non-IOU fueled appliances, or bear the costs of replacing or repairing those appliances if they do not pass the tests, we are not persuaded that the Team's recommendation on this issue is the best option.

Accordingly, we direct the Standardization Team to further explore alternatives, some of which are discussed in today's decision, with input from the Low Income Oversight Board (LIOB), community-based organizations and other

[4] It would, however, receive feasible non-infiltration reduction measures, such as compact fluorescent lamps, high efficiency refrigerators and low-flow showerheads.

interested parties. We also direct the utilities to provide additional data for our consideration of alternatives. We augment Phase 4 of the Standardization Project for this purpose, and direct the Standardization Team to file its report and recommendations within 120 days from the effective date of this decision.

In sum, we adopt the Team's recommendations for CO testing procedures, with two exceptions. First, as discussed above, we do not adopt flue testing as a standard procedure (or utility option) for space and water heating, as proposed by the Team. Second, we defer consideration of a final policy on the treatment of homes using non-IOU fuels until further data is available, and until we explore additional alternatives. In the interim, we authorize the utilities to continue their current CO testing procedures to qualify these homes for infiltration-reduction measures until we finalize our policy in the coming months. For low-income homes that use IOU-fuel for space heating and for all other combustion appliances in the homes, we adopt the CO testing procedures presented in Attachment 7.

We also adopt the Team's recommendations for actions to take when appliances fail one or more of the CO tests. Those actions are described in Section 4.8.2, and include the repair or replacement of natural gas space heaters and water heaters. Adding the replacement of natural gas water heaters to current procedures will increase program expenditures by an estimated $1.9 million in 2004 for the three natural gas utilities combined. However, this change will not require any rate increases for 2004. The increased costs for repairs and maintenance will be offset by the elimination of certain measures from the program. (See Table A above.)

To implement today's adopted policies and procedures, the Standardization Team will need to develop specific instructions and protocols,

and make additional revisions to the Policy and Procedures Manual. We direct the Standardization Team to submit this documentation as a compliance filing within 20 days from the effective date of this decision. Protests or comments will be due 10 days thereafter, and the Standardization Team may respond within 5 days. If there are no protests to the Standardization Team's compliance filing, then the Assigned Commissioner (in consultation with Energy Division) may issue a ruling approving the filing without further action by the Commission.

Today's decision completes a major effort to standardize policies and procedures related to the LIEE program. However, as noted by the Standardization Team in its report, other aspects of program procedures--such as pre-approvals of the installation of LIEE program measures--still vary considerably among the utilities. We solicit comment from the utilities and interested parties on what additional areas of the LIEE program should be standardized, if any. In consultation with Energy Division, the Assigned Commissioner should develop a scoping memo for future phases of the Standardization Project, as appropriate, taking parties' comments and the availability of Commission resources into consideration.

## 2. Background

By statute, the utilities provide direct weatherization and energy efficiency services to qualified households under the LIEE program. Weatherization measures include attic insulation, caulking, weatherstripping, low flow showerheads, water heater blankets and door and building envelope repairs which reduce infiltration. Relamping (i.e., replacing incandescent bulbs with compact fluorescent bulbs) and replacing inefficient refrigerators with more efficient ones has also become a standard service under the program. In addition, all of the utilities provide in-home energy education as part of their

LIEE programs, along with minor home repair and furnace repair and replacement. As directed in D.01-05-033, every LIEE recipient is required to receive every feasible measure offered under the program.

In D.01-05-033, we authorized the utilities to offer the following new measures on a pilot basis: high efficiency air conditioners, duct sealing and repair, whole house fans, high efficiency water heaters, the installation of set-back thermostats and evaporative cooler maintenance. In addition, we authorized the utilities to install LIEE equipment measures (e.g., refrigerators, air conditioners, evaporative coolers and hard-wired fixtures) in rental units, on an interim basis.[5] We added these measures in order to accelerate peak load savings and bill savings during the energy crisis, with the expectation that a comprehensive cost-effectiveness review of all LIEE measures, including the experimental ones authorized in D.01-05-033, would further refine LIEE program offerings in the future.

Since 1999, at the recommendation of the Low Income Advisory Board (which has been superseded by the Low Income Oversight Board), we have moved towards uniform, statewide program designs and implementation of LIEE measures.[6] As we stated in D.00-07-020, this effort ensures that all low-income customers served by the utilities under our jurisdiction are offered a consistent set of services and that contractors participating in the delivery of those services work under consistent rules and expectations.[7] This enables us to

[5] However, we required landlord co-payments under certain circumstances.

[6] See Resolution E-3586, D.99-03-056, *mimeo.*, p.18.

[7] D.00-07-020, *mimeo.*, p. 86.

*Footnote continued on next page*

improve the consistency and efficiency of providing LIEE services in a nondiscriminatory manner.

To this end, we initiated the LIEE Standardization Project, which is being conducted in four phases. Phase 1 and Phase 2 produced statewide weatherization installation standards and a set of common measure-specific policies and procedures, including standardized criteria for the installation of measures in a specific home. These earlier phases also produced standardized policies for customer eligibility, minor home repairs and furnace repairs/replacements, inspection procedures, insulation levels, the eligibility of master-metered units for the program, among others.[8]

In Phase 3, we addressed a number of additional policies and procedures related to LIEE program implementation, including: 1) eligibility of customers on business rates, 2) eligibility based on heating fuel, 3) limits on prior participation in the program, 4) qualification of multifamily units and mobile homes, 5) limitations on expenditures by housing type, 6) inspection frequencies, 6) ceiling insulation levels, and 7) inspector-contractor dispute resolution procedures, among others. By D.02-04-049, we adopted refrigerator grounding standards.

In today's decision, we address two major Phase 4 issues. First, we determine which LIEE measures should continue to be offered under the program, based on the results of an extensive cost-effectiveness evaluation of each measure and of the program as a whole. Second, we adopt standardized

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[8] See D.00-09-036 and D.01-03-028.

policies and procedures regarding carbon monoxide (CO) testing under the LIEE program, referred to as "Natural Gas Appliance Testing" or "NGAT." We present the background and procedural history for each of these issues below.

### 2.1. LIEE Cost-Effectiveness Testing

Pub. Util. Code § 2790(a) directs the Commission to consider "both the cost effectiveness of the services and the policy of reducing the hardships facing low-income households" in designing LIEE programs. We have articulated our approach to implementing this statutory requirement, as follows:[9]

- The LIEE program serves an equity objective in assisting customers who are highly unlikely or unable to participate in other residential programs and therefore the program is not subject to strict cost-effectiveness requirements. At the same time, the Commission should promote the consideration of cost-efficiency in the provision of these services.
- Accordingly, the LIEE program should be examined from two different perspectives, with some weighing and judgment applied to the results in selecting eligible measures or in evaluating overall program effectiveness.
- The first perspective is that of the low-income customer, in terms of reducing hardship. This includes bill savings, as well as non-energy benefits that the program or measure provides to the recipient.
- The second perspective is that of customers who directly subsidize the program costs through their rates, i.e., non-participating customers. We therefore need to also evaluate the LIEE program and individual measures from a cost-efficiency perspective, in terms of the resource required to provide services to low-income customers.

In D.01-12-020, we instructed the Standardization Team and the Reporting Requirements Manual (RRM) Working Group to develop joint recommendations

[9] See D.02-08-034, *mimeo.*, pp. 11-12.

for updating traditional cost-effectiveness tests consistent with the above. The utilities and project consultants (Regional Economic Research, Inc. and Richard Heath & Associates) comprise the Standardization Team, with coordination assistance from the Commission's Energy Division. The RRM Working Group was formed in 1986 on an ad hoc basis to assist the Commission in developing a consistent and common framework for reporting on demand-side management activities across utilities, including cost-effectiveness results. The RRM Working Group has convened periodically through the years to address reporting issues, and usually consists of Commission staff and representatives from the utilities. It is open to all interested parties.

The schedule, scope and budget for Phase 4 of the Standardization Project has been established via Assigned Commissioner rulings, per the Commission's direction.[10] On March 28, 2002, the RRM Working Group and Standardization Team filed a joint report recommending a specific set of criteria to be used to assess the cost effectiveness of measures offered through the LIEE Program.[11] In D.02-08-034, the Commission adopted these criteria and instructed the utilities to use this methodology to augment their PY2003 LIEE program applications with an evaluation of the proposed measures to be offered in that year. The utilities filed a preliminary report on September 30, 2002.

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[10] "The Assigned Commissioner shall direct the project with respect to the scope of work, budget and schedule." (D.01-03-028, Ordering Paragraph 8. See also D.01-05-033, Ordering Paragraph 18.) Assigned Commissioner's Rulings dated February 19, 2002, September 17, 2002, January 28, 2003 (as corrected on February 24, 2003) and April 8, 2003 established the current scope, schedule and budget for Phase 4.

[11] *Final Report for LIEE Program and Measure Cost Effectiveness, Submitted by the Cost Effectiveness* Subcommittee of the RRM Working Group and Standardization Project Team, March 28, 2002.

The preliminary report[12] described the analysis of cost effectiveness and presented preliminary recommendations with respect to individual LIEE program measures to be dropped or retained for the 2004 program year. The Office of Ratepayer Advocates (ORA) and the Insulation Contractors Association (ICA) filed comments on November 14, 2002, and the Joint Utilities filed reply comments on December 4, 2002.

In D.02-12-019, issued on December 12, 2002, the Commission authorized "stay the course" annual funding levels that would continue LIEE rapid development efforts into PY2003 without interruption. Because this represented a larger budget and change in the mix of LIEE measures for some of the utilities than the preliminary report evaluated, the Commission instructed the utilities to "…evaluate the extent to which the September 30, 2002 filings need to be revised based on today's adopted budgets, and to submit any significant changes to the cost-effectiveness assessment and measure recommendations…" The Commission also instructed the utilities to submit "all data, assumptions, and methods used to calculate per home installation costs, including measure mix."[13] The utilities filed this report on January 6, 2003.[14]

The Energy Division held workshops on the revised cost-effectiveness assessment on January 21, 2003 in San Francisco and January 23, 2003 in San Diego. Representatives from the utilities, Team consultants, Commission staff, ICA, Winegard Energy and Latino Issues Forum attended one or both of the

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[12] *LIEE Measure Cost Effectiveness: Preliminary Report*, September 30, 2002.

[13] D.02-12-019, Ordering Paragraph 4, p. 27.

[14] *The Joint Utilities Revised Results of Measure Cost-Effectiveness*, January 6, 2003.

workshops. Summaries of public input at the workshops, in addition to the written workshop comments submitted by ICA, are included in the final report.

On February 24, 2003, the Commission approved a revised work plan for Phase 4 of the LIEE Standardization Project. This work plan called for further analysis of LIEE measure cost-effectiveness, and provided for the submission of an updated assessment on or before April 1, 2003. On March 21, 2003, the utilities requested an extension of this deadline to June 2, 2003. An Assigned Commissioner's Ruling dated April 8, 2003 approved this extension.[15]

The utilities filed the final, updated LIEE cost-effectiveness assessment on June 2, 2003.[16] No comments were filed in response.

### 2.2. Natural Gas Appliance Testing (NGAT)

During earlier phases of the Standardization Project, the Commission explored current utility practices with respect to natural gas appliance testing or "NGAT," i.e., testing for gas leaks and CO emissions from natural gas appliances.[17] We also use the term "combustion appliance testing" in today's decision to refer generically to CO testing of household appliances that use combustion fuels, such as natural gas or propane.

To achieve greater consistency among utility practices, the Commission adopted minimum procedures for how the testing would be conducted, e.g.,

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[15] *Assigned Commissioner's Ruling Revising the Due Dates for the Final Reports on LIEE Measure Assessment and Energy Division's Audit of the California Alternate Rate for Energy program Administrative Expenses*, April 8, 2003.

[16] *Low-Income Energy Efficiency Program Measure Cost Effectiveness Study Final Report*, June 2, 2003.

[17] See the Standardization Team's *LIEE Program Standardization Project Phase II Follow-Up Report*, October 26, 2000.

what inspectors will check for visually (flue and vent system, appliances) and CO test sampling procedures at the home. The adopted procedures, referred to as the Minimum Standard, include olfactory tests, visual examinations, ambient CO tests and smoke and tactile draft tests which are implemented whenever natural gas appliances are present in the dwelling and natural gas is served by the utility providing the LIEE program to the household. The current Minimum Standard is outlined in Attachment 3.

However, our earlier standardization efforts did not achieve consistency on when the NGAT procedures should be implemented--after the installation of measures only (post-testing), or both before and after installation (pre- and post-testing). There continued to be fundamental differences in opinion, and lack of sufficient information, regarding the extent of gas leak/CO emission risks and the proper means of mitigating them, as well as the extent to which infiltration reductions resulting from LIEE activities exacerbate existing conditions.

As a result, we allowed the utilities to continue with NGAT procedures under LIEE that were not necessarily consistent across service territories, as long as they met the Minimum Standard. We directed the Standardization Project to conduct a Phase 4 study of natural gas appliance safety conditions and alternative NGAT procedures, including the feasibility of utilizing CO alarms. The Team was instructed to obtain public input on these issues, and to file an NGAT report on April 1, 2003 with recommendations on further standardization of NGAT procedures. By Assigned Commissioner's ruling dated February 24, 2003, this deadline was extended to May 5, 2003.

The Standardization Team scheduled two public workshops on a draft of the Phase 4 report. The first workshop was held in San Francisco on April 22, 2003, and the second was held in San Diego on April 24, 2003. Representatives

from ICA and Proctor Engineering Group attended the first workshop. No members of the public attended the second. Comments from ICA and Proctor Engineering Group at the first workshop, including ICA's written submission, are included in the Team's final report.

