Pilot Project Assessment Report

for the

One-on-One On-Site (O^4S) Training Project

conducted for the

Boston Region Weatherization Program

(Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, and New York)

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Preparing a wall in Massachusetts, O^4S Pilot Project

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Executive Summary

Introduction

The idea for the regional one-on-one, on-site training project originated in the spring of 2002. After refinement of the project details and dissemination of a request for proposals, a contract was signed with R.J. Karg Associates in December 2002. The contract scope of services stated:

> [The contractor shall provide] on-site training in each of the seven states (NY, VT, NH, ME, MA, CT, RI) as agreed upon by the seven state Weatherization Program Managers and US Department of Energy Boston Regional Office Weatherization Program Supervisors[1]. Trainings are intended to increase the knowledge and technical skills of crews and contractors involved with the installation of energy efficiency measures with the DOE Weatherization Assistance Program.

Rick Karg of R.J. Karg Associates agreed to act as the only trainer. The training was intended to ". . . be directed toward weatherization installers with some experience on the job, both crews (employees of weatherization agencies) and contractors. It [was] not intended to train new crew or contractor workers, nor [was] it intended for auditor/estimators or management personnel."[2]

Additionally, the training was intended to be one-on-one and to take place on actual work sites. All instruction was intended to be ". . . on-demand, without a curriculum, and without long-term planning. The overall framework of the instruction [was] 'the house as a system' and it [addressed] the whole house environment"[3]

Blower Door Testing in Maine

As the project developed, it became larger in scope than defined above. Auditors, estimators, inspectors, agency weatherization directors, and state monitors *were* included in the training. One-on-one instruction did take place, but a training environment characterized by small groups – and sometimes large groups of more than twenty – were very common. Judging by the participant evaluations, this spillover into additional job categories and larger groups was beneficial.

The expected results of the project were:

1. The field instruction for installation workers will bring greater uniformity to weatherization installation within states and, secondarily, to the region.
2. The instruction is likely to result in higher quality weatherization installations.
3. The project is likely to bring the state installation procedures closer to the best practices, assuming that some of the state practices are not now "best practices".

[1] Because New York was negotiating for in-house trainers, they graciously opted out of the project, giving permission to allocate their training days to the other states.
[2] Project proposal by R.J. Karg Associates, page 2.
[3] *Ibid*, page 2.

4. The O^4S Project is likely to help crew and contractor workers feel more a part of the weatherization process and network.[4]

Because the project has not been formally evaluated, it is not possible to determine if these results have been realized, however, it seems likely that they have.

In addition to the expected results mentioned above, additional important outcomes include the discovery of:

1. Necessary changes to future O^4S training projects. Refer to page 10 or this report for more information.
2. Training needs of the weatherization personnel in the six New England States. Refer to page 10 of this report for a detailed list of training needs.
3. Suggested alterations to the six New England weatherization programs. Refer to page 12 of this report for more information on this topic.
4. The importance of region wide initiatives. Refer to page 12 of this report for more information.

Number of Participants in Training Sessions

Two hundred thirty weatherization personnel were exposed to the O^4S training activities over the course of the pilot project. The personnel contact hours at training sessions totaled 2244 (see Tables 1 and 2).

Table 1
Number of Weatherization Personnel Attending an O^4S Training Event and Personnel Contact Hours at Training

State	*Number of Personnel Attending O^4S Training**	*Number of Personnel Contact Hours at O^4S Training***
Connecticut	29	426
Maine	65	498
Massachusetts	40	264
New Hampshire	19	240
Rhode Island	25	492
Vermont	52	324
Totals	***230***	***2244***

* Personnel attending more than one day were counted only once. For example, many state monitors attended five days, but were only counted once. The low count in New Hampshire is the result of two contractor crews attending two days each.
** These values were derived by multiplying the number of participants attending each training session (including those attending two or more days,) by six hours per day.

The largest number of people attending a training day occurred in Maine with a count of twenty-nine. The smallest was in New Hampshire with a count of five. There was never just one person at a training site – as the name of this project might suggest – but one-on-one training often occurred.

[4] *Ibid*, page 3.

Training Dates

Most of the O^4S training in the six states took place during the summer of 2003. The training dates, along with the number of participants attending each day, are listed in Table 2.

Table 2
Training Dates for Pilot O^4S Project
and Number of Personnel Attending Each Day

State	**Training Dates in State, 2003** *(Number Attending Each Day)*
Connecticut	April 28, 29, 30, May 1, 2 *(19, 16, 13, 11, 12)*
Maine	August 25, 26, 27, 28, October 14 *(9, 14, 29, 15, 16)*
Massachusetts	April 14, 15, 16, 17, September 19 *(8, 8, 8, 13, 7)*
New Hampshire	February 11, 12, September 3, 4, 5 *(5, 6, 8, 6, 5)*
Rhode Island	July 21, 22, 23, 24, 25 *(16, 16, 17, 20, 13)*
Vermont	June 9, 10, 11, 12, 13 *(11, 17, 8, 6, 12)*

Evaluation of Training

The training for the pilot O^4S project was evaluated by the participants either at the end of the training day or within a few days of a training session. A standard evaluation form was used in all states but Maine and Rhode Island.[5] This form is reproduced in this report on page 80. Table 3 on page 79 lists the number of training evaluations collected in each state. Please refer to pages 81 through 88 for composites of the responses from each state. These composites list the average responses to the numeric ranking questions and list all responses to the fill-in-the-blank questions. The vast majority of the participants responding on evaluation questionnaires found the training experience very informative and useful.

A state program manager from each state wrote and submitted an overview and evaluation of the training in their state. Each of these reports is included in this document. The report from Glenn Bernard and Tom Coker of Connecticut starts on page 25, that of Tony Gill of Maine starts on page 37, that of Ken Rauseo of Massachusetts starts on page 46, that of Andy Gray of New Hampshire starts on page 52, that of Mike Snitzer of Rhode Island starts on page 64, and that of Dwight DeCoster of Vermont starts on page 73. These reports reflect a very positive response to the O^4S training experiences in each state.

[5] In Maine, two evaluation forms were used, each made up by Tony Gill of Maine State Housing Authority. These two forms are included in this report. Although the Rhode Island evaluation form used was slightly different from the standard O^4S evaluation form, it was similar enough to reliably report a summary of participant responses on the standard O^4S form. The original completed evaluation questionnaires collected are available at the offices or R.J. Karg Associates.

General Observations

Attending the training sessions were state monitors, agency weatherization directors, agency-employed installers, contractors, contractor-employed installers, and auditors/inspectors. Generally, the discovered needs of each of these job groups were different.

Those installing weatherization measures were most interested in information about air sealing, blower door testing, and the details of insulating properly. Contractors were more interested in equipment needs while crew workers tended to be more interested in the correct installation methods. However, a number of crew workers wanted to discuss tool needs, especially when they thought their employer – weatherization agency or contractor – was not providing the proper tools to get the work completed efficiently.

The auditors/inspectors were more interested in diagnostic procedures, auditing methods, the determination of the thermal envelope, state weatherization field standards, supervision of weatherization work, and inspection of completed jobs.

State monitors were usually in the position of providers and caretakers of the O^4S training environment. They handled the coordination of the training sites, communication with the clients, the availability of food for lunch, and hospitality for the trainer. Most of the participating state monitors took part in the training as co-trainers, or assistants and, because of their hosting responsibilities, did not have time to act as participants.

The O^4S pilot project provided an excellent opportunity for observation of the interaction among auditor/inspectors, agency installers, contractors, and state monitors. In some cases, the personnel at the various levels were on friendly terms and worked very well together, in other cases, there was evidence of surprisingly little communication and a poor working relationship.

Major Training Topics Addressed during the Pilot Project

There was a broad range of training required across the New England area, for example, the installers in one state had not heard of dense packing cellulose insulation in walls, but in other states, many of the contractors are very knowledgeable of dense-pack techniques.

Of course, those attending came with the different job categories of crew worker, contractor, foreman, auditor/inspector, and state monitor, therefore, training needs varied.[6] The training most often took place in small groups of crew workers or auditors/inspectors. It was also common for individuals to ask Karg a question privately, often prefaced by "I have always wondered about . . ." The most anxious and urgent one-on-one training moment for the trainer was when he stopped a worker from filling a generator with gasoline while smoking a cigarette. This generator was located in the back of a box van!

[6] The daily training notes by Karg list the training topics addressed for each of the thirty days of the pilot project. In this document, these notes begin on page18 for Connecticut, page 28 for Maine, page 40 for Massachusetts, page 48 for New Hampshire, page 58 for Rhode Island, and page 66 for Vermont.

Contractors, Foremen, and Installers

Contractors, their employees, and agency-employed installers generally needed instruction in the areas of insulation installation (especially dense pack cellulose), blower door use (including general operation and as a tool for blower door guided air sealing), and air sealing techniques and materials.

Insulation methods most often included dense packing walls. Topics included fill tube rigidity and length, tube insertion methods, measuring density, and blowing machine characteristics required for higher densities. Generally, installers working for programs in the southern New England states were less apt at dense packing cellulose than those in the northern states. During the training in Maine and the last three days in New Hampshire, the trainer acquired equipment for testing insulation blowing machines and for measuring installed wall insulation density by taking core samples. These proved to be excellent training tools, but unfortunately were not available to those attending sessions earlier in the pilot project period.[7]

Another common insulation topic was that of blowing cellulose over existing fiberglass batts in attics. The instructor informed the participants that the fiberglass should be removed or folded back for one to two feet at the perimeter of the attic floor so that the cellulose makes contact with the upper surface of the ceiling. This method prevents lateral air leakage through the porous fiberglass. This type of air leakage diminishes the effectiveness of the added cellulose.

Dense Blowing Wall in Maine

Many of the contractors and installers were making mistakes with the set up and operation of blower doors. These operation deficiencies included improper zeroing of gauges, failure to include the baseline pressure, misunderstanding of the fan rings, and gross lack of equipment maintenance. At almost all sites, the instructor began the training with a blower door test, explaining the proper operation and maintenance. Then, with the blower door running, the group was told to search for leaks. Many participants mentioned that they had never before looked for air leaks in this manner.

Auditors/Inspectors

Compared with contractors and crew workers, auditors/inspectors are probably more guarded about their knowledge deficiencies. They are expected to be the experts on the site and they are obligated to call for corrections to substandard work.

Many of the auditor/inspectors demonstrated difficulty correctly defining the dwelling thermal envelope, especially in the basement area. The difficulty of the proper treatment of a basement area was often made unnecessarily confusing by terms such as

[7] The trainer recommends that these tools be used in the next phase of O^4S training.

"unintentionally heated area, intentionally heated area, living area, unfinished area," etc. Many auditors/inspectors benefited by lengthy discussions regarding the determination of the boundaries of the thermal envelope.