The Standardization Team's final report was filed on May 5, 2003. No comments were filed in response.[18]

## 3. LIEE Cost-Effectiveness Results

In the following sections we briefly summarize the LIEE cost-effectiveness methodology and results presented by the Standardization Team in their final report, followed by our consideration of the Team's recommendations.

### 3.1. Overview of Methodology

The methodology adopted in D.02-08-034 considers the cost-effectiveness of the LIEE program and measures from two perspectives: cost efficiency from the perspective of the non-participant, and hardship reductions from the perspective of the participant. To this end, we apply two tests of cost-effectiveness: a modified Participant Cost ($PC_m$) Test and a Utility Cost (UC) Test. The $PC_m$ Test divides the participant benefits by the utility costs of the program or measure.[19] This test produces a benefit-cost ratio that expresses the level of the participants' benefits, relative to program dollars. The UC Test produces a ratio

[18] *Low Income Energy Efficiency Standardization Project: Final Phase 4 Report On Natural Gas Appliance Testing Study Results*, May 5, 2003. (NGAT Final Report.)

[19] As explained in D.02-08-034, the traditional Participant Cost Test ratio would be an undefined number for LIEE programs because the out-of-pocket costs to participants are generally zero. Therefore, this modified version of the test was developed and adopted for application to LIEE activities.

of the benefits to the general ratepayers who subsidize the program, relative to program costs. Both tests are designed to incorporate a set of non-energy benefits (NEBs) as well as direct energy-related benefits. These NEBs are meant to capture a variety of effects such as changes in comfort and reduction in hardship, which are not captured by the energy savings estimates derived from a load impact billing evaluation and are ignored in more traditional cost effectiveness approaches. The Commission adopted the methods for calculating NEBs in D.02-08-034.

In assessing overall program cost effectiveness, the Standardization Team considered both direct measure costs and a variety of indirect costs (administration costs, outreach, shareholder earnings, etc.). In evaluating the cost effectiveness of individual measures, however, only installed measure costs were considered. As explained in the utilities' September 30, 2002 filing, the rationale for this latter approach is that, from an economic perspective, cost effectiveness analysis should consider only those costs that are truly affected by the decision at hand. These are sometimes called incremental costs, or marginal costs. In applying the cost effectiveness framework to individual measures, the decision at hand is whether or not a specific measure should be added to or dropped from the program. Insofar as retaining or dropping a specific measure will have a relatively minor impact on indirect costs, these indirect costs were ignored in the application of the measure level cost effectiveness tests.

For all measures, cost effectiveness ratios were developed by residence type and (where applicable) fuel type. For measures with weather-sensitive effects, the analysis was also conducted for individual climate zones. The climate zones used for this purpose were the California Energy Commission's sixteen Title 24 climate zones, which are depicted in Figure 1. This disaggregated

approach was designed to recognize the variation in benefits and costs across specific applications of the measures in question. However, it also yielded situations in which measures were cost-effective in some applications (some residence types, some climate zones, or one fuel) but not others. In the September 30, 2002 preliminary report, the Standardization Team made recommendations for the treatment of these situations on a case-by-case basis. In its subsequent comments, ORA objected to the nonsystemmatic nature of these preliminary recommendations and proposed that the Team develop more systematic decision rules to be used to maintain consistency in the treatment of these cases. The Team developed such rules and presented them in the June 2, 2003 final report, as discussed further below.

In the analysis underlying its final report, the Team used per measure savings estimates based on the recent load impact evaluation of the 2001 LIEE Program.[20] It reflects the Team's judgment that the measure-specific impacts provided in the 2001 evaluation are superior to those developed in the 2000 load impact study. This judgment is based in turn largely on the specific design of the 2001 impact evaluation. In previous impact evaluations, the primary focus had been on the estimation of overall program savings, although savings were developed for individual measures and groups of measures. In response to the Commission's instruction to the joint utilities to assess cost-effectiveness of individual measures and to use these results in measure selection, the Team requested that the project consultant, XENERGY, refine the 2001 impact analysis to more effectively isolate individual measure impacts. This refinement took the

[20] See Final Report by XENERGY, Inc.: "Impact Evaluation of the 2001 Statewide Low-Income Energy Efficiency (LIEE) Program," April 2003.

form of an extensive review and revision of the preliminary engineering estimates used in the development of weights for measure savings in the XENERGY billing analysis model. Many of these engineering estimates were derived from the Database for Energy Efficiency Resources (the DEER database), which was developed by XENERGY under a previous statewide project.[21] In addition, XENERGY refined the analysis to better isolate the savings from ceiling insulation by estimating a separate statistical adjustment coefficient for that measure.

While the Team considers the 2001 impact study estimates the best available estimates for the purposes of cost-effectiveness assessment, it cautions that all estimates are subject to statistical error. Estimates of savings from measures with low impacts are particularly subject to high percentage errors as a result of inherent difficulties in isolating these impacts in the statistical analysis of changes in energy consumption. The Team also notes that subsequent years' program impact evaluation studies may yield measure savings estimates that differ somewhat from those used in this study, and that reconsideration of the program measure mix may be necessary over time as such changes occur.

### 3.2. Team Recommendations

In D.02-08-034, the Commission adopted a set of guidelines for considering whether to retain specific LIEE program measures. First, measures that have

[21] XENERGY, Inc. "2001 DEER Update Study, Final Report." August 2001. The DEER database is housed at the California Energy Commission, and the Public Utilities Commission funds the research. The database represents a current standard source for estimates of incremental measure costs and engineering estimates of per-unit energy savings. It is updated periodically and available over the Internet at http://www.energy.ca.gov/forecasting/DEER.html.

both a $PC_m$ and UC benefit-cost ratio greater than or equal to the average program $PC_m$ and UC should be included in the LIEE program. This applies for both existing and newly proposed measures. This approach encourages improvement in program efficiency by selecting measures that will improve the cost-effectiveness of the LIEE program from both the participant and non-participant perspectives.

Second, existing measures with one of the two benefit-cost ratios less than the average program $PC_m$ and UC for that utility would be retained in the program. However, new measures meeting this criterion would not be accepted because of the substantial effort required to integrate a new measure into the program.

Finally, existing and new measures with both the UC and $PC_m$ test results less than the average program $PC_m$ and UC for that utility should be excluded from the LIEE program unless substantial argument can be made that significant NEBs are not currently being accounted for in the $PC_m$ and UC test values or there are other policy or program considerations that require the measure to be retained.

Attachment 2 presents the detailed results of the Team's cost-effectiveness evaluation, in tabular form. We summarize the results and the Team's recommendations in the following sections. We refer to measures with benefit-cost ratios that exceed the program average test results as "passing" the $PC_m$ or UC tests, based on the adopted guidelines described above.

### 3.2.1. Non-Weather Sensitive Measures

Non-weather sensitive measures are those whose impacts do not vary across climate zones. These include hard-wired compact fluorescent porch lights, compact fluorescent lamps (CFLs), faucet aerators, low-flow showerheads, high

efficiency refrigerators, water heater blankets, water heater pipe wrap, and high-efficiency water heaters. Based upon the application of the cost effectiveness criteria and judgments with respect to other factors, the Standardization Team presented the following recommendations with respect to individual non-weather sensitive program measures:

- ***Hard-wired compact fluorescent porch lights*** for single-family applications pass the $PC_m$ and UC tests in PG&E and SDG&E's service areas, and nearly satisfy both tests for SCE. However, this measure fails both tests in PG&E's and SCE's service areas for multifamily residences and mobile homes by a fairly large margin. The Team recommends that this measure continue to be offered for single-family homes but not for multifamily residences or mobile homes.
- ***CFLs*** pass both tests in all applications, and should continue to be offered for all residence types and in all climate zones.
- ***Faucet aerators*** pass the $PC_m$ Test and / or the UC Test in all applications and should continue to be offered for all residence types and in all climate zones.
- ***Low-flow showerheads*** are cost-effective in all applications, and should continue to be offered for all residence types and in all climate zones.
- ***High efficiency refrigerators*** pass both tests in all applications, and should continue to be offered for all residence types and in all climate zones.
- ***Water heater blankets*** pass both tests in all applications, and should continue to be offered for all residence types and in all climate zones.
- ***Water heater pipe wrap*** passes both tests in all applications, and should continue to be offered for all residence types and in all climate zones.
- ***High efficiency water heaters*** do not pass either test for any water heating fuel, residence type, or service area. As a result, the Team recommends that they be dropped from the program.

### 3.2.2. Weather-Sensitive Measures

Weather-sensitive measures are those whose impacts vary significantly across climate zones. While the Commission mandated only that ceiling insulation be evaluated at the climate zone level, the Team agreed to assess all

weather-sensitive measures (other than outlet gaskets) at this level. For these measures, the Team faced three options: offer a measure in all climate zones; do not offer the measure in any climate zone; or offer the measure in selected climate zones. For the purposes of the analysis, the Team further divided weather-sensitive measures into two groups; infiltration reduction measures and non-infiltrationreduction measures.

#### 3.2.2.1. Infiltration-Reduction Measures

Infiltration-reduction measures are measures whose primary effect is to reduce air transfer through the thermal shell in participating homes. The LIEE program currently includes five such measures: caulking, door weatherstripping, attic access weatherstripping, evaporative cooler covers and outlet gaskets. The cost-effectiveness of these five measures is discussed below.

- **Caulking**. Caulking fails both the $PC_m$ and the UC test in all applications for three of the utilities. However, caulking passes one or both tests in some or all climate zones for SoCalGas. The reason for this difference is that SoCalGas reports far lower installed costs for caulking than the other utilities.
- **Evaporative cooler covers.** Evaporative cooler covers are not cost effective in multifamily dwellings or in any residence type with electric space heat. However, they are cost effective for SDG&E in two climate zones for homes with gas heat.
- **Weatherstripping attic doors.** Weatherstripping attic doors does not appear to be cost effective in any zone, for any heating fuel, or in any residence type.
- **Weatherstripping doors.** Door weatherstripping does not appear to be cost effective for any residence types, heating system, or climate zone
- **Outlet gaskets**. Measure impact estimates were not available by climate zone for this measure, in spite of the fact that its impacts are weather-sensitive. As a result, an overall average cost-effectiveness ratio was developed for each heating fuel and each residence type. Outlet gaskets pass the $PC_m$ and / or the UC test when electric space

heat is present in a majority of cases, but fail both tests for all applications involving gas space heating.

The cost-effectiveness results for these measures are not particularly favorable. Nonetheless, the Team recommends that they be retained for the 2004 LIEE program. The Team bases this recommendation on a number of factors:

- In general, the cost of installing these measures is quite low, and the energy savings are correspondingly low. The Team notes that the degree of uncertainty surrounding the estimates of energy savings for these measures is relatively high, and it is extremely difficult to isolate their impacts on energy consumption through engineering analysis, billing analysis, or a mix of the two (as in the PY2001 impact evaluation).

- There may be significant interactions between infiltration-reduction measures and other weatherization measures. That is, infiltration reduction measures may enhance the savings from other measures through thermodynamic interactions.

- Infiltration-reduction measures lower draftiness and thereby provide significant non-energy benefits relating to comfort. While comfort benefits are included in the NEB workbook, they are allocated across a wide range of measures encompassing both infiltration-reduction and non-infiltration-reduction measures. The Team believes that the allocation of these benefits by energy savings probably understates the benefits associated with infiltration-reduction measures.

- Most of these measures tend to be installed in a high percentage of participating homes. As pointed out by the ICA in workshop comments, their costs may be overstated if contractors disproportionately assign "windshield drive time costs" to these measures.[22] Dropping these measures could have the impact of adversely affecting the costs (and cost effectiveness) of other measures

[22] Windshield drive time costs refer to the costs of having a crew available and moving it from one home to another.

in the future, should contractors assign more of their indirect costs to those measures.

- Eliminating the measures would significantly reduce the number of homes weatherized.

#### 3.2.2.2. Non-Infiltration Reduction Measures

Non-infiltration reduction measures are measures for which the primary effect on energy use is through some mechanism other than infiltration reduction. Several LIEE measures fall into this category. Results and recommendations relating to these measures are presented below.

- **High efficiency central air conditioner replacements.** High efficiency air conditioners do not pass either the $PC_m$ or UC Test in any case except for one utility (SDG&E) in Climate Zone 15. The Team recommends that this measure be dropped from the program in all areas.
- **High efficiency room (window/wall) air conditioner replacements.** High efficiency room air conditioners are cost effective in climate zones 13 and 15 for one of the utilities serving those zones. Nonetheless, the Team recommends that high efficiency room air conditioners be offered for all residence types in climate zones 11-15, which have the most extreme summer conditions. The Team believes that the potential reduction in risks to customer health and safety associated with the availability of high efficiency units, which may not be fully reflected in current NEBs used in the analysis, justifies offering this measure in these extreme climate zones.
- **Ceiling insulation.** Ceiling insulation passes the $PC_m$ and / or the UC Test in virtually all cases. The Team recommends that ceiling insulation be retained in the program using current polices with respect to ceiling insulation thresholds and final levels.
- **Duct testing and sealing.** Duct testing and sealing is cost effective only for SoCalGas and only in Climate Zone 14. The Team recommends that this measure be dropped from the program.
- **Evaporative cooler maintenance.** This measure is cost-effective for only one utility (SDG&E) and in only one climate zone. The Team recommends dropping this measure altogether from the program.

- **Evaporative coolers.** This measure is cost-effective for mobile homes and single family homes in at least one utility in climate zones 11, 12, 13, 15 and 16.[23] However, the measure is cost-effective for only one utility in one zone for multifamily dwellings. The Team recommends that evaporative coolers be retained in climate zones 11-16, but only for single family homes and mobile homes.
- **Furnace filters.** Furnace filters were assessed under two scenarios: (1) one where their installation either does not require a licensed Heating, Ventilation and Air Conditioning (HVAC) contractor or a licensed HVAC contractor is already on site to do a furnace repair or replacement; and (2) where a licensed HVAC contractor has to make a special trip to install the filter. Installed costs are obviously higher under the second scenario than the first. Furnace filters are cost effective in many zones and for most utilities under the first scenario. However, furnace filters are cost effective only for SoCalGas in climate zone 14 under the second (more expensive) scenario. The Team believes that it is prudent to require that furnace filters be installed by licensed HVAC contractors. As a result, the Team recommends that furnace filters be installed in all zones, but only as part of furnace repairs or replacements. To some extent, this is a practical matter, in that it would make little sense to make significant furnace repairs or to replace a furnace without replacing the filter.
- **Gas Furnace Repairs.** Gas furnace repair is cost-effective in some but not all zones, and for some but not all utilities. However, the Team believes that the NEBs incorporated into this analysis do not fully reflect the non-energy benefits associated with this measure. NEBs are distributed in proportion to energy savings, and the energy savings associated with this measure are assumed to be experienced only by households who were previously using their furnace. However, households who were not using their furnaces prior to repairs clearly obtain some comfort benefits as well, and these benefits are not explicitly encompassed by the method of allocating NEBs to individual measures. Moreover, there may be some

[23] Under current LIEE Statewide Policies and Procedures, evaporative coolers are offered in climate zones 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, and 16.

safety benefits that are not recognized by the NEB framework.[24] In recognition of this shortcoming in the cost effectiveness methodology, the Team recommends that gas furnace repairs continue to be offered in all climate zones.

- **Gas furnace replacements.** Gas furnace replacements are also cost effective in only some zones and for some utilities. Using the same rationale as discussed for furnace repairs, the Team recommends that furnace replacements continue to be offered in all zones.
- **Minor Home Repairs**. Minor home repairs carry very significant participant NEBs, and are consequently highly cost effective according to the $PC_m$ Test in nearly all climate zones. They are not cost effective in quite so many zones under the UC Test, largely due to the differences in participant and utility NEBs. The Team recommends that they continue to be offered in all zones, even those in which they do not appear to be cost effective. The rationale here is that these repairs are often necessary to accommodate the installation of other cost-effective measures offered through the program, and thus have an additional indirect benefit.
- **Setback Thermostats.** Like furnace filters, setback thermostats were assessed under two scenarios: (1) that an HVAC contractor is already on site to do a furnace repair or replacement; and (2) that an HVAC contractor has to make a special trip to install the programmable thermostat. This measure is cost effective in some climate zones for at least one utility under the first scenario. However, it fails to be cost effective in all climate zones, fuels, utilities, and residence types under the second scenario. The Team recommends that this measure be dropped from the program, except in cases where furnace repairs or replacements are being made and local code requires programmable thermostats.
- **Whole house fans.** Whole house fans are cost effective only in climate zone 10 for SDG&E. The Team recommends that whole house fans be dropped from the program.

[24] The NEB study initially identified CO testing as a service that may yield safety benefits, but this non-energy benefit was not estimated as part of that study. Although such safety benefits may also be associated with improved furnace operation, the NEB study did not identify them.

### 3.2.3. Summary

Table 1 below presents an overview of the recommendations of the Standardization Team.

**Table 1: Recommendations on Individual Measures**

| Measure | Recommendation |
|---|---|
| Non-Weather-Sensitive Measures | |
| Hard-wired CFL porch lights | Retain in all climate zones for single family homes, but drop for multi-family and mobile homes |
| Compact fluorescent lamps | Retain in all climate zones and residence types |
| Faucet aerators, | Retain in all climate zones and residence types |
| Low-flow showerheads, | Retain in all climate zones and residence types |
| High efficiency refrigerators | Retain in all climate zones and residence types |
| Water heater blankets | Retain in all climate zones and residence types |
| Water heater pipe wrap | Retain in all climate zones and residence types |
| High-efficiency water heaters | Drop from Program |
| Weather-Sensitive Measures | |
| Outlet gaskets | Retain in all climate zones and residence types |
| High efficiency central Acs | Drop in all climate zones and residence types |
| High efficiency room Acs | Retain in Climate Zones 11, 12, 13, 14, and 15 |
| Caulking | Retain in all climate zones and residence types |
| Ceiling Insulation | Retain in all climate zones and residence types |
| Duct testing and sealing | Drop in all climate zones and residence types |
| Evaporative cooler covers | Retain in all climate zones and residence types |
| Evaporative cooler maintenance | Drop in all climate zones and residence types |
| Evaporative coolers | Retain in Climate Zones 11 – 16 for single family and mobile homes; drop from Program for multi-family homes and in Climate Zones other than 11 – 16. |
| Furnace filters | Retain, but only as part of furnace repair or replacement |
| Gas furnace repairs | Retain in all climate zones and residence types |
| Gas furnace replacements | Retain in all climate zones and residence types |
| Minor home repairs | Retain in all climate zones and residence types |
| Setback Thermostats | Drop from Program except where required by code in conjunction with furnace repair or replacement |
| Weatherstripping attic doors | Retain in all climate zones and residence types |
| Weatherstripping doors | Retain in all climate zones and residence types |
| Whole house fans | Drop from Program |

## 4. NGAT Study Results

The general purpose of the NGAT Study was to obtain information that would allow the development of uniform LIEE program standards, policies and procedures regarding combustion appliance testing. The following research questions were addressed by the NGAT study:

1. In low-income homes in California, what are the pre-existing levels of CO in the following locations: a) in indoor ambient air, b) in the proximity of specific appliances, c) in flue gases, and d) in the surrounding outdoor air?
2. What effect does the installation of infiltration-reduction measures have on CO levels within the home?
3. Do pre-existing or post-installation CO levels found in low-income homes represent a potential hazard to the occupants? What is the frequency and duration of elevated CO levels?
4. Are the existing policies and procedures and Minimum Standard for natural gas appliance testing previously recommended by the Team and adopted on an interim basis by the Commission necessary, and, if so, are they appropriate to identify high levels of CO and other combustion-related hazards in the homes of LIEE weatherization recipients?
5. To what extent would the detection of CO problems be affected by the elimination, reduction, expansion or modification of steps included in the Minimum Standard (including the installation of CO alarms as an alternative or supplement to gas appliance testing)?
6. What modifications, if any, to the current natural gas appliance CO testing policies and procedures should be adopted for the LIEE Program?

Briefly, the study approach involved: (1) a review of the literature on CO levels and impacts, (2) a survey of private contractor practices relating to combustion appliance testing, (3) analysis of data on CO testing under the PG&E LIEE program, (4) an extensive on-site survey of low-income homes, including extensive CO testing, (5) blower-door tests of infiltration reduction in a

sub-sample of these homes and (6) an assessment of the performance of CO alarms in a sub-sample of these homes. Each of these study elements is described in considerable detail in the May 5, 2003 final NGAT report.

In the following sections we summarize the Team's findings and recommendations, based on the study results.

### 4.1. CO Effects on Health and Related Issues

As a context for addressing the research questions listed above, the Team conducted an extensive literature review with respect to CO and its effects on health, CO levels found in residential buildings, linkages between infiltration rates and CO concentrations and related issues. In this section, we briefly present a summary of the study findings from the literature research, and refer the interested reader to Section 3 and Appendix E of the final NGAT report for additional detail. [25]

As the Team explains in the report, several studies indicate that prolonged exposure to high levels of CO can have dire consequences on human health. CO's affinity to bind with blood hemoglobin is 200 times higher than that of oxygen. CO poisoning occurs when high levels of CO combine with hemoglobin in the blood to form COHb, thereby impeding the flow of oxygen in the body. In general, as blood COHb levels become higher and higher, the symptoms of CO poisoning become more and more severe. Blood COHb levels vary as a function of time and level of exposure, respiratory rate, age of the patient, and presence of underlying illness. Initial symptoms of CO poisoning include headache, fatigue, shortness of breath, nausea, and dizziness. Extended exposure to high levels of

[25] The summary in this section is taken nearly verbatim from pp. 3-1, E-12, E-27 to E-31.

CO leads to cardiovascular and neurological symptoms and can eventually result in unconsciousness and death.

Analyses of unintentional deaths due to CO exposure have shown that between 1979 and 1993, the number of unintentional CO-related deaths fell in real numbers and as a percentage of all CO-related deaths. Furthermore, CO poisoning appears to be predominantly a cold weather phenomenon. Death rates in California are low relative to national rates. The number of unintentional CO-related deaths in California during the ten-year period from 1979-1988 period totaled 444, based on data from a 1993 study.[26]

California data show that 39% of unintentional CO-related deaths had combustion appliances as a source, or a total of 177 deaths over the 1979-1988 period.[27] California data also show that CO levels tend to be higher in multi-family dwellings and temporary shelters than in single family homes. Additionally, bottled tank and liquefied petroleum gas-fueled appliances exhibit a greater tendency to CO problems than natural gas-fired appliances.

CO exposure problems associated with combustion appliances stem from the "spillage" of combustion byproducts into the room. Spillage is usually caused by inadequate drafting, i.e., an insufficient amount of force to pull byproducts through the appliance vent or exhaust. In addition, spillage can be caused by negative pressure in a room, caused by an exhaust fan. For example, the range hood exhaust fan in a kitchen can cause spillage from a water heater in

[26] Final NGAT report, May 5, 2003, p. E-10, Table E-5.

[27] *Id.*

the same room, under certain circumstances. Finally, blockage or obstruction in a vent (e.g., a bird's nest) can cause spillage.

The Team considered previous evidence on the potential impacts of infiltration reduction on ambient CO levels. On a theoretical level, the overall impact of infiltration reduction on ambient CO may depend on three factors. First, infiltration reduction measures may significantly reduce air exchange rates and lessen the escape of CO to the outside. As joints, cracks in walls, floors and ceilings and around windows and doors become sealed, the rate at which outdoor air replaces indoor air is lowered (i.e., infiltration rates are lowered). To the extent that significant internal sources of CO are present, ambient CO levels may increase because of the reduced flow of air through the home and the associated escape of the CO to the outside.

Second, infiltration reduction and other weatherization measures may significantly reduce the amount of heating needed. If heating systems are responsible for CO concentrations, these CO emissions from heating appliances should also decrease. If most pollutants inside the home are by-products of heating appliances, then the emission of these pollutants may remain constant or actually decrease with the installation of these measures.

Third, apart from the low air exchange rates mentioned above, another infiltration-related problem is that air exhaust systems can remove too much air from the house, thus creating a slight negative pressure inside the house. When too much air is removed, the negative pressure can become large enough to reverse the natural flow of gases up the furnace flue and instead cause the flue to become a passageway for the supply of outside air into the house. If the furnace burner is operating at that time, its products will not escape through the flue, but will instead enter the house, causing spillage problems. However, the

relationship between negative pressure inside the house and infiltration reduction measures also is not clear. This is because one cause of negative pressure (referred to as the "stack effect") can actually be reduced using infiltration reduction measures, while a second cause of negative air through exhaust devices can be exacerbated with the installation of infiltration reduction measures.[28]

On a priori grounds, then, it is not clear if infiltration reduction measures would actually increase or decrease the levels of CO found inside the home. The Team found that the empirical studies to date do not offer strong evidence of a relationship between infiltration reduction and ambient CO. According to one study, infiltration is not reduced to the levels required for new energy efficient construction, and the California Energy Commission has found that these new construction standards cause no internal air quality problems. However, the Team was not able to locate research on the incidence of backdraft conditions in California homes.

### 4.2. Standards on Threshold Levels of CO

There are various locations in the vicinity of a household appliance where CO levels can be tested. Ambient CO levels can be measured in the middle of a room (generally referred to as a "room ambient test") or close to a particular

[28] For example, add a broken kitchen window to the example of spillage given above (a range hood fan creating spillage from a water heater in the same room). It is now possible that the range hood fan would pull air out of the room from the infiltration opening (broken window), rather than from the water heater vent. Under this hypothetical scenario, the spillage problem with the water heater arises only once the broken window is fixed, i.e., post-weatherization.

appliance ("appliance ambient test"), such as a water heater. In addition, CO levels can be measured within the appliance itself at a point before room air mixes with combustion byproducts. This type of test is referred to as a "flue" or "exhaust" test, depending on the appliance.[29]

As the Team reported during earlier phases of the Standardization Project, there are no U.S agency standards for CO levels in indoor residential environments. However, varieties of organizations do have published standards for ambient CO in other environments (outdoor and industrial), which are summarized in the final NGAT report. The standards are generally set to protect the safety of individuals with relatively high susceptibility to CO, and also vary across applications and jurisdictions. The Commission considered these standards in developing threshold CO levels as a component of the Minimum Standard for gas appliance testing in D.01-12-020.[30] For the purpose of evaluating the CO levels detected in the NGAT study, the Team utilized the Commission-adopted thresholds, as follows:

- An ambient threshold of *10 ppm as an action level*, or a level that should prompt more extensive investigation and analysis of the source of CO.
- An ambient level of ***35 ppm*** as a ***threshold level*** at which the home should be ventilated, the occupants should be advised to evacuate, and the technician should restrict exposure to

[29] Not all appliances have flues—such as closed combustion furnaces or cook tops. For them, the Team conducted what it termed "exhaust tests". In both types of test, the idea is to measure CO levels before any significant amount of room air is allowed to dilute the CO levels produced by the appliance.

[30] See D.01-12-020, pp. 40-41.

15 minutes. In these cases, the offending appliance is made inoperable pending repair or replacement.

The American National Standards Institute (ANSI) also publishes standards for flue CO levels that the utilities use (along with standards they have developed over the years) to test to see if an appliance is operating properly. The Team considered these standards as they conducted the CO tests described below.

### 4.3. Pre-Weatherization CO Levels and Sources

The NGAT study examined pre-weatherization ambient CO levels for a sample of 786 LIEE-eligible homes. For this purpose, ambient CO was measured under a variety of conditions with respect to appliance operation, exhaust fan operation and window and door positions, and ambient readings were taken with two different instruments.