Very few of the auditors/inspectors understood or used zone pressure testing. There were only a handful of dwellings that would have benefited from such diagnostic testing, but only one or two auditors understood the methods.

In too many cases, auditors/inspectors were calling for basement duct sealing on their work orders. This needless work was a likely result of confusion regarding the boundaries of the thermal envelope. In at least one-half of the states, a good portion of the training time spent with auditors/inspectors addressed this topic.

The job description of auditors/inspectors appeared to be ill defined in some programs. What are the auditor/inspector's responsibilities? Don't they include energy auditing, building diagnostics, client education, contractor task manager, job monitor, trainer, specification writer, etc.? Many of the auditors/inspectors welcomed a discussion about their responsibilities and expressed confusion about that for which they are expected to be accountable. This was not a topic that could be resolved during the training time.

In addition, many auditor/inspectors are unclear about their state's field standards. It is likely that the apparent nebulous character of some field standards make it very difficult for the auditor/inspector to adequately supervise and inspect the work of installers. This could be the reason that many installers have continued to do substandard work for extended periods without corrective action from the auditors/inspectors.

Although the format of the O^4S training was intended to be on-site, there were two days of classroom training for the auditors/inspectors in Rhode Island. These two days served as an important introduction to their on-site training.[8]

Overall Recommendations

These recommendations are intended to improve the second round of O^4S training sessions, enhance the effectiveness of the state programs, and promote economies of scale and reduce redundancy of effort on a region wide basis.

Recommended Changes to Future O^4S Training Structure

Of course, lessons were learned about the best strategies for future O^4S training sessions. At the beginning of the pilot project, the trainer had a number of concerns about the structure of the training, including the productivity loss contractors would experience, the extemporaneous nature of the training format, and the possibility that more than one contractor would attend a training session, causing a possible clash of egos. Now that the pilot phase of the project has been completed with thirty days of training behind us, these concerns have faded.

The anxiety the trainer initially held about the lack of structure fostered by the extemporaneous nature of the training was quelled by clearly defining the daily activities

[8] See page 58 for the agenda of this two-day classroom training.

at the beginning of each day. A brief statement of the funding source, the objectives, the expectations, and the informal character of the training was made clear just after all arrived at the training site. There were a few days that the trainer did not state these issues as clearly as he should have; on these days the quality and flow of the training suffered. It became clear that directed and formal introductory remarks were very important for the success of the training experience. This lesson must be remembered for the next phase of the project.

As the training moved through the six states, it became obvious that the better the preparation on the state/agency level and the better the pre-training communication between the trainer and the state manager(s), the higher the quality of the training experience for the contractors, crew workers, and auditors. Where preparation and/or communication was lacking, the training experience suffered.[9] In order to ensure the highest quality training experience for the next phase of O^4S, state/agency preparation of for the training should be well planned in advance by:

1. Scheduling appropriate dwellings,
2. Telling clients what to expect during the training day,
3. Informing contractors and crew workers of the character of the training,
4. Providing the trainer with work orders for each training house,
5. Planning for the noon meal,[10]
6. Providing the trainer and others with printed directions to each training house, and
7. Supplying the trainer with a tentative roster of those expected to attend each training day.

In addition, the pre-training communication from the state manager(s) to the trainer should include:

1. Ideas of what the training needs of the attendees might be,
2. Problems that have surfaced within the program that might be addressed and corrected to some degree by the training, and
3. Recent changes to the program that might cause confusion in the field.

Measuring density by core sampling

The five days of training in Maine demonstrated that more than one contractor attending training at a site did not cause difficulties, but actually enhanced the training experience. The contractors who were more experienced with general weatherization and dense blowing techniques gladly passed information on to very receptive, less knowledgeable contractors. All attending – as many

[9] More often than a lack of preparation or communication, there were last-minute changes in plans forced by bad weather or other unexpected occurrences (in one case, the client died the day before the training was scheduled at her home).

[10] During the pilot, lunch was often provided by the state or the local host agency. Of course, this is not a requirement. If lunch is not provided by the hosting agency or state, the manager(s) should be clear beforehand about their decision. The trainer suggests that the host agency or state provide lunch at the site because the training presents a rare opportunity for informal discussion and promotes good will with the participating trainees.

as six contractors at once – appeared to benefit from this experience; there was no evidence of difficulties between contractors. As a result, during the next phase of O^4S training, multiple contractors at a training event should be treated as an opportunity rather than an obstacle to the training experience.

Another unique characteristic of the five training days in Maine was that the weatherization monitor, Tony Gill, made it mandatory for contractors doing work for the low-income weatherization program to attend at least one day of O^4S training. In addition, he paid contractors an attractive hourly rate for each employee attending. This two-part strategy – mandatory attendance and hourly payment – should be considered by other state managers for the next phase of the project because it assured high attendance and eliminated any financial burden for participating contractors.

Recommended Future Training Topics

If there is another O^4S training project phase, the following topics should be considered for presentation. Of course, because the character of this training demands that the instructor present training extemporaneously, he or she must be ready for most any weatherization-relevant topic. However, there is a fairly high degree of predictability for the requested or needed topics, so the topics below are quite likely to be appropriate for future O^4S projects in the region.

Contractors and Installers

The topics that were most often needed by contractors and crew workers during the pilot O^4S project will probably remain important topics for future O^4S training. These include:

1. Blower door operation.
    a. Proper use of manometers.
    b. Baseline readings.
    c. Blower ring use.
    d. Can't-reach-fifty multipliers.
    e. Use of blower door for finding leaks.
    f. Blower door-guided air sealing.
2. Insulation installation.
    a. General installation techniques.
    b. Dense-pack cellulose insulation.
        i. Methods and equipment.
3. Air sealing methods.
    a. Where and how to air seal.
        i. Attic bypasses.
        ii. Treatment of existing fiberglass.
4. Attic ventilation methods.
5. Zone pressure testing methods.
6. Worst-case draft testing after all weatherization work is complete.

Tony Gill of Maine checks for sound

A number of contractors would benefit from information about what tools to purchase. For example, a contractor in Maine had just purchased a new insulation-blowing machine a few weeks before the O^4S training. After Karg tested the static pressure capacity at the blowing machine takeoff during the training, the contractor realized that his new machine did not have the capacity to dense pack insulation in walls. Of course, he was quite upset having spent a few thousand dollars on an inadequate piece of equipment. A number of other contractors were unknowingly using inadequate insulation machines.

At least five contractors in Maine demonstrated that they were unaware of the proper maintenance of their insulation-blowing machines. Often these machines are purchased second-hand, increasing the likelihood of a missing operation manual. Substandard maintenance items included clogged machine filters, leaky seals, and worn out motors. These contractors benefited from spending a day with other more knowledgeable contractors and crews who were willing to discuss proper maintenance. Other contractors and agency crews in the region would benefit from such peer training in the future.

Auditors/Inspectors

The topics that were most often needed for auditors/inspectors during the pilot O^4S project will probably remain important topics for future O^4S training. These include:

1. Effective energy auditing.
    a. Important diagnostic procedures.
        i. Building Tightness Limits.
        ii. Worst-case draft testing.
        iii. Zone pressure testing.
    b. Calculation of square footage and volume.
    c. Definition of the thermal envelope boundaries.
        i. Where to put insulation.
        ii. When to seal ductwork.
        iii. Where air sealing should be done.
    d. Cost-effective measures.
2. Blower door operation.
    a. General setup and operation.
    b. Techniques for multi-family buildings.
3. Worst-case draft testing.
    a. Setup for and performance of test.
    b. Solutions for houses that fail test.
4. Zone pressure testing methods.
5. Definition and determination of the boundaries of the thermal envelope.
6. The responsibilities of the auditor/inspector.

Of course, if there are changes to any of the state programs regarding energy-saving measures, required diagnostic procedures, health and safety, etc., these changes will foster questions at future training sessions. The O^4S trainer will have to prepare for training on these program changes.

During the O^4S training in Vermont the trainer had the opportunity to witness the use of the "insulation boxes" designed by Gary Roundy and Bill Hulstrunk and built by Gary Roundy. These boxes are an extremely useful training demonstration for the installation

of cellulose for they allow the trainee to see the cellulose blowing into the box, feel the density of the insulation, and then precisely determine the density when the box is weighed. The trainer for the pilot project has spoken with Gary Roundy about building two of these insulation demo boxes for the next phase of the O^4S training. It is strongly recommended that these demonstration boxes be included in the budget for the next phase so that they can be used at each training site.

Gary Roundy with Insulation Box

Recommended State Program Changes

During the thirty days of field training in the six New England states the trainer had the opportunity to listen to state monitors, energy auditors/inspectors, contractors, and crew workers talk about their work, their opinions of the weatherization field standards, and their relationships with personnel working at other levels of their state program. Although most of this information was subjective, it was valuable for establishing a snapshot view of the health of the weatherization program in the state.

Over the last ten years trainers and program managers have stressed the vital importance of the house-as-a-system or the holistic approach to weatherization work. Energy auditors, crew workers, and others have been taught to consider the client, the comfort systems, the pressures, air quality, health and safety, etc., *and the interaction of these elements* in their strategies for weatherization work. The primary objective of the O^4S pilot project was to improve the quality of weatherization measures installation in New England with the valuable and versatile tool of on-site training. *However, improvement in quality is not only accomplished by on-site training, it can also be achieved by programmatic changes. Just as weatherization work must be characterized by a holistic approach, state weatherization programs must be analyzed holistically and improved systematically.*

For example, when contractors and crew workers demonstrate deficient air sealing techniques, is this a result of 1) a lack of proper training, 2) an absence of clearly defined air sealing techniques in the state's weatherization field standards, 3) poorly enforced weatherization field standards, or 4) a plethora of weatherization installation standards (low-income and utility) and the resulting confusion arising from which standard applies to which jobs?

The recommended programmatic changes suggested just below for the state level and those in the following section, Recommended Region wide Initiatives, are based on a holistic and systematic look at the state programs and the New England region.

These suggested state program changes are not needed by every state in New England.[11] The spirit of these recommendations is not intended to be negative, but to suggest some methods to state managers for making their programs more effective, productive, and professional, while, at the same time, accomplishing the valuable societal mission of the low-income weatherization program. These recommendations are:

1. Develop and maintain vital state field standards. These field standards should include, as a minimum:
    a. Administration and scope.
    b. Health and safety.
        i. Carbon monoxide testing.
        ii. Venting for acceptable indoor air quality.
        iii. Moisture assessment.
        iv. Asbestos safety.
        v. Lead-safe procedures.
        vi. Worker health and safety.
        vii. Client health and safety.
        viii. Combustion appliance safety.
        ix. Electrical safety.
            1. Knob and tube wiring.
            2. Aluminum wiring.
    c. Energy audit requirements.
    d. Inspection requirements.
    e. General heat waste measures.
        i. Air sealing.
        ii. Ducted distribution.
        iii. Piped distribution.
        iv. Domestic hot water.
    f. Proper insulation installation.
        i. Attics/roofs.
            1. Dense-pack cellulose in slopes and vaulted ceilings/roofs.
            2. Dense-pack cellulose in attic floors.
        ii. Sidewalls.
            1. Dense-pack cellulose in site-built homes.
            2. Mobile home wall insulation.
        iii. Foundations.
        iv. Floors.
    g. Window and door replacements.
    h. Mobile home requirements.
    i. Combustion appliances.
    j. Client educations
    k. Electric base load measures
    l. Best practices for testing and diagnostics procedures:
        i. Blower door use.
        ii. Blower door guided air sealing.