Table 2 summarizes the results of the distribution of the maximum of all readings. The last column summarizes the distribution of the maximum of all readings. This is based upon the highest reading from all ambient tests, regardless of the room and the type of test.

**Table 2: Distribution of Highest Net Reads for CO Ambient Tests**

| CO Read in PPM | Test #1 Room Ambient | Test #2 Room Ambient | Appliance Ambient | Maximum Across All Tests |
|---|---|---|---|---|
| Percent with Ambient CO at or above the action level of 10 ppm | 0.16% | 6.30% | 3.22% | **7.1%** |
| 90% confidence interval on Percent with Ambient CO at or above the action level of 10 ppm | -0.07% to 0.39% | 4.87% to 7.73% | 2.15% to 4.29% | **5.59% to 8.61%** |
| Percent with Ambient CO at or above The threshold level of 35 ppm | 0.00% | 0.33% | 0.19% | **0.50%** |
| 90% confidence interval on Percent with Ambient CO at or above the threshold level of 35 ppm | | 0.00% to 0.66% | 0.03% to 0.35% | 0.09% to 0.91% |
| Arithmetic Average CO (ppm) | 0.38 | 3.239 | 1.90 | 3.51 |
| 90% confidence interval on arithmetic average CO (ppm) | 0.31 to 0.46 | 2.89 to 3.59 | 1.69 to 2.11 | 3.14 to 3.87 |
| Geometric Average CO (ppm) | 0.08 | 0.83 | 0.39 | 0.96 |
| 90% confidence interval on geometric average CO (ppm) | 0.07 to 0.09 | 0.73 to 0.94 | 0.34 to 0.45 | 0.85 to 1.08 |
| Number of Homes w CO Reads | 786 | 785 | 730 | 786 |

Based on these results, the Team reached two conclusions:

- In a population of 1000 homes, 71 (on average) would have at least one ambient reading at or above 10 ppm and would require further investigation of CO sources in the home. There were 55 such homes in the statewide NGAT sample.
- In a population of 1,000 homes, five homes (on average) would have an ambient reading of 35 ppm or greater. At this threshold, the home should be ventilated, the occupants should be advised to evacuate, and the technician should restrict exposure to 15 minutes. In these cases, the offending appliance should be made inoperable pending repair or replacement. There were four such homes in the statewide NGAT sample.

The Team also assessed the sources of preexisting ambient air CO levels, based on the NGAT sample. They found that the two rooms that were most likely to have room ambient CO levels at or above 10 ppm were kitchens and

living rooms. The data also suggests that the most cases of "action level" (greater than 10 ppm) ambient CO levels were associated with kitchen appliances.

In addition, appliance exhaust / flue CO tests were conducted as part of the survey in order to test the role of such tests in detecting potentially hazardous levels of CO. At present, only PG&E conducts these tests as a standard procedure, in lieu of ambient CO tests. The other natural gas utilities (SDG&E and SoCalGas) conduct room ambient CO testing and use a variety of diagnostic approaches (including flue testing for specific appliances, depending on the circumstances) to determine the cause of CO readings at or above the 10 ppm action level. The flue / exhaust tests taken during the NGAT study were conducted under default worse case conditions in terms of home ventilation and appliance operations, and at various flue / exhaust pipe locations. As discussed in the report, the flue / exhaust CO levels vary widely across appliances and homes, and tend to exceed standards most frequently for ovens and broilers.

### 4.4. Impact of Infiltration Reduction Measures on Ambient CO Levels

Currently, only PG&E requires testing of CO levels both before and after the installation of LIEE infiltration-reduction measures (caulking, door weatherstripping, attic access weatherstripping, evaporative cooler covers and outlet gaskets ). The other utilities test CO levels after measure installation. One of the key research questions addressed in the NGAT study was the potential impact of infiltration reduction on ambient CO levels.

Accordingly, the Team analyzed changes in ambient household CO levels from the pre-weatherization period to the post-weatherization period. These changes were measured with appliances off (Room Ambient Test #1) and with

appliances on and the home in a "typical" condition (Room Ambient Test #2). Tables 3 and 4 present the results of these two tests.

**Table 3: Changes in Room Ambient Test #1**

| | Change in Average Reading | | Change in Maximum Reading | |
|---|---|---|---|---|
| Change in CO in ppm | Unweighted Household Numbers | Weighted Household Percentage | Change in CO in ppm | Unweighted Household Numbers |
| <-5 | 6 | 0.76% | 7 | 0.87% |
| -5 | 1 | 0.11% | 4 | 0.43% |
| -4 | 7 | 0.82% | 8 | 1.00% |
| -3 | 24 | 3.00% | 25 | 3.30% |
| -2 | 48 | 6.37% | 56 | 7.21% |
| -1 | 67 | 8.82% | 60 | 7.85% |
| 0 | 552 | 69.56% | 550 | 69.48% |
| 1 | 55 | 7.27% | 41 | 5.43% |
| 2 | 16 | 1.97% | 19 | 2.41% |
| 3 | 5 | 0.60% | 8 | 0.99% |
| 4 | 2 | 0.28% | 4 | 0.50% |
| 5 | 0 | 0.00% | 0 | 0.00% |
| > 5 | 3 | 0.43% | 4 | 0.54% |
| Average Change | -0.21 | -0.21 | -0.21 | -0.21 |
| % with Positive Change | 10.68% | 10.89% | 9.44% | 9.58% |
| % with Negative Change | 21.99% | 23.06% | 22.24% | 23.11% |
| Average Positive Change | 1.46 | 1.45 | 2.07 | 2.10 |
| Average Negative Change | -1.82 | -1.79 | -2.03 | -2.02 |
| Total Number of Homes | 786 | 786 | 786 | 786 |

**Table 4: Changes in Room Ambient Test #2**

| Change in CO in ppm | Change in Average Reading | | Change in Maximum Reading | |
|---|---|---|---|---|
| | Unweighted Household Numbers | Weighted Household Percentage | Unweighted Household Numbers | Weighted Household Percentage |
| <-5 | 15 | 1.79% | 29 | 1.81% |
| -5 | 16 | 2.03% | 21 | 37.94% |
| -4 | 37 | 4.69% | 36 | 7.02% |
| -3 | 48 | 5.82% | 66 | 9.29% |
| -2 | 81 | 10.46% | 71 | 9.37% |
| -1 | 114 | 14.94% | 86 | 8.96% |
| 0 | 325 | 41.60% | 318 | 5.89% |
| 1 | 80 | 9.79% | 71 | 4.51% |
| 2 | 36 | 4.55% | 42 | 3.09% |
| 3 | 13 | 1.65% | 17 | 3.75% |
| 4 | 5 | 0.59% | 12 | 1.83% |
| 5 | 4 | 0.61% | 2 | 5.36% |
| > 5 | 11 | 1.48% | 14 | 0.99% |
| Average Change | -0.53 | -0.50 | -0.67 | -0.64 |
| % with Positive Change | 19.75% | 19.46% | 19.63% | 19.24% |
| % with Negative Change | 42.36% | 42.81% | 40.87% | 41.30% |
| Average Positive Change | 1.98 | 2.04 | 2.54 | 2.64 |
| Average Negative Change | -2.27 | -2.216 | -3.01 | -2.95 |
| Total Number of Homes | 785 | 785 | 785 | 785 |

As indicated above, no significant change in ambient CO was found for homes receiving infiltration-reduction measures on average. In fact, the data indicates that CO levels fell very slightly on average between the pre- and post-weatherization periods for homes tested under this statewide survey.[31] Observed positive changes in CO levels were lower in magnitude (on average) than observed negative changes, and were relatively low in absolute terms (2 ppm or less). In addition, the Team conducted blower door tests on a sample of homes

[31] The Team considers this change too small to be particularly meaningful, given that the instrument measuring CO levels has a tolerance of ± 1 ppm.

both pre- and post-weatherization in order to more directly examine the relationship between changes in infiltration and changes in CO. This examination also did not reveal any systematic relationship between infiltration-reduction measures and CO levels, i.e., that such measures caused an increase in CO levels.

In addition, the Team examined the effect of infiltration-reduction measures on drafting. Of the 1,110 pre-weatherization and post-weatherization spillage tests conducted, there were only two instances (.018% of all spillage tests) in which the appliance "passed" the draft tests during the pre-weatherization survey and "failed" during the post-weatherization survey. The reason for the draft test fails could not be conclusively isolated to the installation of infiltration measures, in either instance.

In sum, the study reveals no clear evidence that weatherizing LIEE program homes significantly impacts the overall level of room ambient CO, or significantly affects appliance drafting. However, the Team presents two caveats to these results. First, the Team suggests that confounding factors like the influence of dust buildup in seldom-used appliances may have affected the results. Second, the Team believes that it is possible that the effect of building infiltration reduction on ambient CO levels may take a considerable amount of time to take effect and may be missed by spot tests, such as the ones used in the study.

### 4.5. Adequacy of Minimum NGAT Standard

The current minimum NGAT standard (Standard) is presented in Attachment 3. Based on the identification of the sources of CO level problems in each home, the Team assessed the adequacy of the Standard to detect pre-

weatherization ambient CO levels above the action level. The Team points out the following about this Standard:

- The Standard entails a series of visual examinations focusing on flue/vent systems and appliance components. These elements of the Standard are most relevant to space heating and water heating, although at least some utilities may do other checks not included in the Standard on other appliances.
- The Standard includes indoor ambient CO tests similar to those used in the NGAT survey. However, the Minimum Standard Room Ambient Test 2 is conducted with only the space heating system in operation, whereas this test was conducted with all combustion appliances operating under the NGAT protocols. Further the Standard Room Ambient Test 2 is conducted in the middle of the living space away from registers and appliances, whereas this test was conducted in several rooms under the NGAT protocols.
- The Standard includes tactile and smoke draft tests, but not an instrument test.

In most of the homes with ambient CO levels at or above the action level (10 ppm), the cause of the CO appeared to be a kitchen appliance, generally an oven. The Team also found that that ambient CO levels above the threshold of 35 ppm were traceable to kitchen appliances in two homes.

The Standard identified all seven of the homes for which space heating appliances appeared to be responsible for CO at or above the 10 ppm action level. However, the Standard only detected CO problems in one of the 47 homes at or above the action threshold for which kitchen appliances were responsible. In the Team's view, this is because the Standard is not specifically designed to assess the performance of kitchen appliances. Problems in the remaining 46 homes would have been detected if the Standard required a room ambient test in the kitchen while kitchen appliances were operating, as well as visual inspections of kitchen appliance burners/pilots. Kitchen appliance exhaust/flue tests would

also have revealed the CO problems. However, these tests would also have failed 124 homes with ambient CO levels below 10 ppm.

The Team also found that the current Standard did not provide sufficient information to identify all of the three water heaters responsible for ambient CO readings at or above 10 ppm for the survey sample. The testing also revealed that over 5% of water heaters had inadequate draft. Under the current Standard, room ambient tests are taken with the water heating appliance off. If these tests were taken with water heating appliances operating, the three homes with CO levels exceeding the 10 ppm threshold (as well as one home that exceeded the 35 ppm threshold) would have been identified. A water heater flue test or appliance ambient test would also have detected problems in the remaining homes. However, the flue test would also have failed 24 homes with ambient CO levels below 10 ppm.

The Team also assessed the application of the Standard to gas logs and combustion dryers. Only 26 homes had gas logs, and only one of these homes was found to have ambient CO levels above the action level. Because the Standard does not explicitly apply to gas logs, it did not discern this one case. The NGAT survey gave no evidence of any ambient CO associated with combustion dryers, and none of these appliances exceeded standards for as-measured flue CO.

### 4.6. Relationship Between Flue Tests and Ambient CO Levels

The Team concludes from the results of the NGAT survey that the relationship between exhaust flue CO levels and room ambient CO levels is relatively weak**.** In other words, detections of CO levels above standards for appliance flue / exhaust tests do not systematically translate to ambient air CO

levels that exceed safety standards. Nonetheless, the Team postulates that exhaust / flue CO could present a problem if there is inadequate draft, and that this may not show up in ambient tests under certain weather conditions. As the Team explains:

> "…[T]he instrument draft test is designed to indicate whether or not appliance draft problems could occur under more adverse weather conditions than experienced at the time of the survey tests. Combustion appliance drafting tends to be somewhat minimized in warmer weather, so readings taken on relatively warm days (like those experienced during most of the survey period) may not be accurate indicators of appliance draft performance under winter conditions. One question to be addressed by this study is the adequacy of a less rigorous testing (i.e., the tactile test and the smoke test) to detect the potential draft problems that could be revealed by instrumented draft tests."[32]

The Team proceeded to evaluate the accuracy of the draft test options, and found that the smoke tests give virtually identical results to those yielded by instruments, at significantly less cost.

### 4.7. CO Alarm Study

The primary goal of the CO Alarm study was to evaluate whether CO alarms could be used as an alternate or supplement to combustion appliance testing in weatherized homes. To determine this, CO alarms were installed, studied and monitored in 100 of the homes included in the NGAT study. The Team found that ten percent of alarms failed the tests conducted to determine their sensitivity to a specific level of CO, based on ANSI standards, and that the nuisance rate of the alarms was relatively high (15%).

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**32** NGAT Study, p. 6-17.

### 4.8. Team Recommendations

The Team first considered the threshold issue of whether the levels of CO found in the NGAT survey homes were high enough to warrant conducting any tests for CO or CO-related problems as part of the LIEE program. The Team found that addressing this question is complicated by two issues:

- First, there is considerable disagreement about the level at which CO presents a potential hazard. Health effects depend partly on the characteristics of the parties subject to exposure. Moreover, the relationship between health effects and CO levels is more or less continuous, and characterizing a specific level at which CO becomes hazardous is an inherently judgmental process.

- Second, the results discussed in this section do not directly deal with the issue of duration of CO exposure and the cumulative effects of multiple exposures during a 24-hour period. Both are strong determinants of health effects. This issue cannot be addressed as rigorously as would be desirable because of the necessity of relying on short-term readings in the NGAT survey. The study considered the sources of high CO and concluded that many of the high readings were associated with kitchen appliances. Unfortunately, the nature of the data collected in this survey makes it difficult to generalize with any certainty about the duration of high CO levels and the potential of multiple episodes during a 24-hour period.

In consideration of these and other issues, the Team recommends that CO testing continue under the LIEE Program. The Team makes several recommendations to further standardize these testing procedures, based on the results of the NGAT survey. These recommendations are discussed below and summarized in Attachment 4.

#### 4.8.1. CO Testing Procedures

Based on the study results, the Team recommends that CO testing take place only on a post-installation basis, for all utilities. This represents a

fundamental change for PG&E, which has been routinely testing CO levels both pre- and post-installation for many years.

In addition, the Team recommends specific changes and additions to the NGAT testing procedures. In particular, the Team recommends that room ambient CO tests be conducted for rooms with water heaters and kitchen appliances (cook top, over / broiler), with these appliances turned on. In addition, the Team recommends that gas logs be tested for CO levels in the form of an exhaust test. Smoke draft tests would now become a required procedure for space heaters, natural draft water heaters and gas logs. The Team also recommends adding visual examination procedures for cooking appliances, gas logs and clothes dryers. Attachment 4 presents a summary of the Team's recommended NGAT testing procedures, as compared with the current Minimum Standard.

The Team recommends against the use of CO alarms as either a substitute for or a supplement to the testing procedures, based on the high failure rate during the sensitivity tests, the number of nuisance alarms and information gathered during the literature review.

With respect to flue tests, the Team recommends that the utilities retain discretion over whether to conduct these tests for heating appliances and water heaters. The Team's recommendation on this issue reflects a fundamental disagreement among Team members concerning the relevance of flue CO levels. Some members believe that the flue CO, in itself, is not relevant to health and safety insofar as it is normally contained in the flue and does not affect the air the customer breathes. Others believe that flue CO should be assessed even in the absence of high ambient CO levels because it could constitute a potential future problem should drafting become impaired. As a result, the final report presents

an "either or" option with respect to this issue. That is, the utility may *either* conduct indoor ambient CO tests with water and space heating appliances operating *or* flue CO tests of the individual appliances, at the utility's discretion. Kitchen appliances do not have flues, and therefore the Team recommends ambient CO tests (with the probe located within 24 inches of the appliance) in combination with visual and draft tests for these appliances. (See Attachment 4.)

### 4.8.2. Actions When Appliances Fail Test(s)

The Team also addressed the issue of what actions to take when appliances are found to have problems, and recommends the following:

- In owner-occupied homes, natural gas space heaters failing one or more of the tests covered by the new protocol should be repaired or replaced.
- In owner-occupied homes, natural gas water heaters failing one or more of the tests should be repaired or replaced.
- In owner-occupied homes, natural gas appliances other than water heaters or space heaters (e.g., gas oven) failing one or more of the tests covered under the new protocol should be serviced.[33] If these repairs do not correct the problem in question, the appliances in question should be capped and reported to the owner.
- In renter-occupied homes, appliances failing one or more of the tests covered by the new protocol should be serviced. If servicing an appliance does not correct the problem in question, the appliance be should be tagged, shut off, capped and reported to the tenant and the landlord.

[33] In this context, "servicing an appliance" entails providing services that are within the scope of the gas service department for customers in general, e.g., cleaning orifices, adjusting burners and taking other minor corrective actions.

As the Team points out, this approach would expand the types of appliances repaired or replaced under the program to include water heaters that are found to have CO-related problems. The Team estimates that the cost to expand repairs and replacements to cover water heaters would be approximately $1.9 million in 2003 for the three natural gas utilities (PG&E, SoCalGas and SDG&E).

### 4.8.3. Application of NGAT to Non-IOU Fueled Combustion Appliances and Related Issues

The Team also addresses two issues related to the applicability of NGAT procedures to combustion appliances that do not use investor-owned utility (IOU) natural gas, such as propane, kerosene or wood. The first issue relates to the issue of program eligibility based on which services a customer takes from the IOU. By way of background, it is important to note that customers who take service for space heating (either electric or natural gas) from the IOU are currently eligible for both LIEE infiltration-reduction measures (e.g., weatherstripping and caulking) and non-infiltration reduction measures (e.g., high efficiency refrigerator and room air conditioner replacements, evaporative coolers). Customers who do not take service from an IOU for either space heating or air-conditioning are not eligible for *any* LIEE measures. For homes that take air-conditioning services (but not space heating) from the IOU, the utilities have been authorized to offer heating, ventilating and air-conditioning LIEE measures, but not infiltration-reduction measures.[34] As discussed in D.01-12-020, we did not authorize infiltration-reduction measures for these

[34] For a discussion of the eligibility issues related to fuel use, see D.01-12-020, *mimeo.*, pp. 17-25.

homes because doing so "would require the IOUs to assume responsibility for implementing safety testing and repairs on a broad range of heating equipment that is not within their expertise, for which standards have not been established under the LIEE program, and for which funding has not been authorized in rates."[35] However, we directed the IOUs to refer these customers to other available assistance programs for weatherization services. We also stated that we might revisit this issue after we completed Phase 4 of the Standardization Project.[36]

The Team addresses this issue in the Phase 4 report by generally endorsing the policy established in D.01-12-020, adding a refinement to address the implications of expanding CO tests to appliances other than space heating. As discussed above, the current Minimum Standard requires that only space heaters/furnaces be operating under the room ambient CO tests. The Team's recommendation that water heaters and kitchen appliances also operate during these tests raise the following questions: (1) Should the utilities conduct CO tests in the home if it has combustion appliances that do not utilize IOU natural gas? and (2) If the answer to question (1) is "no," should these homes be eligible for infiltration-reduction measures from the IOU?

The Team recommends that both questions be answered "no." Under the Team's proposed approach, utilities would not conduct CO testing procedures on homes that use IOU fuels for space heating but use non-IOU combustion fuels for one or more other end uses. Infiltration-reduction measures would automatically

[35] *Ibid.*, p. 24.

[36] *Id.*

be deemed "non-feasible" in these homes, and would not be provided. However, the utilities would install non-infiltration reduction measures in these homes. The Team recommends that homes for which infiltration reduction measures are deemed non-feasible under this approach be referred to the Low Income Home Energy Assistance Program (LIHEAP), or, in the case of homes with non-IOU natural gas appliances, the relevant natural gas utility for full treatment. The Team also proposes that LIHEAP contractors and non-IOU natural gas utilities report back to the involved IOU to verify that service was provided. Attachment 6 provides an overview of current policy and the Team's recommendation with respect to non-IOU fuel use.

A second issue relating to the application of combustion appliance testing is the treatment of homes scheduled to receive only electric measures. As part of rapid deployment, utilities are permitted to go back to homes that have already been weatherized in order to install additional electric measures such as energy efficient replacement refrigerators. The Team recommends that natural gas appliance testing not be required in such cases where weatherization is not provided.

## 5. Discussion

We commend the Standardization Team for conducting a comprehensive analysis of measure cost-effectiveness and NGAT procedures—efforts that represents the first of their kind for the LIEE programs in California. In addition, we commend the Team for its responsiveness to public workshop and written input, which undoubtedly contributed to the fact that the final reports were uncontested. As described in Section 2.1 and in the workshop report itself, the public had several opportunities to address the Team's approach to analysis and recommendations, and the Team was responsive to those comments.

### 5.1. LIEE Measure Cost-Effectiveness

We have carefully reviewed the Team's recommendations regarding which LIEE measures to continue to offer, and which to drop for PY2004 based on cost-effectiveness considerations. We find that the Team has applied the cost-effectiveness guidelines adopted by the Commission in D.02-08-034 consistently, and reasonably. In those instances where the Team recommends retaining measures that do not meet the specific cost-effectiveness thresholds established by those guidelines, the Team has offered persuasive reasons for doing so based on policy or program considerations. In particular, we share the Team's concern, also voiced by interested parties during workshops, that a strict adherence to cost-effectiveness results would eliminate several infiltration-reducing measures without sufficient consideration of the potential understatement of benefits and overstatement of costs associated with the analysis. We will adopt the Team's recommendations for PY2004, and until further order by the Commission.

At the same time, we believe that further work is needed to improve our capability to assess the benefits and costs of specific program measures and the LIEE program overall. As we discussed in D.02-08-034, program measurement issues should be revisited periodically:

> "To this end, we will initiate an examination of savings measurement issues for the LIEE program sometime during 2003, as time and resources permit. We will examine the utilities' current methods for estimating energy efficiency program and measure savings, as well as the types and frequencies of the utility's measurement studies. Our consideration of these issues will need to be coordinated with the AEAP…. We delegate to the Assigned Commissioner the task of developing the scope and schedule for this review as a separate phase of this rulemaking, in

> conjunction with the PY2004 LIEE program planning process or by other means (i.e., a new proceeding), as appropriate."[37]

We will be embarking on the PY2005 LIEE program planning cycle in the coming months. We encourage the Assigned Commissioner, in consultation with Energy Division and the assigned administrative law judge (ALJ), to initiate this examination at the earliest opportunity. As directed in D.02-08-034, the examination of methods for estimating energy efficiency program and measure savings should be coordinated with the AEAP.

In addition, we note that the Team's study (Appendix B) indicates sizable disparities across utilities in the cost for certain measures installed in the same climate zone. Further examination of the utilities' estimating methods should seek to explain these disparities more fully. To this end, the utilities should submit a per measure cost break-down of materials, labor, administrative and travel (or "windshield time") costs within 60 days from the effective date of this decision. The submittal should include an explanation of the reasons for these disparities, with recommendations for further evaluation work, as appropriate. As a model for this explanation, the utilities should refer to the Bill Savings Standardization Report, which analyzes in some detail the causes for the variability in overall program cost-effectiveness across utilities.[38]

Despite the fact that further examination of LIEE measure savings (and costs) is warranted, we are satisfied that the cost-effectiveness results presented in the Team's report are reasonable for the purpose of modifying current LIEE

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[37] D.02-08-034, *mimeo.*, p. 16-17. See also Ordering Paragraph 3.

[38] See LIEE Program Costs and Bill Savings 2001 Report, April 30, 2002, Section 3.2.2.

program design at this time. The thoroughness of the report itself and responsiveness to public input, as discussed above, persuades us that the Team prepared its recommendations using reasonable assumptions and in full recognition of the limits inherent in any attempt to quantify the cost-effectiveness of specific measures installed within a comprehensive LIEE program. Moreover, we note that the Team used the results of a load impact study that also underwent considerable public scrutiny, as described in Attachment 5. In sum, we find the Team's recommendations regarding which measures to include in PY2004 LIEE program plans reasonable, and will adopt them until further Commission order.

### 5.2. Natural Gas Appliance Testing

As the Team acknowledged in the NGAT report, the issues related to CO testing are complicated and the empirical evidence is not always conclusive. In particular, the empirical evidence does not clearly indicate that installing infiltration-reduction measures will increase CO levels in the home. Since this is the major hypothesis underlying the policy for testing CO levels in LIEE-eligible homes, the results of the NGAT study call into question whether such testing is necessary at all.

Nonetheless, we agree with the Team that some type of CO testing is warranted for the LIEE program for the following reasons:

- Some homes covered by the NGAT survey were measured to have ambient CO levels above at least some of the current standards and thresholds.
- The LIEE Program is unique in that it entails the provision of a comprehensive set of energy-efficiency measures spanning both building envelope infiltration reduction and appliance repair and replacement. Given this comprehensive treatment, the potential for adversely affecting CO levels is greater than in other programs.

- Low-income households are generally less financially capable of maintaining their natural gas appliances, and may be less likely to know that gas appliance testing and services are available at no cost from their local gas utility.

In terms of timing, we concur with the Team's recommendation that CO testing be conducted only after weatherization. Conducting CO tests both pre- and post-weatherization would, in our view, be excessive in light of the study findings. By conducting these tests after weatherization, we can at least guard against the possibility that infiltration-reduction measures do have some influence on drafting or longer-term concentrations of CO in the home. We also agree with the Team's recommendation that preliminary combustion air ventilation evaluations be conducted as part of the initial home assessment. This would identify those instances, which the Team acknowledges are rare but potentially very costly, where major work to add combustion air venting is required to pass inspection.[39] In those instances, infiltration-reduction measures would not be installed under the program.

With respect to further standardizing the CO testing procedures, we find that the Team generally proposes a very sensible approach. In those instances where the NGAT survey data points to areas of improvement in the Minimum Standard, the Team has recommended modifications or additions to that Standard, across all utilities. For example, the new procedures expand room ambient CO testing to take into account not only space heating appliances, but water heating and kitchen appliances as well. (See Attachment 4.) Where the

[39] For examples of these types of structural ventilation problems, see NGAT Final Report, p. 9-18.

NGAT survey has indicated that certain assessments are superfluous (e.g., ambient or flue tests for dryers), the Team has eliminated such procedures. We also concur with the Team's assessment that CO alarms not be used in combustion appliance testing at this time.

However, we are not persuaded that the decision to conduct flue tests or room ambient tests for space and water heating should be left to the utility's discretion, as the Team recommends.[40] This approach was proposed because the individual utilities could not agree on the relative importance of flue tests. For the utility that conducts flue tests as the standard practice, this means that many customers' appliances would be "red-tagged" (disconnected) pending repair or replacement, even when CO levels in the room are well within safety thresholds and all appliances pass the draft tests. This is because there are far more test "fails" at the flue level, than in the room ambient air. Under the Team's recommendation, flue testing for CO levels could become standard procedure at the sole discretion of the utility--even though the NGAT study does not yield clear evidence that weatherization even increases CO levels in the home.