[11] For general observations and recommendations for each of the six state programs, see page 24 for Connecticut, page 37 for Maine, page 45 for Massachusetts, page 51 for New Hampshire, page 64 for Rhode Island, and page 72 for Vermont.

iii. Building tightness limit calculation to ensure that all houses are in compliance with ASHRAE 62.2-2003, *Standard for Acceptable Indoor Air Quality in Low-Rise Residential Buildings*.
iv. Duct leakage testing.
v. Duct blower use, if required in state.
vi. Room-to-room pressure testing.
vii. Zone pressure testing
viii. Worst-case draft testing.[12]

2. If not already in place, form a technical committee that meets regularly and ensure that all important stakeholders are represented on this committee. The tasks and functions of this committee might include:
    a. Periodic review of the state field standards and recommend changes to the appropriate authority in the state.
    b. Determine the training needs of auditors/estimators, contractors, and crew workers.
    c. Identify and discuss problems with existing weatherization measures. Make recommendations for improvement to these procedures to the appropriate authority in the state.
    d. Draft recommendations for the enhancement of professionalism for auditor/estimator, contractor, foreman, and crew worker.[13]
    e. Develop a minimum standard for a weatherization energy audit.
    f. For states where low-income weatherization workers (contractor or agency employed) are also installing conservation measures for utility programs, develop and recommend a uniform field standard that can be used by low-income weatherization *and* the utility programs. If this is not possible, at least attempt to bring as much uniformity to the various installation standards with in the state as possible.

Recommended Region Wide Initiatives

The New England low-income weatherization programs are as diverse as the region's geography, however, there are enough programmatic similarities to reap benefits from acting in a unified, region wide fashion.[14] Recommendations for region wide initiatives are:

1. Set up a regional task force with representatives from each of the New England states. This task force could meet quarterly or twice annually to facilitate region wide initiatives that will save the individual state programs money and time. Some of these recommendations will offer the advantages of economies of scale and avoidance of redundancy and others will lead to market transformation. These initiatives should include:
    a. Establish boiler plate, best practices field standards document (see number 2, on the next page).

[12] Apparently, this important health and safety test is not required in all of the weatherization programs in New England.
[13] As examples of moving weatherization personnel to a higher level of professionalism, the weatherization programs of Maine and New Hampshire have instituted a senior auditor proficiency test and certificate.
[14] There is a strong rationale for the six New England states to act in a unified manner, but only in ways that will allow the six state programs to enjoy the advantages of economies of scale and avoidance of redundancy.

b. Work with regional insulation manufacturers to:
    i. Develop and deliver insulation installation training.
    ii. Add a chart to cellulose insulation packaging that includes high density values (3.25 through 3.75 pounds per cubic foot).
    iii. Develop dense packing protocols, especially for walls, but also for floors and sloped ceilings.[15]
c. Work with insulation blowing machine manufacturers, their representatives, and their distributors to:
    i. Begin publishing machine static pressure ratings in product catalogs for the information of buyers. The static pressure at the machine takeoff must be at least 2.8 pounds per square inch (77.5 inches of water column) if the machine is to have the capacity to dense pack cellulose.[16]
    ii. Develop a method of rating and listing a rigidity rating for wall insulation insertion tubes in project catalogs. This rating scale should span a range of one to ten (ten being the most rigid). Each tube's rigidity rating should be specified at the temperatures of 20^o, 50^o, and 80^o Fahrenheit.
d. Draw up sample request-for-bids forms. Provide to each program or agency so that the forms can be altered as required for the unique needs of the program or agency.
e. Coordinate and foster better communication among stakeholders for weatherization work provided for other organizations – such as utilities – so that a higher degree of uniformity is developed for this "outside" utility work, not only within the region, but within each state.
f. Discuss and study the balance of power between the state agencies and the state administering organization. What is the balance of power within each state that will foster the most productive and best program?

2. The New England states should develop a boiler plate, best practices field standards document. This region wide document could then easily be altered appropriately by each of the states to suit the unique characteristics of their programs.[17] There are climatic and geographical variations within the New England region, but not enough to warrant significant standards differences from one state to another. The vast majority of weatherization measures performed in any one of the New England states are also performed in each of the other states. As a result of these significant similarities in required program standards, such a region wide effort would save precious resources and foster uniformity and cooperation among the six state programs.

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[15] Experiments during the O^4S training in Maine demonstrated that there is still much to be learned about dense packing cellulose in walls. More study is needed on the topics of insulation machine static pressure output, proper machine maintenance, appropriate machine settings, the best place for tube insertion, insertion tube rigidity, interior finish material strength and degree of deflection, and simple ways to measure installed density. Cellulose manufacturers might be willing to help finance some of this research.

[16] During the training sessions it was discovered that some weatherization contractors had purchased insulation blowing equipment with the assumption it would have the capacity to dense pack cellulose insulation in walls, only to find through on-site testing that it did not.

[17] This boiler plate field standards document is not intended to replace or compete with the *Northeast Weatherization Field Guide* written by John Krigger of Saturn Resource Management. The Krigger book is intended to be a field guide, not the precise field standards by which the programs are governed.

Reflections and Concerns at Beginning of Pilot Project

Karg's Thoughts Regarding Project After First Two Days of Training

1. Wait about a week after the training experience to give the evaluation to the trainees. Have someone from agency send evaluations back to Karg.
2. Contractors might have difficulty with the conflict or tradeoff between the educational experience (long-term benefit) and production loss (short-term cost). The contractor is there to get the job done. Taking time out for training periods is in conflict with getting the work done. Training leads to better work and fewer reworks; this saves contractor money and increases production in the long-term. Karg must be clear about this tradeoff at the beginning of session. Perhaps a good idea to have a conference call with contractor, auditor, state-level person before session to develop and discuss objectives. Contractors should get paid for the training time or should negotiate with the housing director regarding special payment for the job. Donna Cunningham, the housing director at Southwest Community Services, NH – the local agency – said she would discuss payment adjustments with the contractor.
3. Training experience needs more structure because of the above tradeoff.
4. The training will work better with agency crews than with contractors because the crews get paid whether they are being trained or working. This is not the case for contractors.
5. Probably will not work well if there is more than one contractor on the site at a time. Might be issues of competition, accounting for work done, tool problems, etc. On the other hand, having more than one agency crew on the site will not create these problems.
6. Karg, auditor, and any other "outside" people need to be ready and willing to help with the work to make up for lost production time and to enhance credibility of outsiders.
7. Worked well to have the job energy auditor and state monitor on site for the session. They did not get in the way of the training, but answered important questions that Karg could not have answered, including state policy questions.
8. Good idea to have the auditor on the site for the training. Karg should make attempts to determine the needs of the trainees before the training begins. Talking with the auditor can help here. Might be good to talk with the contractor, also.

Recommendations for Remaining O^4S Pilot Training

These recommendations were based on the first two days of O^4S training in New Hampshire, February 11 and 12, 2003. These recommendations were e-mailed to all of the program managers in the five other states. The other training sessions were scheduled and held with these comments in mind.

1. Contractors should get paid – or compensated in some fashion – for the lost time spent on training. Agency crews already get paid for time spent on training. This issue should be worked out in advance of the training.
2. If the training is for contractors, only one contractor should be on the training site at a time.
3. Karg and others must make it clear to contractors and agency crews that the loss in productivity in the short-term because of training will be outweighed by the increase in productivity and reduction in the number of reworks in the long-term.

4. The number of people on the site, in addition to the client(s) and Karg, should be limited to about six.
5. The site selected for the training should be matched to the training needs of the contractor or agency crew. When selecting the site, these questions should be considered:
    a. Will the client cooperate with the training activity?
    b. Does the house have enough room for extra people during the weatherization work?
    c. Does the weatherization work match the training needs of the contractor or agency crew?
    d. Are there issues beyond the scope of weatherization that should be addressed before this training?
    e. Will the weatherization work required and the extra time for training fit into a convenient timeframe of one or two days?
    f. Is the job site at a convenient location for all parties involved?
6. There should be communication among the trainees, auditor, state personnel, and Karg before the training day. The objectives of this communication should be to:
    a. Introduce all the parties before meeting on the site.
    b. Determine the training needs.
    c. Work out scheduling issues.
    d. Introduce the trainees to the short-term productivity loss/long-term benefits tradeoff.
    e. Discuss the characteristics of the job order.
    f. Discuss the characteristics and appropriateness of job site.
7. The auditor and/or state monitor should be on the site with Karg and the contractor or agency crew. These agency and state personnel serve as an important link in the training and communication process at the site.
8. A work order for the job should be sent to Karg and agency and state personnel before the day of the training.
9. All required tools and materials should be available at the site so that the work can proceed smoothly. All equipment should be in good working order.
10. Karg and agency and state personnel on the site should, as much as possible and practical, assist the contractor or agency crew with the weatherization work.
11. Within a week following the training, the agency energy auditor should give each trainee a training evaluation form (provided by Karg). The auditor will be responsible to collect these completed evaluation forms and mail them to Karg.

Notes from each Training Day[18]

Connecticut

Training in Bridgeport, Connecticut, April 28, 2003

1. Attending session:
    a. Rick Karg
    b. Glenn Bernard, CT Technical Monitor
    c. Tom Coker, CT Technical Monitor
    d. Robert Bracero, weatherization director for local agency, ABCD
    e. Tyreese Maloy, auditor from New Haven agency
    f. Antoine McCray, auditor from New Haven agency
    g. Augusto Silvany, salesman for National Fiber
    h. Carl Mattson, CT WRAP administrator
    i. Aubyn Clarke, ABCD energy auditor
    j. Federico Sanchez, ABCD energy auditor and coordinator
    k. Nick Resto, ABCD crew
    l. Vincente Roman, ABCD crew
    m. George Perrin, ABCD crew
    n. Ray Perrault, ABCD crew
    o. Contractor performing work (Temp-Check)
        i. Karl Christy (owner)
        ii. Kirt Christy
        iii. Glenn Christy
        iv. Richard Jackson
    p. Contractor visiting (New York Energy Conservation)
        i. Hugo Salinas (owner)
        ii. Tony Illescas (owner)

Dense blowing in Connecticut

2. Training was at the home of Federico Sanchez, the ABCD coordinator. The Cape Cod style house with a partial dormer off the back side, had vinyl siding that was shaped to look like shingles. The pre-weatherization blower door test gave a CFM_{50} of 2700 with the basement door open and a CFM_{50} of 2400 with the basement door closed. The basement was finished to some degree and is used as a family room. The agency usually installs the attic cellulose and a contractor installs the wall cellulose. Agency does all air sealing work. They typically install vinyl v-seal under the bottom rail of double-hung windows (and sometimes vinyl v-seal at the meeting rails). They install sash locks and pulley seals.
3. Topics addressed during training

[18] Unless otherwise noted, these notes are written by Rick Karg.

a. Use of the blower door.
    i. Zeroing properly.
    ii. Using the analog and digital gauges.
    iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
    iv. Walking around house looking for leaks with blower door running.
b. Discussion and calculation of density in one blown wall. Calculated an installed density of 2.0 pounds of cellulose per ft^3 in the east wall (this was with the use of a tube, but it was only three feet long). Left the contractor with a number of blank density calculation sheets.[19] On the west wall the contractor achieved a density of 3.7 pounds of cellulose per ft^3. This was after adjusting the settings on the Krendl 2000 and using a six foot tube in the wall upward and then downward.
c. Special treatment of Cape style house with cellulose to stop airflow through second floor bays.
d. Air sealing around chimney and plumbing stacks.
e. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.
f. Importance of plugging holes at the top of the house first and most importantly.
g. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
h. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They have been typically insulating basement ceilings rather than treating the walls.
i. Dense packing of slopes in Cape house.
j. Handed out the J & R Products catalog[20] to contractors and others.

Training in Bridgeport, Connecticut, April 29, 2003

1. Attending session:
    a. Rick Karg
    b. Eric Beaton, Boston DOE
    c. Glenn Bernard, CT Technical Monitor
    d. Tom Coker, CT Technical Monitor
    e. Robert Bracero, weatherization director for local agency, ABCD
    f. Tyreese Maloy, auditor from New Haven agency
    g. Antoine McCray, auditor from New Haven agency
    h. Augusto Silvany, salesman from National Fiber
    i. Aubyn Clarke, ABCD energy auditor
    j. Federico Sanchez, ABCD energy auditor and coordinator
    k. Nick Resto, ABCD crew
    l. Vincente Roman, ABCD crew
    m. George Perrin, ABCD crew
    n. Ray Perrault, ABCD crew
    o. Contractor performing work (Temp-Check):

[19] These density calculation sheets can be viewed and printed at www.karg.com/insulationdensity.htm.
[20] J & R Products, Inc. is an equipment supplier for residential and commercial insulation installers.

i. Karl Christy (owner)
ii. Kirt Christy
iii. Glenn Christy
iv. Richard Jackson

2. Training was at the home of Federico Sanchez, the ABCD coordinator for the first part of the day. The Cape Cod style house with a partial dormer off the back side, had an vinyl siding that shaped to look like shingles. The pre-weatherization blower door test gave a CFM_{50} of 2700 with the basement door open and a CFM_{50} of 2400 with the basement door closed. The basement was finished to some degree and is used as a family room. Training the later in the day was at the home of Jose and Eva Colon, a large Victorian home with a basement and three full floors. The pre-weatherization blower door test was 6800 CFM_{50} with the basement door closed and door to the third floor open.
3. Topics addressed during training, Sanchez house.
    a. Conducted a "classroom" type training in the basement family room on the topic of zone pressure testing. The contractor's crew members did not attend this session, it was requested and attended by ABCD and New Haven energy auditors.
    b. Post-weatherization blower door readings were 1933 CFM_{50} with the basement door opened and 1720 CFM_{50} with the basement door closed.
4. Topics addressed during training, Colon house.
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
        v. Because the blower door was set up at the kitchen door, which connected to a back porch, Karg used a digital manometer to ensure that the back porch was at the same pressure as the outdoors.
    b. Discussion and calculation of density in one blown wall. Temp-Check had a longer tube – at least eight feet – to use, but because they didn't extend the tube all the way up or all the way down, they did not achieve the desired insulation density.
    c. Air sealing around chimney and plumbing stacks.
    d. Importance of plugging holes at the top of the house first.
    e. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
    f. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They have been typically insulating basement ceilings rather than treating the walls.
    g. At lunch time back at the ABCD facility, showed the Energy Conservatory video of the Indiana house which was very similar to the Colon house. This was very helpful.

Training in Bridgeport, Connecticut, April 30, 2003

1. Attending session:
   a. Rick Karg
   b. Tom Coker, CT Technical Monitor
   c. Robert Bracero, weatherization director for local agency, ABCD
   d. Tyreese Maloy, auditor from New Haven agency
   e. Antoine McCray, auditor from New Haven agency
   f. Aubyn Clarke, ABCD energy auditor
   g. Federico Sanchez, ABCD energy auditor and coordinator
   h. Nick Resto, ABCD crew
   i. Vincente Roman, ABCD crew
   j. George Perrin, ABCD crew
   k. Ray Perrault, ABCD crew
   l. Contractor performing work (Temp-Check):
      i. Kirt Christy
      ii. Glenn Christy
      iii. Richard Jackson
2. Training was at the home of Jose and Eva Colon, a large Victorian home with a basement and three full floors. The pre-weatherization blower door test was 6800 CFM_{50} with the basement door closed and door to the third floor open.
3. Topics addressed during training, Sanchez house
   a. In the morning before going to the Colon house, the group went to the Sanchez house to conduct a zone pressure test. Because we could not reach 50 Pascals of pressure difference at the Colon house, we went back to the Sanchez house for this.
4. Topics addressed during training, Colon house
   a. Use of the blower door.
      i. Zeroing properly.
      ii. Using the analog and new digital gauges.
      iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
      iv. Walking around house looking for leaks with blower door running.
      v. Because the blower door was set up at the kitchen door which connected to a back porch, Karg used a digital manometer to ensure that the back porch was at the same pressure as the outdoors.
      vi. Did not get a final blower door reading because training ended before weatherization was completed.
   b. Discussion and calculation of density in one blown wall. Temp-Check had a longer tube – at least eight feet – to use, but because they did not extend the tube all the way up or all the way down, they did not achieve the desired insulation density. Before contractor left for the day, Karg discussed with them the reasons they were not achieving the proper density in the walls. They seemed to understand.
   c. Air sealing around chimney and plumbing stacks.
   d. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.

e. Treatment of pocket doors with pockets extending to the exterior walls (this house had two). Measured the pressure in the pocket areas with the house at -50 Pascals. Got a -22 in both pocket cavities, demonstrating attachment to the outdoors. We tried to remove the pocket doors for further inspection, but we could not get them off their tracks without a major amount of work. Drilled an observation hole through the outside sheathing into the pocket cavity. Found it would be very difficult to block the air flow. Discussed using a plastic bag blown up with cellulose inserted through holes in the outside wall. Did not do this because we could not access the top of this cavity. Assumed that the energy saved from this difficult process would not be worth the expense.
f. House had a front porch with a finished ceiling space. With the house at a -35 Pascals, got a pressure of -9 in the porch ceiling area, demonstrating some degree of connection between the house and this porch area. We made a temporary hole in the porch roof so that we could inspect the house wall above the porch roof ceiling. We found that there was sheathing in place, but that there were some spaces between sheathing boards. We assumed the cellulose would fill these voids when these walls were blown.
g. Discussed third-floor/attic air sealing issues with Sanchez and Aubyn, including cedar closet spaces, slopes, and flat ceilings. We determined that it was not cost-effective to treat these areas because of the difficulty of access.
h. Showed Sanchez resources on the Internet for zone pressure testing software and other information.

Training in Bethel, Connecticut, May 1, 2003,

1. Attending session:
   a. Rick Karg
   b. Glenn Bernard, CT Technical Monitor
   c. Tom Coker, CT Technical Monitor
   d. Norm Lambert, weatherization director for local agency, NO, Inc.
   e. Fred Rosado, auditor and foreman for agency
   f. O.B. Byrd, crew chief for agency
   g. Richard Lindsay, crew for agency
   h. Sam Otiz, crew for agency
   i. Bob Anders, crew chief for agency
   j. Bermondy Kenyattaia (City), crew for agency
   k. Contractor performing work (American Energy Savers):
      i. Adrian Corici
      ii. Alex Cortez
2. Training was at a ranch style house with wood shingle siding and a full basement. The pre-weatherization blower door reading was 2900 CFM_{50} (the NO, Inc. auditor had found a pre-weatherization blower door reading of 4800 CFM_{50}), the post was 1950 CFM_{50}. The walls were blown, the attic was blown, basement windows repaired, some upstairs windows were repaired, rim joists insulated and doors were weatherstripped.
3. Topics addressed during training
   a. Use of the blower door.
      i. Zeroing properly.
      ii. Using the analog and new digital gauges.

iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
iv. Walking around house looking for leaks with blower door running.
v. The two agency crews present did not know where the blower door rings were, so they could not properly zero their manometer or take baseline, nor could they get accurate readings on tight dwellings. We discussed the importance of the rings; by the end of the day Norm Lambert had gone back to the office to find a set of rings to use.

b. Discussion and calculation of density in one blown wall. Calculated an installed density of 3.0 pounds of cellulose per ft^3 in the east wall (this was with the use of a tube, but it was only three feet long). Left the contractor with a number of blank density calculation sheets. The contractor was using a modified tubing method, but instead of using a tube, he was using 2 ½" hose in the wall. Karg gave him a J & R catalog and informed him of the tubing method. The contractor's blowing machine was very large and powerful.
c. Air sealing around chimney and plumbing stacks.
d. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.
e. Importance of plugging holes at the top of the house first and most importantly.
f. They had been putting rim joist insulation in incorrectly for years, with the craft paper to the outdoors. This was corrected on this house.
g. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They have been typically insulating basement ceilings rather than treating the walls.
h. Handed out the J & R catalog to contractors and others.
i. Agency crews have not been venting dryers.

Training in, Danbury, Connecticut, May 2, 2003

1. Attending session:
   a. Rick Karg
   b. Glenn Bernard, CT Technical Monitor
   c. Tom Coker, CT Technical Monitor
   d. Norm Lambert, weatherization director for local agency, NO, Inc.
   e. Fred Rosado, auditor and foreman for agency
   f. O.B. Byrd, crew chief for agency
   g. Richard Lindsay, crew for agency
   h. Sam Otiz, crew for agency
   i. Bob Anders, crew chief for agency
   j. Bermondy Kenyattaia (City), crew for agency
   k. Vinnie Ferguson, weatherization director for New Haven agency
   l. Contractor performing work (American Energy Savers):
      i. Adrian Corici
      ii. Alex Cortez
2. Training was at a ranch style house with vinyl siding and a full basement. The pre-weatherization blower door reading was 3800 CFM_{50} (the NO, Inc. auditor

had found a pre-weatherization blower door reading of 5200 CFM_{50}), the post was 3727 CFM_{50}. The walls were blown, the attic was blown, rim joists insulated, installed Energy Guardian attic hatch, some upstairs windows were repaired, and doors were weatherstripped.