Proponents of flue testing of CO levels argue that appliances that fail this test may present a problem at a later date if venting problems occur. However, the Team presents no empirical evidence or research to indicate whether, or to what degree, CO levels in the flue that exceed certain thresholds may present health problems in the future. Implicit in this argument is the presumption that

[40] As discussed in this decision, cooking appliances do not have flues. Therefore, the Team appropriately recommends that the ambient CO test become the standard test for these appliances, with the modification that the probe be placed within 24 inches of the cooking appliance and that the appliances operate during "appliance on" testing. We concur with this approach.

CO testing procedures under the LIEE program should guard against any future potential safety problem associated with combustion appliances in the home. As the Team acknowledges in its report, NGAT procedures cannot make such guarantees. NGAT procedures are designed to evaluate CO levels and test for adequate drafting at a particular point in time. These conditions may change over time due to a variety of unpredictable factors.[41]

For the reasons discussed above, we believe that the results of the NGAT study support some continued testing of CO levels in the home after weatherization. However, we find nothing in those results to warrant the use of flue tests as the standard procedure for assessing space and water heating appliances, as allowed for under the Team's proposed testing protocols. Instead, we will adopt the room ambient CO tests and the other standard testing procedures (olfactory and visual tests, smoke draft tests, combustion air evaluation) proposed by the Team. If CO levels in a particular room (or rooms) are at or above the 10 ppm action level, then the utility may (but is not required to) conduct flue tests as one diagnostic tool to identify the source(s) of the problem, as appropriate. This is the current manner in which SDG&E and SoCalGas utilize flue tests in combination with ambient tests in their NGAT procedures, and we adopt this approach for all utilities.

We now turn to the Team's recommendation regarding the treatment of homes that contain a non-IOU fueled combustion appliance. Under this recommendation, the utility would no longer provide infiltration-reduction measures to any eligible low-income home (one that utilizes a IOU-fuel for space

[41] NGAT Final Report, p. 9-3.

heating) if it also uses a non-IOU combustion fuel for one or more other end use. For example, a home with electric heat and electric cooking appliances would not receive infiltration-reduction measures (e.g., weatherstripping and caulking) under the LIEE program if it also uses a propane water heater.

Currently, PG&E performs CO tests on propane and other non-natural gas combustion appliances in these customer homes that could qualify for infiltration-reduction measures (i.e., that utilize electric heat). If a CO-problem associated with non-natural gas appliances is identified, the customer is referred to the supplier and receives only non-infiltration reduction LIEE Program measures. Otherwise, PG&E will provide infiltration-reduction measures to these homes. SoCal and SDG&E currently test ambient CO levels after weatherization with only the natural gas furnace / space heater operating, consistent with the current Minimum Standard. Under this testing approach, infiltration-reduction measures are installed irrespective of the fuels used by non-space heating appliances. Attachment 6 summarizes how the Team's recommendation would modify current practices with respect to the provision of infiltration-reduction measures, depending on appliance fuel-use.[42]

Clearly, some number of customers in the utilities' service areas that are currently eligible for infiltration-reduction measures under the LIEE program would no longer be eligible for these measures under the proposed policy. However, the report does not provide sufficient information to allow us to assess the relative impact of the Team's proposal on program services, or to fully consider policy options.

[42] The summary for SCE and SoCal in Attachment 6 accounts for the fact that homes are assessed first, and then assigned to one of these utilities.

At the request of the assigned Administrative Law Judge, the utilities provided supplemental information on this issue. The utilities provided estimates of the percentage of homes that use an IOU space heating fuel but use a non-IOU fuel for another end-use (e.g., cooking, water heat, pool heater). These estimates are presented in Attachment 6.

PG&E estimates that 5-7% of all its customers fall into this category, but states that the percentage in rural ZIP codes is probably higher. Based on LIEE program data for PY2002, PG&E estimates that 16.3% of LIEE participating customers in rural ZIP codes without PG&E gas accounts had propane appliances. (See Attachment 6.) In addition, PG&E estimates that over 20,000 customers would fall into this category in just the eleven rural counties of Alpine, Amador, Calaveras, El Dorado, Lake, Lassen, Mariposa, Plumas, Sierra, Trinity and Toulumne.[43]

SoCalGas, SCE and SDG&E only provide estimates based on the entire population, stating that information on the low-income population in their service territories was not available. They estimate that approximately 1% or less of their entire population use an IOU fuel for space heating and a non-IOU combustion fuel for one or more other end-uses. (See Attachment 6.)

At least for PG&E, the data available to date indicates that the impact of this new policy would be significant over time in rural areas, where many electric customers do not have natural gas available for space heating, and therefore use electric heating and non natural gas combustion fuels (e.g., propane) for water heating and other end uses. Given this impact, we believe that it is prudent to

[43] NGAT Final Report, p. 9-9.

obtain additional information and explore alternative options, with input from the Low Income Oversight Board, community-based organizations and other interested parties, before finalizing our policy on this issue.

First, we need better information on the relative impact of the Team's proposed policy regarding non-IOU fuels on the LIEE program in the Southern California service areas, and a presentation of data on a more consistent basis across utilities. In addition to the percentage of eligible LIEE homes that fall under this category, we need to see what percentage of homes actually treated over the last few years would have been affected by this policy, i.e., use IOU-fuel for space heating and non-IOU combustion fuels for other end uses. This will give us an idea of the potential impact in terms of annual program numbers, by service territory. The information to date indicates that the vast majority of the impact would be in rural counties, but we need additional data to support this assumption.

Second, we need to explore alternative policies in greater depth than presented in the Team report. In doing so, we need to carefully take into account *both* the study results with regard to the health effects of infiltration-reduction measures *as well as* the impacts of each alternative on meeting the needs of low-income customers. For example, the Team dismisses one option that the Southern California IOUs have implemented for many years and that is also consistent with today's determination to only conduct CO testing post-weatherization. This is the option of restricting NGAT assessments to IOU natural gas appliances, but installing infiltration reduction measures in homes

with other combustion appliances.[44] We believe that this option warrants further consideration in light of the NGAT study results.

We also want to explore alternatives that would tailor the Team's proposed policy to a more specific set of circumstances, depending upon the type and/or location of the non-IOU fueled appliance. For example, infiltration-reduction measures might still be offered to homes with electric space heating and kitchen appliances, as long as the appliance that uses non-IOU combustion fuel (e.g., gas water heater) is located in a mudroom, garage, or other area that is unlikely to affect room ambient CO levels. In considering ways to fine-tune this policy, we will need information on the location of such appliances in the home affected by the Team's proposal, based on survey data and/or experience in the field.

Finally, we want to explore a leveraging option in conjunction with the Team's recommendation for homes that take service from the IOU for space heating, but use non-IOU combustion fuels for other end-uses. In its report, the Team recommends that these homes be referred to LIHEAP or non-IOU gas utilities for combustion appliance testing and the installation of infiltration-reduction measures (if they pass those tests). As we understand the Team's proposal, LIEE funding would no longer be used to provide those homes with infiltration-reduction measures.

This represents a significant decrease in LIEE-funded services to homes that are currently receiving such services from the program and contribute to the costs of LIEE through the public goods charge on their electric bills.[45] According

[44] NGAT Final Report, p. 9-8.

[45] The public goods charge is a separate component of utility rates that collects monies to fund LIEE and other public purpose programs administered by the utilities.

to PG&E, homes that pass the CO tests receive approximately eight measures on average through the LIEE program. Under the Team's proposal, these same homes would only receive (on average) approximately three non-infiltration-reduction measures.[46] In effect, the Team's proposal would shift the costs of those additional (on average) five measures per home from LIEE to the LIHEAP program or non-IOU gas utility.

While we concur with the Team that IOU ratepayers should not be responsible for conducting safety tests on non-IOU fueled appliances, or bear the costs of replacing or repairing those appliances if they do not pass the tests, we are not persuaded that the costs of installing infiltration-reduction measures in those homes should no longer be funded out of the LIEE program. As noted above, these low-income households use IOU-fuels for space heating (generally electric heat), and often also for air conditioning, and contribute to the cost of the LIEE program through the public goods charge. Therefore, we believe it is appropriate to explore an approach that would use LIEE funding to "leverage" the provision of infiltration-reduction measures to these homes by LIHEAP or non-IOU gas utilities. Under this leveraging approach, LIEE funds would be used to pay for the LIEE infiltration-reduction measures that are feasible in these homes, provided that they pass either the IOU, LIHEAP or non-IOU gas utilities' safety testing procedures for combustion appliances. The infiltration-reduction measures would be installed by the non-IOU gas utility or under LIHEAP, as the Team proposes, but in addition the IOU would reimburse the non-IOU gas utility or LIHEAP on a per measure basis from LIEE program funds. The

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[46] *Supplemental Information in Support of the Final Phase 4 Report on the Low Income Weatherization Program,* September 4, 2003, Attachment B.

reimbursements would be contingent upon the receipt of appropriate documentation that the home passed the LIHEAP or non-IOU gas utility's combustion appliance tests, and could be subject to the same pre- and post-inspection procedures the IOUs currently implement to monitor their LIEE contractors.

Coupled with this form of leveraging, the Team's proposal would continue allocate LIEE funding for infiltration-reduction measures to low-income homes based on their space heating fuel, as is currently done, rather than based on the fuels used in the home for other end uses. At the same time, this approach provides for combustion appliance safety testing by entities other then the IOUs for homes that have appliances that use propane, kerosene or wood (or non-IOU natural gas), as proposed by the Team. We think that this leveraging approach has appeal, and should be explored as a potential modification to the Team's proposal.

These and other alternatives to the Team's proposal regarding the treatment of homes that contain a non-IOU fueled combustion appliance should be explored as a further task for Phase 4 of the Standardization Project. Consistent with prior Commission direction regarding the Standardization Project, the Assigned Commissioner shall direct this task with respect to the scope of work, budget and schedule.[47]

In order to obtain broad input from the low-income community on this issue, Energy Division should schedule and notice a presentation by Team consultants to the Low Income Oversight Board (LIOB), with notice to all parties

[47] D.01-03-028, Ordering Paragraph 8. See also, D.01-05-033, Ordering Paragraph 18.

in this proceeding and to all community-based organizations (CBOs) that currently participate in the LIEE programs. The utilities should provide the additional data discussed above for inclusion in the presentation, along with any additional information that Energy Division deems appropriate. The presentation may occur at a regularly scheduled LIOB meeting, a workshop, or other public forum. It may involve a single meeting, or multiple meetings. The Team consultants should include a summary of the comments and recommendations of the LIOB, participating CBOs and other interested parties in their supplemental Phase 4 report, along with Team recommendations. The report should include a discussion of the pros and cons of each policy alternative, along with the estimated impact on services to low-income customers relative to current policy.

We emphasize that the public discussion and the supplemental report should address the treatment of homes that use non-IOU combustion fuels in the context of the NGAT policies and procedures that we adopt today, e.g., post-weatherization testing only, room ambient CO testing as the standard procedure, rather than flue testing, etc. We will not consider further argument or proposed modifications on these issues. In order to provide sufficient time for this effort, the final report on this issue shall be due 120 days from the effective date of this decision. Comments on the report will be due 30 days after the report is issued, and reply comments are due 15 days thereafter.

In the meantime, the utilities should implement the NGAT assessment procedures adopted in this decision for all homes that use IOU fuels for space heating and other end uses. These procedures are summarized in Attachment 7. For homes that utilize an IOU-fuel for space heating, but non-IOU fuels for other end uses, we authorize the utilities to continue their current CO testing

procedures to qualify these homes for infiltration-reduction measures until we finalize our policy in the coming months. For SoCalGas and SDG&E, this means that they would continue to conduct ambient CO tests for these homes based on the current Minimum Standard, but in all other respects incorporate the new NGAT procedures we adopt today. (See Attachment 7.) PG&E would continue to conduct both pre- and post-weatherization CO testing of these homes using its current testing procedures, until further notice.

When appliances are found to have problems, the utility should take the actions recommended by the Team, as described in Section 4.8.2. We agree with the Team's assessment that natural gas water heaters failing one or more of the tests should be repaired or replaced, as is the current practice for natural gas space heaters. We recognize that this will increase program expenditures on repairs / replacements, relative to the status quo (by an estimated $1.9 million in 2003 for the three natural gas utilities). However, now that we are requiring more extensive tests (e.g., ambient CO testing) for water heaters using natural gas, it makes no sense to treat these appliances differently from space heaters in terms of authorized replacements. The continued operation of both types of natural gas appliances (water and space heating) are important to the well-being of low-income residents and should be replaced, rather than shut off, by the natural gas utility if they are tested and found not to be functioning safely, and cannot be repaired. We note that this change will not increase LIEE program costs overall for 2004, in light of our decision to eliminate certain measures from the program.

Today's decision describes the general policies and procedures we adopt for NGAT. As discussed above, we have adopted final policies and procedures for homes that utilize IOU-fuels, and have adopted interim NGAT procedures for

homes that utilize non-IOU fuels until we finalize our policy with respect to offering infiltration-reduction measures to those homes in the coming months. Translating these policies and procedures into specific instructions will require some further work by the Team. For example, the addition of ambient CO testing for cook tops will require a write-up of specific protocols or instructions on how far the instrumentation should be placed from the cook top, the number of minutes the cook top should operate before measurements are taken, etc.

We direct the Standardization Team to complete the documentation of CO testing protocols and revisions to the Policy and Procedures Manual to reflect today's decision, and to submit this material as a compliance filing within 20 days. The filing should include protocols for the preliminary combustion air ventilation evaluations discussed above. Protests and comments will be due 10 days thereafter, and the Team should respond to protests or comments within 5 working days. If there are no protests to the Team's compliance filing, then the Assigned Commissioner or Administrative Law Judge, in consultation with Energy Division, may issue a ruling approving the testing protocols and revisions to the manual without further action by the Commission. Changes to NGAT testing procedures in the field will need to await approval of the protocols and manual revisions by ruling or Commission decision.