3. Topics addressed during training
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussion and calculation of density blown walls. The contractor was using a modified tubing method, but instead of using a tube, he was using 2 ½-inch hose in the wall. Karg gave him a J & R catalog and informed him of the tubing method. The contractor's blowing machine was very large and powerful.
    c. Air sealing around chimney and plumbing stacks.
    d. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.
    e. Importance of plugging holes at the top of the house first and most importantly.
    f. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They have been typically insulating basement ceilings rather than treating the walls.
    g. Handed out the J & R catalog to contractors and others.
    h. Agency crews have not been venting dryers.

Karg's discussions with Augusto Silvany, sales representative for National Fiber, manufacturers of cellulose insulation

1. Talked with him about National Fiber providing high-density wall insulation training for programs in the New England states.
2. Discussed possibility of printing a new table on insulation package for 3.5 pounds per ft^3 (now there is a table for 2.7 pounds per ft^3).
3. He said I should stop in for lunch sometime at the facility at 50 Depot Street, Belchertown, MA 01007 413-283-8747 or 800-282-7711.

General Observations and Recommendations for State of Connecticut Weatherization Program

[These observations have been deleted from this document for general distribution]

Glenn Bernard and Tom Coker Report on Connecticut Training

One-on-One On Site Training with Rick Karg
April 28, 2003 through May 2, 2003
Connecticut Summary Report

Connecticut hosted a full week of training by Rick Karg, of R. J. Karg Associates on the above dates. For background information, Connecticut has five Weatherization Program operators. Two of these programs are crew based and three are contractor based. These programs operate with a combination of USDOE and utility funding. There is no state or LIHEAP funding available for the program at this time.

The program is administered by the State of Connecticut Department of Social Services, which has two Program Specialists (Glenn Bernard and Tom Coker) that monitor program activity. All work done is determined by the utility funded WRAP energy audit. An individual audit is done for each job.

Preparation:
The initial reports from Rick and Andy Gray, concerning the two days of training in New Hampshire, were very helpful in our preparation for this training. We decided to concentrate our training on our two crew-based agencies. The logic was that they would be more receptive to the training. After initial consultations with the two agencies to be trained and Rick, we decided that he should concentrate his efforts on teaching the procedures necessary for achieving optimal insulation density (dense packing), blower door guided air sealing and time permitting, an introduction to zone pressure diagnostics.

We felt that it was very important to give the agencies targeted for training as much opportunity as possible to provide input on what kind of training they wanted. We stressed that this was their training and we encouraged them to take an active role. This worked out very well and we recommend that other states use the same approach. We also put Rick in direct contact with the Weatherization Directors he would be working with, so they would have an opportunity to discuss each other's concerns and expectations informally over the phone. This helped cultivate their comfort level with each other. Logistical information concerning directions and recommendations for lodging was also provided at this time, which worked out well.

It was also important to give the Auditors at each agency plenty of time to find suitable sites and clients willing to put up with a crowd. Client related variables were our greatest concern. Because of this, each agency had a backup site ready to work on besides their two primary sites.

On Site Training – Bridgeport:
Our initial training was held at ABCD, Inc. in Bridgeport on Monday, April 28th through Wednesday, April 30th. Rick met the ABCD crew first thing in the morning at the weatherization office. Also present was the regional sales rep. for National Fiber, the company that supplied the cellulose for the job and an insulation contractor out of New York that does Weatherization Program work in both states. They were both interested in learning more about dense pack insulation techniques. All materials needed for the job

that day were already loaded on the truck and ready to go. After initial introductions were made, Rick reviewed the training goals again and then the work order for the first job. He stressed that he was there to help, not check up on them, which was also helpful.

We then caravanned to the job site, which was just a short distance away. The insulation contractor (Temp-Check Insulators) and his crew met us at the house. They had already been briefed on the goals of the training, so Rick didn't have to spend too much time getting them up to speed. The house was a single-family cape built in the 1950s. While the insulation crew began preparing the walls for blown cellulose, Rick did a walk through with the ABCD auditors and crew. They then set up the blower door to conduct a test. Rick spent a considerable amount of time going over proper set-up procedures and use and maintenance, which were good, because over time, bad habits can set in. After identifying the major air leakage areas in the attic and basement, Rick got the ABCD crew started on the air sealing work. The insulation crew was now ready to begin blowing. They had been introduced to the single hole, tube fill, method previously, but the tube they were using was too short, which resulted in inconsistent density throughout the stud bays. With his bag count method, Rick was able to show them the higher density that could be achieved with a longer tube. Rick also trained the auditors to calculate density, using his bag count method. Lunch was provided on site, to save time, which we highly recommend to others. By the end of the day, all the walls were insulated, and the attic and basement were air sealed (foundation perimeter, joists below knee walls, chimney and plumbing chases). On the second day, the insulation contractor completed all the attic blowing (floors behind knee walls, slopes and peak) and the ABCD crew finished all their work. The difference between the pre and post blower door results was significant. Also on the second day, Rick gave an introduction to zone pressure diagnostics, which was followed up afterwards with a demonstration.

By the time work was completed on the first house, we were well into the afternoon. Fortunately, the second house was just a short distance away and we were able to get started there. This house presented an interesting change of pace. It was a very large two story colonial, built around 1910, with 10-foot ceilings and a very spacious, walk up attic, that the owner had partially finished. As he did on the first job, Rick reviewed the work order and did a walk through with ABCD and the insulation contractor. There were many challenges here, such as complicated porch/wall interfaces, balloon framing bypasses, large bay windows and pocket doors open to the outside walls. The electrical system had been upgraded previously, so knob & tube wiring was not an issue here. The entire next day, which was Rick's last day in Bridgeport, was spent on this house. The ABCD crew completed most of the insulation/insulation prep work and Temp Check Insulators spent the day insulating the sidewalls using the techniques Rick had taught them at the first house. Rick came up with an innovative idea to address the open pocket doors. He suggested stuffing large plastic bags through the drill holes in the stud bays to contain the cellulose and seal the openings to the pocket doors. The job was completed the following day.

On Site Training – Waterbury:
Rick's last two days in Connecticut were spent with the crew from New Opportunities, Inc. and their primary insulation contractor, American Energy Savers, Inc. The two houses they selected were both single-family ranches, in Bethel and Danbury. Because

of the considerable distance from the Weatherization office in Waterbury, everyone met at the job sites both days. Rick conducted his training here in a very similar manner, however because the New Opportunities crew is not as advanced, with insulation practices as the previous crew was, he had to adjust his approach somewhat, which he skillfully managed to do. The work orders for both homes called for insulation of the walls, attic and basement ceiling. This presented two excellent opportunities to discuss the pros and cons of basement ceiling insulation, the importance of which has been de-emphasized in Connecticut recently. Ultimately, it was decided on both homes that the basement ceiling would not be insulated and we would address the basement perimeter instead. Rick's training with the insulation crew on these jobs went very well. They have been using the two hole (no fill tube) method exclusively. After seeing for themselves how much more effective the single hole, tube fill, method is, and how much time it saves, they were definitely sold on the new procedure. They agreed to use this procedure on their future jobs and they will use the bag count density calculation that Rick taught them to monitor their performance. The New Opportunities crew also benefited greatly from this training. Their skill level and confidence with blower door guided insulation work is much improved.

General Comments:
Overall, we were very pleased with this training and the feedback that we have received from everyone involved is very positive. We would like to thank the Boston Regional Office, Eric and Lois in particular, for their assistance in making this training possible. We would also like to thank Steve Eckberg and Andy Gray for their efforts in making this possible. We think Rick did an excellent job and we highly recommend more of this type of training in the future.

Maine

Training in Smyrna, Maine, August 25, 2003

1. Attending session:
    a. Rick Karg
    b. Tony Gill, State Monitor
    c. Jim Baillargeon, ACAP Housing Director
    d. George Tobin, ACAP auditor
    e. Pete Delano, ACAP auditor
    f. Barry Clark, ACAP crew
    g. Rodney Roy, ACAP crew
    h. Dale Ouellette, ACAP crew
    i. Contractor
        i. Jim Collins, owner
        ii. Brock Graford

Readying cellulose for wall blow in Maine

2. Very large two story farm house rented to a number of tenants. The blower door test gave a CFM_{50} of 7000 with the basement door closed. The house has an oil-fired furnace in a very wet basement. It was difficult to determine the most reasonable borders for the thermal envelope.
3. Topics addressed during training:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussed attic bypasses and the correct way of treating.
    c. Discussed how to determine whether air leakage at kitchen cabinets is from outdoors or from the basement.
    d. Related to just above, discussed that basement air leakage often originates in the attic.
    e. Tested ACAP and contractors blowing machines for static pressure at the takeoff.
        i. ACAP's Force 2 produced 90 inches of water or 3.25 psi.
        ii. Contractor's Krendl 200 produced 55 inches of water or 2 psi. This contractor has just purchased a new $800 blower (externally mounted) for this machine.
        iii. Need 77 inches of water or 2.8 psi static at takeoff for capacity to dense pack walls.
    f. Talked about rigidity of tubes for blowing walls and the proper way to reduce hose to tube to reduce chance of clogging.
    g. Karg did a number of core samples to check for insulation density. Found samples from 1.3 to 4.5 pounds per cubic foot.
    h. ACAP adjusted their Force 2 machine (same air for less material) to get the proper density.

i. Jim Collins, the contractor, was never able to dense pack a wall with his substandard insulation machine.

Training in Montville, Maine, August 26, 2003

1. Attending session:
    a. Rick Karg
    b. Tony Gill, State Monitor
    c. Larry Horvath, WCCSA auditor for this job.
    d. Tom Brown, PCAP auditor
    e. Skip Butler, PCAP auditor
    f. Elliott Decker, CED auditor
    g. Bill Trufant, CED auditor
    h. Hal Barter, CED auditor
    i. Paul Sheppard, CCAP auditor
    j. R. Skidgell, contractor
        i. Ray Skidgell, owner
        ii. Rich Tervo
    k. Morgan Contracting
        i. Earleen Morgan, owner
        ii. Nathan Felch
    l. Frye Mountain contractor (this contractor was responsible for completing the work)
        i. Paul Jameson, owner
        ii. Bryan Clark
2. Story and one-half farmhouse lived in by elderly woman. Wood stove for heat. The blower door test pre-weatherization yielded a CFM_{50} of 5775 with the basement door closed. The house has a dry basement that was considered to be within the borders of the thermal envelope.
3. Topics addressed during training:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussed attic bypasses and the correct way of treating.
    c. Discussed how to determine whether air leakage at kitchen cabinets is from outdoors or from the basement.
    d. Related to just above, discussed that basement air leakage often originates in the attic.
    e. Tested contractors blowing machines for static pressure at the takeoff.
        i. Frye Mountain's primary Force 2 produced 2.9 psi (OK).
        ii. Frye Mountain's secondary Force 2 produced 1.2 psi (substandard).
        iii. Morgan Contracting Force 2 produced from 0.5 to 3.0 psi (this unit probably had very bad seals that need replacing).
        iv. Skidgell's Krendl 1000 produced 3.2 psi (OK).
        v. Need 2.8 psi static at takeoff for capacity to dense pack walls.

f. Talked about rigidity of tubes for blowing walls and the proper way to reduce hose to tube to reduce chance of clogging.
g. Each of the contractors blew some wall areas.
h. Karg did a number of core samples to check for insulation density. Found samples from 1.7 to 4.7 pounds per cubic foot. Skidgell was the only contractor that was able to dense-pack walls with his insulation blowing machine.

Cellulose core sampling kit

i. All auditors and contractors were able to see the core sampling procedure.
j. The wall cavities in this house were as wide as 32 inches. These wide cavities presented difficulties for the tubing process. It seemed that the tubes often bend back on themselves, making it very difficult to apply cellulose at the proper density in all areas of the cavity. We found that more rigid tubes are needed for wide cavities than for normal 16 inch wide cavities.
k. Frye Mountain blew cellulose behind knee wall on second floor with three inch hose (not tube). Although no core sample was possible here, the density seemed to be higher that 3.25 pounds per cubic foot.
l. Passed out and explained the density calculation sheet to the auditors present.

Training in Montville, Maine, August 27, 2003

1. Attending session:
    a. Rick Karg
    b. Tony Gill, State Monitor
    c. Larry Horvath, WCCSA auditor for this job.
    d. Norm Wacker, KVCAP auditor
    e. Gerry Smith, KVCAP auditor
    f. Bruce Mathews, KVCAP auditor
    g. David Baker, KVCAP auditor
    h. Gary LaGrange, WMCA auditor
    i. Randy Burguess, WMCA auditor
    j. Diane Haley, WMCA auditor-to-be
    k. Ed Turner, WHCA auditor
    l. Allen Slater, WHCA auditor
    m. Paul Sheppard, CCAP auditor
    n. WHCA crew
        i. Mason Phillips
        ii. Ernie Hedberg
    o. Triple-D Builder, contractor
        i. Dan Hood

ii. Lisa Hood
iii. Bill Annis

p. Bangor Abatement, contractor
i. Kevin Littlefield
ii. Travis Kimball

q. Frye Mountain, contractor (this contractor was responsible for completing the work)
i. Paul Jameson, owner
ii. Bryan Clark

r. F & E Builder, contractor
i. Frank Stevens, owner
ii. Everett Conkey, owner
iii. Mike Waven
iv. David Lisherness
v. Richard Wilcox (Radar)
vi. Dale Ouellette
vii. Dan Agren

s. Jay Johnson, AJ's Construction, contractor

2. Same house as previous day. Story and one-half farm house lived in by elderly woman. Wood stove for heat. The blower door test pre-weatherization yielded a CFM_{50} of 5775 with the basement door closed. The house has a dry basement that was considered to be within the borders of the thermal envelope.
3. Topics addressed during training:
   a. Use of the blower door.
      i. Zeroing properly.
      ii. Using the analog and new digital gauges.
      iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
      iv. Walking around house looking for leaks with blower door running.
   b. Discussed attic bypasses and the correct way of treating.
   c. Tested contractors blowing machines for static pressure at the takeoff.
      i. Frye Mountain's primary Force 2 produced 2.9 psi.
      ii. Frye Mountain's secondary Force 2 produced 1.2 psi.
      iii. WHCA Krendl 450A produced 3.0 psi (made no difference when the dirty filter was removed).
      iv. Bangor Abatement's Krendl 450 produced 2.0 psi.
      v. F & E Builder's Krendl 2090 produced 4.3 psi.
      vi. F & E Builder's Krendl 450 produced 4.5 psi.
      vii. F & E Builder's shop vacuum produced 2.0 psi.
      viii. Need 2.8 psi static at takeoff for capacity to dense pack walls.
   d. Talked about rigidity of tubes for blowing walls and the proper way to reduce hose to tube to reduce chance of clogging.
   e. Each of the contractors and crew blew some wall areas.
   f. Karg did a number of core samples to check for insulation density. Found samples from 0.9 to 4.4 pounds per cubic foot. F & E Builders were the only contractor that was able to dense-pack walls with their insulation blowing machine. We found that in the narrower 16-inch cavities it was much easier to get the proper density.

g. All auditors and contractors were able to see the core sampling procedure.
h. The wall cavities in this house were as wide as 32 inches. These wide cavities presented difficulties for the tubing process. It seemed that the tubes often bend back on themselves, making it very difficult to apply cellulose at the proper density in all areas of the cavity. We found that more rigid tubes are needed for wide cavities than for normal 16 inch wide cavities.
i. Passed out and explained the density calculation sheet to the auditors present.
j. After lunch, Karg gave a ten-minute talk about the pros and cons for dense packing walls. These are:
    i. No settling of insulation.
    ii. Stops airflow through insulation.
    iii. Good sound insulation.
    iv. Dense packing takes more material.
    v. Dense packing takes longer.
    vi. Dense packing may damage interior walls.
k. Karg also discussed what we had learned at this house after a day and one-half of attempting to dense-pack walls:
    i. The width of the cavity has an influence on the density of the insulation. It seems to be easier to dense pack a narrow cavity than a wider cavity.
    ii. For wider cavities, stiffer tubes are needed so that the tube does not come around on itself (point downward) when inserted.
    iii. Perhaps it is best to drill fill hole at the vertical middle of the wall cavity so that the tube can be inserted up and then down, keeping the inserted tube length as short as possible.
    iv. Pressure relief within the cavity in an old house because of leakage to adjacent cavities may allow for a higher density and lessen the possibility of interior wall damage compared with a newer house with tighter wall cavities (drywall). If this is true, it is probably not as important to achieve as high a density in tighter houses with drywall for the walls are tighter to begin with, so why dense pack them if the benefits of air leakage reduction from the high density cellulose will not be realized? Additionally, in tighter houses with drywall, the likelihood of interior wall damage is greater.
    v. The end of the tube must be within a few inches of where the wall is to be dense packed.
    vi. The air-to-material ratio is very important for density. This ratio must be increased to increase density.
    vii. If blowing machines have filters, they should be cleaned weekly.
    viii. Blowing machines need to be properly maintained to produce high enough static pressure to dense pack.
l. One of the contractors constructed a box with Plexiglas on one surface to simulate a small wall cavity. We blew the box with cellulose to watch the pattern and inspect the density. With a nozzle blow, the Plexiglas burst. It was out good fortune that nobody was injured by the flying Plexiglas.

Training in Saco, Maine, August 28, 2003

1. Attending session:
    a. Rick Karg
    b. Tony Gill, State Monitor
    c. Todd Anges, PROP auditor
    d. Randi Curato, PROP auditor
    e. Joe Booth, PROP construction supervisor
    f. George Duranleau, YCCAC auditor
    g. Charlie Allen, CCI auditor
    h. Ray Thompson, CCI auditor
    i. Hollis Construction, contractor responsible for completing job
        i. Hollis Micklin, owner
        ii. Hollis Miklin, Jr
    j. M & J Construction, contractor
        i. Mike Daniels
        ii. Jim Micklin
    k. Darling Weatherization, contractor
        i. Frank Darling
        ii. Karen Darling
    l. Riverside Builders, contractor
        i. Steve Giobbi
        ii. Eric Huber
2. Two-story house with aluminum siding and full walk-up attic. House had already been insulated by a weatherization contractor, but had been done poorly. The house had a basement that was considered to be within the borders of the thermal envelope.
3. Topics addressed during training:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussed attic bypasses and the correct way of treating, including chimney chase treatment.
    c. Tested contractors blowing machines for static pressure at the takeoff.
        i. Hollis Construction's Krendl 1000 produced 4.0 psi.
        ii. Darling Weatherization's Krendl 200 produced 2.0 psi.
        iii. Need 2.8 psi static at takeoff for capacity to dense pack walls.
    d. Talked about rigidity of tubes for blowing walls and the proper way to reduce hose to tube to reduce chance of clogging.
    e. Karg took a number of core samples and demonstrated to all how this is done. The density of the installed cellulose varied from 1.5 (Darling machine) to 4.2 (Hollis machine) pounds per cubic foot. The core sample with the highest density had two unfilled holes at the top of the cavity that were not plugged, but covered by the aluminum siding (these holes were apparently left by the previous contractor. This example adds credence to the idea that a wall that is open to adjacent cavities will reach a higher

density if the machine has the capability to dense pack. Rather than the pressure relief in this case being supplied by openings to other wall cavities, it was supplied by the open holes under the aluminum siding.

f. Unlike the house in Montville with wide cavities (some as wide as 32 inches), this house had 16-inch wide cavities. Tubing these walls was much easier than in the Montville house. Hollis Micklin mentioned that he thinks he knows when the tube comes back around on itself because as he pulls the tube out it the tube will kink because the geometry of the cavity is changed. In this case the tube often clogs and must be pulled out and rammed in again.

Training in Winthrop, Maine, October 14, 2003

1. Attending session:
    a. Rick Karg
    b. Tony Gill, State Monitor
    c. Ed Marsh, MSHA Rehab Specialist
    d. Roger Bondeson, Wx Program Director
    e. Norm Wacker, KVCAP auditor
    f. Gerry Smith, KVCAP auditor
    g. Mark Page, YCCAC auditor
    h. Riverside Builders, contractor
        i. Steve Giobbi
        ii. Eric Huber
    i. F & E Builder, contractor
        i. Frank Stevens, owner
        ii. Everett Conkey, owner
        iii. Mike Waven
        iv. David Lisherness
        v. Dale Ouellette
        vi. Dan Agren
    j. Jay Johnson, AJ's Construction, contractor
2. This house in Winthrop was used for approximately two weeks in May for the Maine energy auditor field certification event, so Gill, Karg, and any energy auditors attending on this day were familiar with the house on Greenwood Street. The asbestos and wood clapboard siding was removed by the homeowner in preparation for new vinyl siding. The roof will be replaced as will the hydronic oil-fired heating system. A back shed will soon be torn down.
3. Topics addressed during training:
    a. Blower door set up and use with both the analog and digital gauges. This was done first thing in the morning (4800 CFM_{50}) and again the last thing with another blower door.
    b. Most of the time together was spent in the shed where Tony Gill had fastened a 4 foot by 8 foot sheet of Lexan over two stud cavities. The homeowner's son was paid to take video footage of the three tests performed in these two cavities.[21] All test blowing was done with the F &

[21] A slide show of these cellulose wall blowing experiments can be viewed and printed at www.karg.com/insulationdensity.htm.