As the Team notes, one of the objectives of the NGAT study was to support the standardization of pre-approvals of the installation of LIEE Program measures. The Team's recommendation on CO testing essentially decouples measure pre-approvals from CO testing, and this is a major step in the direction of standardization. However, the Team did not make recommendations with respect to any other changes to the utilities' pre-approval procedures. Instead, the Team presents the utilities' rationales for differing pre-approval procedures

in the final report, and recommends that they be permitted to retain their current option of conducting appliance assessments in-house or contracting with third parties to provide these services.[48]

We are not prepared to conclude our standardization efforts without further consideration of whether pre-approval practices or other LIEE policies or procedures should be made more consistent across utilities. Within 90 days from the effective date of this decision, the utilities and interested parties should comment on what additional areas of standardization in LIEE procedures or policies should be addressed under the Standardization Project in the future, if any. The comments should discuss the reasons for (or against) further standardization. Reply comments are due 30 days thereafter. We will establish the scope of further standardization efforts, as appropriate, by subsequent Commission decision.

Finally, with respect to PY2004 program funding levels, we note that the utilities are currently authorized to recover in rates the following amounts for LIEE activities, per D.02-12-019: [49]

PG&E: $56,530,000

SCE: $15,893,500

SoCal: $34,521,502

SDG&E: $13,368,093

We make no changes to these authorizations for PY2004. Overall, the cost-effectiveness policies and NGAT procedures adopted today do not suggest that

[48] NGAT Final Report, pp. 9-17 to 9-21.

[49] See D.01-12-019, Ordering Paragraph 2.

significant changes to current LIEE funding levels are warranted. Consistent with our direction in D.02-12-019, any unexpended LIEE PY2004 program funds shall be carried over and made available for funding LIEE program activities in PY2005 or subsequent years as an augmentation to the amounts authorized above.[50] In their PY2005 program applications, due on July 1, 2004, the utilities should present estimates of PY2005 program costs based on the measures authorized today, along with year-to-date LIEE expenditures and estimates of any carryover funds, by budget category.

## 6. Comments on Draft Decision

The draft decision of the ALJ in this matter was mailed to the parties in accordance with Section 311(g)(1) of the Public Utilities Code and Rule 77.7 of the Rules of Practice and Procedure on _____, and reply comments were filed on _____.

## 7. Assignment of Proceeding

Carl W. Wood is the Assigned Commissioner, and Meg Gottstein is the assigned ALJ in this proceeding.

## Findings of Fact

1. The Team followed the Commission-established guidelines in evaluating the cost-effectiveness of LIEE measures.

2. In the analysis underlying its final report, the Team used per measure savings estimates based on the PY2001 load impact evaluation. In contrast to the PY2000 LIEE load impact study, in which the primary focus was the estimation of overall program savings, the more recent PY2001 load impact evaluation focuses

[50] D.01-12-019, p. 22; Ordering Paragraph 3.

on isolating individual measure impacts. The PY2001 includes refinements for this purpose, as discussed in the Standardization Team's June 2, 2003 report on LIEE cost-effectiveness. The PY2001 load impact evaluation also underwent considerable public scrutiny, as described in Attachment 5.

3. Retaining the following measures in the LIEE program is consistent with the Commission's guidelines to offer measures that pass both the $PC_m$ and the UC tests of cost-effectiveness: (1) Ceiling insulation, (2) CFLs, (3) Faucet aerators, (4) Low-flow showerheads, (5) High efficiency refrigerators, (6) Water heater blankets and (7) Water heater pipe wrap.

4. Dropping the following measures from the program is consistent with the Commission's guidelines to discontinue measures that fail both the $PC_m$ and the UC tests of cost-effectiveness, and for which there are no other policy or program considerations that justify retaining the measure: (1) High efficiency central air conditioner replacements, (2) High efficiency water heater replacements, (3) Whole house fans, (4) Setback thermostats (except when required by code in conjunction with furnace replacements), (5) Furnace filters (installed alone), (6) Evaporative cooler maintenance and (7) Duct testing and sealing.

5. The cost-effectiveness results for high efficiency room (window / wall) air conditioner results, which indicate that this measure is only cost-effective for one utility serving zones 13 and 15, may not fully reflect the potential reduction in risks to customer health and safety associated with the availability of these units in extreme climate zones. Retaining this measure across all service territories for zones 11-15, which have the most extreme summer conditions, balances the strict application of cost-effectiveness results with other policy considerations, as provided for in the Commission's guidelines.

6. Although the cost-effectiveness results for outlet gaskets, caulking, evaporative cooler covers, weatherstripping doors and weatherstripping attic doors are not favorable, these infiltration-reduction measures lower draftiness and thereby provide significant non-energy benefits relating to comfort that may be understated in the analysis due to the manner in which these benefits are allocated (e.g., by energy savings). Eliminating these measures would significantly reduce the number of homes weatherized. In addition, these relatively low-cost measures may enhance the savings from other LIEE measures through thermodynamic interactions that are not reflected in the cost-effectiveness methodology. For the reasons discussed in the report, the savings for these measures are difficult to estimate, and their costs may be overstated due to the manner in which "windshield drive time costs" are allocated. Retaining these measures in the program takes into account the above considerations, as provided for under the Commission guidelines.

7. Reducing the number of climate zones in which evaporative coolers are offered, and limiting this measure to single family and mobile homes, is consistent with the cost-effectiveness results presented in the Team's report.

8. Limiting the offering of hard-wired compact fluorescent porch lights to single-family homes is consistent with the cost-effectiveness results presented in the Team's report.

9. Continuing to offer gas furnace repairs and replacements, which are cost-effective in some but not all zones, and for some but not all utilities, recognizes the shortcomings in assessing the non-energy benefits associated with this measure that are discussed in the report.

10. Retaining minor home repairs in the LIEE program, even though they do not pass both tests for all utilities and applications, recognizes that they are often

necessary to accommodate the installation of other cost-effective measures offered through the program.

11. The Team's cost-effectiveness assessment does not obviate the need to periodically examine the utilities' current methods for estimating energy efficiency program and measure savings, or the types and frequencies of the utility's measurement studies.

12. The cost-effectiveness study results (Appendix B) indicate that there are sizable disparities across utilities in the cost for measures installed in the same climate zone.

13. Several studies reviewed by the Team indicate that prolonged exposure to high levels of CO can have dire consequences on human health.

14. California data show that 39% of unintentional CO-related deaths over the 1979-1988 period, or a total of 177 deaths, were attributable to combustion appliances. CO exposure problems associated with combustion appliances stem from the spillage of combustion byproducts into the room, which is usually caused by inadequate drafting.

15. As discussed in this decision, on a priori grounds it is not clear if infiltration reduction measures would actually increase or decrease the levels of CO found in the home. Moreover, the empirical studies reviewed by the Team do not offer a strong evidence of a relationship between infiltration reduction and ambient CO.

16. There are no U.S. agency standards for CO levels in indoor residential environments.

17. The Team's use of the following CO room ambient standards in the NGAT study is consistent with the Minimum Standard for NGAT adopted by the Commission in D.01-12-020: (1) a 10 ppm "action" level to prompt more

extensive investigation and analysis of the source of CO and (2) a 35 ppm threshold at which the home is ventilated, the occupants advised to evacuate, and the offending appliance made inoperable pending repair / replacement.

18. The results of the Team's NGAT survey indicate that, on average, 71 out of a population of 1000 homes before weatherization would have at least one ambient reading at or above 10 ppm and would require further investigation of CO sources in the home.

19. The results of the Team's NGAT survey indicate that, on average, 5 homes out of a population of 1000 homes before weatherization would have an ambient reading of 35 ppm or greater.

20. There is no empirical information available on the potential health effects associated with high flue CO levels. Members of the Team were divided on this issue: Some believe that flue CO, in itself, is not relevant to health and safety insofar as it is normally contained in the flue and does not affect the air the customer breathes. Others believe that flue CO should be assessed even in the absence of high ambient CO levels because it could constitute a potential future problem should drafting become impaired.

21. Smoke draft tests yield virtually identical results as those produced by instrumentation testing, at significantly less costs.

22. The NGAT study results reveals no clear evidence that weatherizing LIEE program homes significantly impacts the overall level of room ambient CO, or significantly affects appliance drafting. The data indicates that CO levels actually fell slightly (on average) between the pre-and post-weatherization periods for homes tested under this statewide survey. The observed positive changes in CO levels were lower in magnitude than observed negative changes, and were relatively low in absolute terms, i.e., 2 ppm or less, on average. Blower

door tests on a sample of homes before and after weatherization also do not reveal a systematic relationship between infiltration-reduction measures and CO levels, i.e., that these measures increase CO levels in the home.

23. The results of the NGAT study may have been affected by confounding factors, such as the buildup of CO in seldom-used appliances. In addition, it is possible that the effect of building infiltration reduction on ambient CO levels may take a considerable amount of time to take effect and may be missed by spot tests, such as the ones used in the study.

24. The current Minimum Standard did not provide sufficient information to identify all of the instances in which a kitchen appliance, water heater or gas log appeared responsible for ambient CO readings at or above 10 ppm, for the homes surveyed.

25. The current Minimum Standard provided sufficient information to identify all of the homes in the survey for which space heating appliances were responsible for CO at or above the 10 ppm action level, for the homes surveyed.

26. The NGAT survey gave no evidence of any ambient CO associated with combustion dryers, and none of these appliances exceeded standards for as-measured flue CO.

27. Flue/exhaust CO levels tested under the NGAT survey vary widely across appliances and homes. The results indicate that the relationship between exhaust flue CO levels and room ambient CO levels is relatively weak, that is, detections of CO levels above manufacturer's standards for appliance flue/exhaust tests do not systematically translate to ambient air CO levels that exceed safety standards. The study indicates that many more homes fail the CO flue/exhaust tests for specific appliances than the number of homes in which room ambient CO levels exceed the 10 ppm action level.

28. Ten percent of CO alarms failed the tests conducted under the NGAT study to determine their sensitivity to a specific level of CO. The nuisance rate of the alarms was also relatively high (i.e., 15%). In light of these findings, it would be premature to use CO alarms in lieu of (or in addition to) combustion appliance testing.

29. The Team's recommended revisions to the Minimum Standard are designed to address the shortcomings of the Standard observed during the NGAT study, and eliminate procedures (e.g., testing for combustion dryers) that appear superfluous.

30. Even though there is no clear evidence that installing infiltration-reduction measures will increase CO levels in the home, some type of CO testing is warranted for the following reasons:

- Some homes covered by the NGAT survey were measured to have ambient CO levels above at least some of the current standards and thresholds.
- The LIEE Program is unique in that it entails the provision of a comprehensive set of energy-efficiency measures spanning both building envelope infiltration reduction and appliance repair and replacement. Given this comprehensive treatment, the potential for adversely affecting CO levels is greater than in other programs.
- Low-income households are generally less financially capable of maintaining their natural gas appliances, and may be less likely to know that gas appliance testing and services are available at no cost from their local gas utility.

31. Conducting CO tests both pre- and post-weatherization would be excessive, in light of the NGAT study findings. Requiring the utilities to conduct these tests post-weatherization is sufficient to guard against the possibility that

infiltration-reduction measures do have some influence on drafting or longer-term concentrations of CO in the home.

32. CO testing should not be required in cases where weatherization is not provided, i.e., when the utilities go back to homes that already have been weatherized in order to install additional electric measures (e.g., replacement refrigerators), as provided for under rapid deployment.

33. Requiring the utilities to conduct preliminary combustion air ventilation evaluations as part of the initial home assessment can identify those instances where major work to add combustion air venting is required to pass inspection. In those instances, infiltration-reduction measures would not be installed under the LIEE program.

34. Under the Team's recommendation, the decision to conduct flue tests for space and water heating appliances in lieu of room ambient CO tests would be at the discretion of the utility. For the utility that conducts flue tests on space and water heating appliances as the standard practice, this means that many customers' appliances would be "red tagged" (disconnected) pending repair or replacement, even when CO levels in the room air are well within safety thresholds and all appliances pass the draft tests.

35. The NGAT study presents no empirical evidence or research results to indicate whether, and to what degree, CO levels in the flue or exhaust that exceed certain thresholds may present health problems sometime in the future.

36. NGAT procedures cannot guarantee against the future possibility of CO problems arising in the home if drafting becomes impaired. These procedures are designed to evaluate CO levels and test for adequate drafting at a particular point in time. These conditions may change over time due to a variety of unpredictable factors.

37. Based on the record in this proceeding, it is reasonable to require all utilities to conduct the room ambient CO tests recommended by the Team, in conjunction with the recommended olfactory tests, visual examinations and smoke draft tests. If CO levels in a particular room (or rooms) are at or above the 10 ppm action level, then the utility may (but is not required to) conduct flue tests as one diagnostic tool to identify the source(s) of the problem, as appropriate. This is the current manner in which SDG&E and SoCalGas utilize flue tests in combination with ambient tests in their current NGAT procedures, and should be adopted as a standardized practice across all utilities.

38. Under the Team's recommendation regarding homes that use non-IOU combustion fuels, some number of customers in the utilities' service areas that are currently eligible for infiltration-reduction measures under the LIEE program would no longer be eligible for these measures. For PG&E, the data available to date indicates that the impact of the Team's recommendation would affect the services provided to 5-7% of all its customers over time, with a higher impact in rural counties.

39. An estimated 16.3% of LIEE participating customers in rural ZIP codes without PG&E gas accounts had propane appliances. PG&E estimates that over 20,000 customers in eleven of its rural counties would be affected by the Team's recommendation regarding homes that use non-IOU combustion fuels.

40. SoCalGas, SCE and SDG&E only provide estimates based on the entire population of customers, for which the impact of the Team's recommendation is estimated at approximately 1% or less.