M Krendl 2090 insulation blowing machine. The tests performed included:[22]

i. With the blowing machine off, tubes of different wall thickness and rigidity (winter and summer) were inserted into a fill hole within six inches of the bottom of each bay. As a technician on the outside of the shed inserted the different tube, all others were able to observe the path of the tube from the inside. The tube judged the best by the observers was the summer-grade tube from Applied Energy Products in Ohio (Karg has acquired a ten foot sample of this tubing the day before).

ii. Test #1 – In both bays the fill tubes were inserted from the bottom of the bay about six inches from the bottom of the bay (the bottom of the bay was not a wooden plate, but was unfaced fiberglass stuffed tightly enough so that the pressure of the blowing insulation did not move the fiberglass plug in either bay). In the right cavity the tube was a summer-grade but too flexible to enter the 22 inch-wide cavity without curling.[23] In this bay, the insulation was blown in with the tube initially pointing downward. A core sample was taken 17 inches down from the top of this bay found an insulation density of 3.1 lb/ft^3. Another core sample 49 inches from the top of the bay also found an insulation density of 3.1 lb/ft^3. It should be noted that when the blowing machine was turned on, the end of the curled tube moved from pointing downward at about 7:00 o'clock to pointing slightly upward at about 10:00 o'clock. In the left bay the favored summer-grade tube from Applied was used. This tube end was at the upper corner formed by a stud and top plate when the insulation machine was turned on. This was assumed to be the best place from which to begin the bay fill when dense packing from a bottom hole. The settings on the Krendl blower were the same for each bay (air on 7 for both blowers and feed set at 3). A core sample was taken 17 inches down from the top of this bay found an insulation density of 5.6 lb/ft^3. Another core sample 49 inches from the top of the bay found an insulation density of 3.6 lb/ft^3. This test demonstrated the importance of using a fill tube rigid enough not to curl in a bay.

Wall Blow Experiments in Maine

[22] Four hours of video tape was taken of these wall insulation experiments. Maine State Housing Authority (MSHA) has the intention of editing this raw video footage down to a fifteen to twenty minute training video. Contact Tony Gill at MSHA for details (tgill@mainehousing.org).

[23] As a result of findings from a previous day of O⁴S Maine training, Karg and Gill were suspicious that the fill tube often curled around and pointed downward in wide bays.

The Lexan was then removed and the cellulose was removed from the two bays and reused in the insulation blowing machine.

iii. Test #2 – For the second set of tests a center fill hole was used in both the right and left bays. The Applied Energy Products summer-grade tube was used in both bays. In the left bay we blew upward first and then downward (the most common and most often recommended sequence) and in the right bay we blew downward first and then up upward. After the bays were blown, core samples were taken 17 inches, 49 inches, and 79 inches down from the top of the two bays. In the left bay (up and then down blow), we found the respective densities of 5.4, 4.5, and 4.0 lb/ft^3. In the right bay (down and then up blow), we found the respective densities of 4.6, 5.8, and 4.8 lb/ft^3. It should be noted that just after the change in direction of the tube from downward to upward in the right bay, the material feed was turned off so that only air came out the end of the tube. This air-only exiting the end of the tube appeared to do a good job of "drilling" through the cellulose already in the top one-half of the bay. This "air drilling" probably was partially responsible for the high mid-cavity density in the right bay.

iv. Test #3 – For the third and final set of tests, the left bay was blown with the Applied Energy Products summer-grade tube from the fill hole about six inches from the fiberglass plug that formed the bottom of the bay (the same fill hole used for test #1). The 1 ¼-inch inside diameter tube was pushed all the way to the top plate of the cavity before the insulation machine was turned on. The settings on the Krendl 2090 blowing machine were set to simulate a machine that was not capable of producing at least 2.8 psi static pressure at the takeoff of the machine (these settings on the Krendl machine were 1 ½ air on one blower – the other blower was off – and a setting of 4 on the material feed).[24] In the right bay we installed the cellulose using the inferior two-hole method with the *proper* settings on the Krendl blowing machine (air on 7 for both blowers and feed set at 3). The 1 ¼-inch inside diameter tube was pointed straight into the lower hole pointing at 90 degrees to the wall surface. The lower hole was 83 inches from the bottom of the top plate. The top hole – 17 inches from the bottom of the top plate and the same hole as that core sampling hole – was plugged with fiberglass while the blowing the bottom hole. Then the top hole was used to complete the filling of the bay. After the bays were blown, core samples were taken 17 inches, 49 inches, and 79 inches down from the top of the two bays. In the left bay (low setting on Krendl machine), we found the respective densities of 2.3, 2.9, and 2.5 lb/ft^3. In the right bay (two-hole method with proper settings on the Krendl machine), we found the respective densities of 4.6, 2.9, and 2.1 lb/ft^3. The high density at the top hole

[24] The static pressure at the Krendl machine takeoff with these settings was 2.6 psi, a static pressure of 2.8 psi is required for a dense-pack density in a wall cavity (3.25 to 3.75 pounds per cubic foot).

of the right bay probably resulted from the fact that the fill hole and the core sampling hole were one in the same. For each of these methods (inferior blower machine characteristics and the two-hole method with superior blower machine characteristics) the resulting densities were unsatisfactory.

General Observations and Recommendations for State of Maine Weatherization Program

[These observations have been deleted from this document for general distribution]

Tony Gill Report on Maine Training

One-On-One On-Site Training
Summary Report
Maine State Housing Authority
Augusta, Maine

Maine chose to use the opportunity provided by the One-On-One On-Site (O^4S) Training to upgrade our installer's knowledge of dense-blow cellulose installation practices. Our general goals were to:

- establish standards and evaluation methods,
- instruct installers on proper machine settings and installation techniques,
- test contractor insulation blowers for capacity to deliver dense blow cellulose &
- inform contractor management of WAP requirements and evaluation methods.

To do this we conducted the two distinct activities described below.

For the first, because we wanted to cover the entire state, we arranged with conveniently located CAAs for the use of three appropriate client homes, one North, one central and one South. We held four sessions of one day each, using the centrally located home twice. All weatherization contractors were required to attend at least one full day. (They were reimbursed at $20/hr/man for attending.) CAA Weatherization Auditor/Inspectors were encouraged to attend also. Over the four days, 36 installers representing eleven independent contracting firms & two CAA crews as well as twenty-five Auditor/Inspectors from Maine's eleven CAAs attended the training. There was also one CAA Housing Director present.

Rick Karg of R. J. Karg Associates conducted the trainings. Each day began with a short on-site class room type discussion covering:

- dense blow pros and cons,
- measure standards,
- machine requirements,
- installation methods &
- measure evaluation methods.

The discussion generally took about ½ hour. It was followed each day by a tour of the home with interactive dialogue about the best measures to install and why they should be

chosen. Each time the tour concluded with a hands-on blower door demonstration. Each day the most experienced contractor present was selected to be "lead contractor" and asked to demonstrate his technique(s) for installing dense blow cellulose after his machine was tested for the capacity to do so. The contractor demonstrations were followed by hands-on practice by all present, after which the others installers were asked to set up their machines for testing and instructed to blow sections of wall under Rick and the lead contractor's supervision. When sufficient walls had been completed, Rick demonstrated the dense blow evaluation process. All four days this exercise generated considerable interest, with the events becoming friendly competitions.

Without question, the four days of installer training were a success. As a direct result of Rick's expert instruction and the "how-to" interactive discussions among all present that he fostered, a general consensus agreement about methods and standards was reached each day. An unexpected result was a general awareness that more work needs to be done to establish a proper dense blow cellulose standard. Prior to this training we were under the impression that a universal "number" for judging all types of dense blow cellulose was not only possible but sensible. We quickly learned that a different, wall construction type specific number must be developed. For example, proper cellulose blower settings for a lath & plaster/ board wall construction will destroy the drywall in a drywall/plywood assembly. Because the blower settings – in conjunction with installer proficiency – determine the installed density, a different density becomes not only acceptable but necessary for different cavity assemblies. MSHA is presently working with Rick and Maine's Building Technical Committee to develop these numbers.

Maine's remaining O^4S day was used at a centrally located client home where we ran the Senior Auditor Evaluation exercise earlier in the year. Over the years, the home had been insulated using a variety of amateur and professional techniques. Again, Rick started the day with a classroom type presentation covering dense blow cellulose and blower door technique, followed by a house tour and blower door demonstration. The latter part of the day was spent having the lead contractor demonstrate methods of upgrading various types of existing wall cavity insulation to true dense blow. All attendees then got hands-on practice with each type. Eleven installers representing three sub-contractor firms and four CAA Auditor/Inspectors attended. (For this exercise, unlike the previous one, we did not require attendance. Distance was prohibitive.)

The home also had an attached shed which was about to be demolished by the homeowner. Construction was board sheathing with clapboard siding. The interior was unfinished with exposed 24" OC 2"x4" studs. As part of the training we installed a sheet of Lexan™ over two wall bays and repeatedly blew them using various machine settings, hole patterns and blowing techniques. All the contractors present were intensely interested in seeing what actually happened in a wall while it was being blown. Extensive discussion about the pros and cons of practically every conceivable scenario and technique filled several hours. The process was filmed. We are now developing a training video from the four plus hours of raw footage which will be used for recruiting and training potential weatherization contractors as well as a refresher for existing installers.

We will also create a blower door training video from footage that was created the same day. This second video will be targeted to contractors obtaining blower doors for the first time under MSHA's ongoing initiative to make blower doors a generally accepted weatherization contractor "tool of the trade" in Maine.

Maine State Housing Authority would like to thank DOE and the BRO for providing the funding to allow these very productive exercises.

Massachusetts

Training in New Bedford, Massachusetts, April 15, 2003

1. Attending session:
    a. Rick Karg
    b. Dave Fuller, MA Technical Monitor
    c. Roi Pires, auditor for local agency
    d. George Allen, auditor for local agency
    e. Contractor (Energy Doctor):
        i. Charlie Delisle (owner)
        ii. Chris Ripanty (foreman)
        iii. Bob Martins
        iv. Jeff Machado
        v. Dan Lincoln

Attic blow through roof in Massachusetts

2. House on 68 Pierce Street in New Bedford was a two-story home with a full basement and forced hot air heat. The CFM_{50} pre-weatherization was 4100, not including the front porch room. After blowing one wall (measured 2.9 pounds/ft^3 density), sealing the chimney chase, and sealing a missing attic hatch in a closet, the CFM_{50} went down to 3259.
3. Topics addressed during training
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussion and calculation of density in one blown wall. Calculated an installed density of 2.9 pounds of cellulose per ft^3. Left the contractor with a number of blank density calculation sheets.
    c. Discussed the tubing methods for dense packing walls. The contractor had never used this method. He did not have the tubes and equipment to do it. Gave him the telephone number of J & R Supply for equipment.
    d. Discussion of recessed lighting fixture treatment and chimney chase treatment. The contractor thought that insulation must be held back one foot from the chimney.
    e. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.
    f. Importance of plugging holes at the top of the house first and most importantly.
    g. Discussion of duct sealing, the difference between doing for energy savings and for health and safety.
    h. Interesting questions came up: If we run the blower door and then fill some holes, won't more air just come through the remaining holes? No, because the pressure across the remaining holes is still 50 Pascals for the second blower door test.