41. The Team's recommendation represents a significant decrease in LIEE-funded services to homes that are currently receiving such services from the program and contribute to the costs of LIEE through the public goods charge on

their electric bills. PG&E estimates the difference to be approximately 5 measures per home, on average. In effect, the Team's proposal would shift the costs of those measures to the LIHEAP program or non-IOU gas utility.

42. The NGAT report does not sufficiently explore alternative policies that would consider a more specific set of circumstances with respect to the type or location of non-IOU fueled combustion appliances in the home. Nor does it consider leveraging with LIEE funds the provision of infiltration-reduction measures to homes that use IOU fuels for space heating (but non-IOU fuels for one or more other end-uses), as discussed in this decision. The Team also dismisses the approach that the Southern California utilities have implemented for many years in conjunction with post-weatherization CO testing of these homes, without adequate consideration.

43. The Team's recommendation to authorize water heater replacements under the LIEE program recognizes that the continued operation of both space and water heating appliances are important to the well-being of low-income residents, and should not be treated differently now that they are both subject to CO testing. Consistent with the current treatment of gas furnaces, natural gas water heaters should be replaced, rather than shut off, by the natural gas utility if they are tested and found not to be functioning safely, and cannot be repaired.

44. Translating the NGAT policies and procedures adopted today into specific instructions and protocols will require some further work by the Team, as described in this decision.

45. The Team's recommendation on CO testing essentially decouples measure pre-approvals from CO testing, which is a major step in the direction of standardization. However, the pre-approval policies and procedures still differ significantly across utilities, particularly with respect to whether they conduct

those procedures in-house or contract with third parties to provide these services. Other LIEE policies and procedures may differ as well.

46. The cost-effectiveness policies and NGAT procedures adopted today do not suggest that significant changes to current LIEE funding levels, as authorized by D.02-12-019, are warranted.

## Conclusions of Law

1. The Team's recommendations regarding which LIEE measures to offer are reasonable and should be adopted for PY2004 and beyond until further order by the Commission.

2. As discussed in this decision, the Assigned Commissioner should initiate the examination of savings measurement issues at the earliest opportunity, as time and resources permit. Further examination of the utilities' estimating methods should be undertaken to explain the disparities in per measure costs, as discussed in this decision.

3. Alternatives to the Team's proposal regarding the treatment of homes that contain a non-IOU fueled combustion appliance should be explored as a further task for Phase 4 of the Standardization Project with input from the LIOB, CBOs and other interested parties.

4. Further standardization of LIEE programs and policies, such as measure pre-approvals, should be considered by the Commission after receiving comments from interested parties.

5. The Team's recommended NGAT policies and procedures, as modified by this decision, are reasonable and should be adopted.

6. LIEE program funding, as authorized per D.02-12-019, should continue until the Commission addresses the utilities' PY2005 program applications, due on July 1, 2004.

7. In order to implement today's policies during 2004 as expeditiously as possible, this decision should be effective today.

## INTERIM ORDER

**IT IS ORDERED** that:

1. For program year (PY) 2004 and until further order by the Commission, the following measures shall be retained / dropped from the Low-Income Energy Efficiency (LIEE) programs of Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southern California Edison Company and Southern California Gas Company, collectively referred to as "the utilities" or "investor-owned utilities" (IOUs):

| Measure | Adopted Action |
|---|---|
| Non-Weather-Sensitive Measures | |
| Hard-wired CFL porch lights | Retain in all climate zones for single family homes, but drop for multi-family and mobile homes |
| Compact fluorescent lamps | Retain in all climate zones and residence types |
| Faucet aerators, | Retain in all climate zones and residence types |
| Low-flow showerheads, | Retain in all climate zones and residence types |
| High efficiency refrigerators | Retain in all climate zones and residence types |
| Water heater blankets | Retain in all climate zones and residence types |
| Water heater pipe wrap | Retain in all climate zones and residence types |
| High-efficiency water heaters | Drop from Program |
| Weather-Sensitive Measures | |
| Outlet gaskets | Retain in all climate zones and residence types |
| High efficiency central Acs | Drop in all climate zones and residence types |
| High efficiency room Acs | Retain in Climate Zones 11, 12, 13, 14, and 15 |
| Caulking | Retain in all climate zones and residence types |
| Ceiling Insulation | Retain in all climate zones and residence types |
| Duct testing and sealing | Drop in all climate zones and residence types |
| Evaporative cooler covers | Retain in all climate zones and residence types |
| Evaporative cooler maintenance | Drop in all climate zones and residence types |
| Evaporative coolers | Retain in Climate Zones 11 – 16 for single family and mobile homes; drop from Program for multi-family homes and in Climate Zones other than 11 – 16. |
| Furnace filters | Retain, but only as part of furnace repair or replacement |
| Gas furnace repairs | Retain in all climate zones and residence types |
| Gas furnace replacements | Retain in all climate zones and residence types |
| Minor home repairs | Retain in all climate zones and residence types |
| Setback Thermostats | Drop from Program except where required by code in conjunction with furnace repair or replacement |
| Weatherstripping attic doors | Retain in all climate zones and residence types |
| Weatherstripping doors | Retain in all climate zones and residence types |
| Whole house fans | Drop from Program |

2. The LIEE funding authorizations adopted in Decision (D.) 02-12-019 shall remain in effect until further Commission order. Consistent with the direction in D.02-12-019, any unexpended LIEE PY2004 program funds shall be carried over and made available for funding LIEE program activities in PY2005 or subsequent years as an augmentation to the amounts authorized in D.02-12-019. In their PY2005 program applications, due on July 1, 2004, the utilities shall present estimates of PY2005 program costs based on the measures authorized today, along with year-to-date LIEE expenditures and estimates of any carryover funds, by budget category. The applications shall also include updated program data using the format provided in Attachments 1 and 2 of D.01-12-019.

3. As discussed in this decision, the Assigned Commissioner shall initiate the examination of savings measurement issues directed by Decision 02-08-034 at the earliest opportunity, and in coordination with the Annual Earnings Assessment Proceeding.

4. Within 60 days from the effective date of this decision, the utilities shall file and serve a per LIEE measure cost break-down of materials, labor, administrative and travel (or "windshield time") costs, including an explanation of the reasons for cost disparities within the same climate zone and recommendations for further evaluation work.

5. The Standardization Team's recommendations regarding Natural Gas Appliance Testing (NGAT) are adopted as proposed, with the following modifications:

   a. The utilities shall perform room ambient Carbon Monoxide (CO) tests for space and water heating as the standard procedure, as discussed in this decision and reflected in Attachment 7. For homes that use IOU fuels for all combustion appliances, the required testing procedures described in Attachment 7 are final and

supersede the Commission's previous direction on NGAT procedures, including the Minimum Standard adopted in Decision 01-03-028.

b. For homes that use an IOU fuel for space heating but non-IOU combustion fuels for one or more other end use (e.g., propane for the water heating), the utilities shall continue their current CO testing procedures to qualify these homes for infiltration-reduction measures on an interim basis until further Commission order, as discussed in this decision.

The policies and procedures adopted in this Ordering Paragraph shall become effective upon approval of the Standardization Team's compliance filing, per Ordering Paragraph 7.

6. The utilities shall take the following actions when appliances fail one or more of the tests covered by the NGAT procedures:

a. In owner-occupied homes, natural gas space heaters failing one or more of the tests covered by the NGAT procedures shall be repaired or replaced.

b. In owner-occupied homes, natural gas water heaters failing one or more of the tests shall be repaired or replaced.

c. In owner-occupied homes, natural gas appliances other than water heaters or space heaters (e.g., gas oven) failing one or more of the tests shall be serviced. This entails providing services that are within the scope of the gas service department for customers in general, e.g., cleaning orifices, adjusting burners and taking other minor corrective actions. If these repairs do not correct the problem in question, the appliances in question shall be capped and reported to the owner.

d. In renter-occupied homes, appliances failing one or more of the tests shall be serviced. If servicing an appliance does not correct the problem in question, the appliance be shall be tagged, shut off, capped and reported to the tenant and the landlord.

7. Within 20 days from the effective date of this decision, the Standardization Team shall file CO testing protocols and revisions to the Policy and Procedures

Manual to reflect today's decision, including procedures to implement the Standardization Team's recommendation that the utilities conduct preliminary combustion air ventilation evaluations as part of the initial home assessment. This document shall be submitted as a compliance filing. Protests or comments are due 10 days after the date of filing, and the Standardization Team shall respond to protests or comments within 5 working days thereafter. If there are no protests to the Standardization Team's compliance filing, then the Assigned Commissioner or Administrative Law Judge, in consultation with Energy Division, may issue a ruling approving the CO testing protocols and manual revisions without further action by the Commission.

8. As discussed in this decision, the Standardization Team shall further explore alternatives for the provision of infiltration-reduction measures and combustion appliance testing in homes that use an IOU fuel for space heating and a non-IOU combustion fuel for one or more other end uses. This task shall be conducted under Phase 4 of the Standardization Project, and the Assigned Commissioner shall direct this task with respect to the scope of work, budget and schedule. Within 30 days from the effective date of this decision, the Standardization Team shall file and serve a proposed scope, budget and schedule for the Assigned Commissioner's consideration. Comments are due 10 days thereafter.

9. As soon as practicable, Energy Division shall schedule and notice a presentation by Standardization Team consultants to the LIOB on the provision of infiltration-reduction measures and combustion appliance testing in homes that use an IOU fuel for space heating and a non-IOU combustion fuel for one or more other end uses, and solicit the Board's comments and recommendations on these issues. The presentation shall describe current policies and procedures, the

May 5, 2003 recommendations of the Standardization Team, and additional alternatives as described in this decision. The presentation shall be noticed to all parties in this proceeding, or its successor proceeding, and to all community-based organizations (CBOs) that currently participate in the LIEE programs. The presentation may occur at a regularly scheduled LIOB meeting, a workshop, or other public forum. It may involve a single meeting, or multiple meetings. The utilities shall provide the additional information discussed in this decision, as well as additional information that Energy Division deems appropriate.

10. Within 120 days from the effective date of this decision, the Standardization Team shall file a supplemental report on these Phase 4 issues, which shall include the following:

a. Summary of the comments and recommendations of the LIOB, CBOs and other interested parties;

b. Final recommendations of the Standardization Team;

c. Discussion of the pros and cons of each policy alternative; and

d. Estimated impact on services to low-income customers, relative to current policies (for each alternative).

The impact estimates required under (d) above shall be specific to low-income households within the utility's service territory. The report shall show the impacts on low-income households within the service territory as a whole, and also on low-income households located in rural areas. The data shall be presented in a consistent manner across utilities.

11. As discussed in this decision, the public discussion and supplemental Phase 4 report shall address the treatment of homes that use non-IOU combustion fuels in the context of the NGAT policies and procedures we adopt today, e.g., post-weatherization testing only, room ambient CO testing as the

standard procedure, rather than fuel testing, etc. Further argument or proposed modifications on these issues will not be considered.

12. Comments on the supplemental Phase 4 Standardization Project report are due 30 days after the report is filed, and reply comments are due 15 days thereafter.

13. Within 90 days from the effective date of this decision, the utilities and interested parties shall comment on what additional areas of standardization in LIEE procedures or policies should be addressed under the Standardization Project in the future, if any. The comments shall discuss the reasons for (or against) further standardization. Reply comments are due 30 days thereafter. The Commission shall consider the comments and address the scope of any further standardization efforts by subsequent decision in this proceeding, or its successor proceeding.

14. All filings and comments shall be filed at the Commission's Docket Office and served electronically on all appearances and the state service list in this proceeding, or its successor proceeding. Service by U.S. mail is optional, except that one hard copy shall be mailed to Judge Meg Gottstein at P.O. Box 210, Volcano, CA 95689. In addition, if there is no electronic mail address available, the electronic mail is returned to the sender, or the recipient informs the sender of an inability to open the document, the sender shall immediately arrange for alternate service (regular U.S. mail shall be the default, unless another means—such as overnight delivery—is mutually agreed upon). Parties that prefer a hard copy or electronic file in original format in order to prepare analysis and filings in this proceeding may request service in that form as well. The current service list for this proceeding is available on the Commission's web page, www.cpuc.ca.gov.

15. For good cause, the Assigned Commissioner may modify the due dates set forth in this decision.

This order is effective today.

Dated _____, at San Francisco, California.

## ATTACHMENT 1

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ALJ | Administrative Law Judge |
| ANSI | American National Standards Institute |
| CBOs | community-based organizations |
| CFLs | compact fluorescent lamps |
| CO | carbon monoxide |
| COHb | carbon monoxide with hemoglobin |
| D. | Decision |
| DEER | Database for Energy Efficiency Resources |
| HVAC | Heating, Ventilation and Air Conditioning |
| ICA | Insulation Contractors Association |
| IOUs | Joint Utilities or investor-owned utilities |
| LIEE | Low-Income Energy Efficiency |
| LIHEAP | Low-Income Energy Assistance Program |
| LIOB | Low-Income Oversight Board |
| *mimeo.* | mimeograph |
| NEBs | non-energy benefits |
| NGAT | Natural Gas Appliance Testing |
| ORA | Office of Ratepayer Advocates |
| p. | page |
| $PC_m$ | Participant Cost |
| PG&E | Pacific Gas and Electric Company |
| pp. | pages |
| ppm | pounds per minute |
| Pub. Util. Code | Public Utilities Code |
| PY | Program Year |
| RRM | Reporting Requirements Manual |
| SCE | Southern California Edison Company |
| SDG&E | San Diego Gas & Electric Company |
| SoCalGas | Southern California Gas Company |
| Standard | NGAT standard |
| “the Team” | Standardization Team |
| “the utilities” | PG&E, SDG&E, SCE, and SoCalGas, collectively |
| UC | Utility Cost |
| XENERGY | XENERGY, Inc. |

**(END OF ATTACHMENT 1)**