Training in Medway, Massachusetts, April 16, 2003

1. Attending session:
    a. Rick Karg
    b. Dave Fuller, MA Technical Monitor
    c. Jim Nolan, auditor for local agency
    d. Ken Jacobson, auditor for local agency
    e. Contractor (EnergyGuard):
        i. Joe Sheridan (owner)
        ii. James Clinton (foreman)
        iii. Matt Ferreira
        iv. Marlin Ramos
        v. Douglas Cunningham
2. House on 20 Charles River Road in Medway was a raised ranch home (from front door, one-half flight of stairs up, and one-half flight of stairs down) with forced hot air heat. The CFM_{50} pre-weatherization was 3300. After blowing three walls (measured densities from 2.2 to 3.0 lbs/ft^3) and attic, the CFM_{50} went down to 2400. By the end of the day, after all wall insulation was installed and all overhangs were blown, the CFM_{50} was down to 1800.
3. Topics addressed during training
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
        v. The blower door the contractor had was defective. The flow ring was broken and was duct taped to the fan (three of the four calibrated holes were obscured). Got a reading of 1400 CFM_{50} from this bad fan. Got 3300 CFM_{50} from a good fan. We were able to get a good blower from a nearby Conservation Services Group auditor.
    b. Discussion and calculation of density in all four blown walls. Calculated an installed density of 2.2, 2.7, 3.0, and 3.2 pounds of cellulose per ft^3 as the day went on. Contractor attempted to increase density during the day by altering blower settings and methods. Left the contractor with a number of blank density calculation sheets. Had the auditors and contractor calculate density for each wall.
    c. Discussed the tubing methods for dense packing walls. The contractor had never used this method. He did not have the tubes and equipment to do it. Gave him the telephone number of J & R Supply for equipment.
    d. Discussion of recessed lighting fixture treatment and chimney chase treatment.
    e. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.
    f. Importance of plugging holes at the top of the house first and most importantly.
    g. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.

Training in North Attleboro, Massachusetts, April 17, 2003

1. Attending session:
    a. Rick Karg
    b. Wes James, MA Technical Monitor
    c. Jim Nolan, auditor for local agency
    d. Mike Childs, auditor for local agency
    e. Jonathan Quintal, auditor for local agency
    f. Contractor (Borges and Son):
        i. Steve Borges (owner)
        ii. Dan Carreiro
        iii. Robert Mota
        iv. Scott Napert
2. House on 183 Jefferson Street in North Attleboro was a one-story house with a crawl space, forced hot air heat, and rather delicate interior walls. The CFM_{50} pre-weatherization was 3650. By the end of the day, after all wall insulation was installed – at an intentionally low density to prevent problems to the interior wall finish – the attic was blown, and some significant air sealing was done in the crawl space, the CFM_{50} was down to 2900. Still much sealing to be done in the crawl space. Found code violation for water heater venting and leaking oil tank (outdoor tank).
3. Topics addressed during training
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussion and calculation of density in blown walls. Calculated an installed density of 1.6 pounds of cellulose per ft^3. Had the auditors and contractor calculate for each wall. Contractor said he would calculate density on each job from now on and put calculation in client file.
    c. Discussed the tubing methods for dense packing walls. The contractor had never used this method. He did not have the tubes and equipment to do it. Gave him the telephone number of J & R Supply for equipment.
    d. Discussion of recessed lighting fixture treatment and chimney chase treatment.
    e. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.
    f. Importance of plugging holes at the top of the house first and most importantly.
    g. Discussion of treating the crawl space as conditioned area rather than unconditioned, and the ramifications of each.
    h. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.

Training in Dracut, Massachusetts, April 18, 2003

1. Attending session:
    a. Rick Karg

b. Wes James, MA Technical Monitor
c. Ron Marchildon, auditor for local agency
d. Ray Carvel, auditor for local agency
e. Fred Girard, auditor for local agency
f. Robbin Rozzi, auditor for local agency
g. Contractor (Mass Weatherization):
    i. Dick Lamby (owner)
    ii. Luis Manalaysay, foreman
    iii. Derek Burke
    iv. Roy Rasmussen
    v. Ronn O'Leary
    vi. John Mahoney
    vii. John Kossivas
    viii. Ron Fitzpatrick

2. House on 14 Janice Avenue in Dracut was a one-story house with a full basement, crawl space under an addition, and forced hot air heat. The CFM_{50} pre-weatherization was 2700. By the end of the day, after all wall insulation was installed, the attic was blown, and some significant air sealing was done in the attic (permanently sealed an attic hatch, sealed opening in wet wall and vent pipe, and treated chimney chase), the CFM_{50} was down to 2036.
3. Topics addressed during training
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
    b. Discussion and calculation of density in blown walls. Calculated an installed density of 2.6 pounds of cellulose per ft^3. Had the auditors and contractor calculate for each wall. Contractor took extra density calculation sheets for future.

Overhang Blow in Massachusetts

    c. Discussed the tubing methods for dense packing walls. The contractor had never used this method. He did not have the tubes and equipment to do it. Gave him a J & R Supply catalog for equipment. Said he will purchase a Krendl blowing machine soon. Some of the machines they had will not be able to reach 3.5 pounds per ft^3 density.
    d. Discussion of recessed lighting fixture treatment and chimney chase treatment.
    e. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.

Crew pulled the existing fiberglass batts away from the perimeter of the attic before blowing cellulose.

f. Importance of plugging holes at the top of the house first and most importantly.
g. Discussion of treating the crawl space as conditioned area rather than unconditioned, and the ramifications of each.
h. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
i. Took 30 minutes to go over the worst-case draft test with the agency energy auditors who were at site.

Training in South Grafton, Massachusetts, September 19, 2003

1. Attending session:
    a. Rick Karg
    b. Jim Nolan, auditor for local agency
    c. Contractor (New England Insulation Company)
        i. Dennis Chicoine, owner
        ii. Bob Saillant, foreman
        iii. Bob Warchal
        iv. Thomas Desrosiers, foreman
        v. Nick Kujawski
        vi. Jason Badewu
2. House on 43 – 45 on Orchard Street in South Grafton was a two and one-half story duplex with a full basement. The CFM_{50} pre-weatherization was 8050. The day was very rainy, so little work could be done outdoors. The house required wall insulation, attic insulation, basement rim joint treatment, and necessary air sealing
3. Topics addressed during training
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog with these Infiltec doors.
        iii. Had to use two doors simultaneously to get a reading on the house and to negate the common wall leakage between the two apartment units. These Infiltec blower doors did not seem to have blowers as powerful and the Energy Conservatory blower doors. We discussed the need to use two blower doors on a duplex like this.
        iv. Had to use Can't-Reach-Fifty values printed on the frame of the blower doors to get the CFM_{50} value. Seemed they did not know much about blower door testing, even though each of their crews has an Infiltec door.
        v. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        vi. Walked around house looking for leaks with blower door running.
    b. This contractor is not dense blowing walls. The two crews have no tubes for wall blowing. They said they had experience dense packing slopes and knee-wall floors. However, I think they feel that a cavity is dense-packed if it is totally filled with insulation. Gave each foreman a J & R Supply catalog for equipment.

c. Discussed sealing basement ceilings. They said that they were told to do this on many of their jobs. They don't think it makes any sense. Karg agreed with them. This contractor is working with nine different utilities and low-income weatherization. Each of the companies has different standards for material installation. This lack of uniform installation standards is very difficult for the foremen and crew members. They often wonder what the right way to install measures is.
d. Contractor mentioned that they often are instructed to seal all duct joints. This was discussed.
e. Measured the static pressure at the outlet of each of the contractor's Force 2 insulation blowing machines. One measured 2.0 psi, the other 2.5 psi. We discussed the fact that these machines in their present condition do not have the capacity to dense-pack walls properly.
f. The knee-wall floors were blown. They claimed to be dense-packing the cellulose under the knee wall area; they were not. I have the installer reduce the material feed for the given airflow. It was now dense packing. The idea was to they increase the material feed after the dense packing was done for the open blow between the joists that had no flooring above. After I left the knee wall area, I think the installer went right back to the way he did things before I instructed him.
g. Measured carbon monoxide in the back of one of their trucks that housed the Force 2 blowing machine and a 7500 Watt generator. The ambient CO readings were from 70 to 90 ppm. I discussed the danger of this with the foreman and suggested an exhaust system that would vent the combustion gases out of the truck. Soon they moved the generator down to the street surface, improving the conditions in the truck significantly.
h. We measured the voltage output of the generator with my SureTest electrical tester. We got a consistent reading of 96 – 98 volts (should have been 115 – 120 volts). We discussed how this can unfavorably impact the capacity of their blowing machines and other electric tools and shorten their life.

4. General comments regarding the contractor and crew.
   a. After spending one-half a day with the contractor and a full day with both of his crews, I am left with the impression that there will not be any lasting changes resulting from this day of training. The moral of the contractor and his foremen is low. The contractor is upset because of the nine sets of installation standards he must follow. His foremen are upset because of the many installation standards and because of the lack of good equipment and training.

General Observations and Recommendations for State of Massachusetts Weatherization Program

[These observations have been deleted from this document for general distribution]

Ken Rauseo Report on Massachusetts Training

May 5, 2003

DHCD' s Weatherization Assistance Program (WAP) hosted four days of Weatherization contractor training by Rick Karg of R. J. Karg Associates on April 15-18 at various locations in Massachusetts. The training was funded primarily by the U.S. Department of Energy's (DOE) Boston Regional Support Office.

DHCD worked with local WAP subgrantees to determine which four weatherization contractor crews needed the most assistance to bring their understanding of the scope of the weatherization program and the quality of their work up to the standards set by DHCD. The four contractors identified were: Energy Doctor Insulation of Fall River, Energy Guard Insulation of Walpole, Borges and Son Insulation of Fall River, and Mass Weatherization of Boston. All of these contractors work at more than one agency and were identified by the agency and DHCD on-site monitoring and infrared scanning visits as having some deficiencies in their work.

The first day of training was held at a single-family home in New Bedford with Energy Doctor Insulation (EDI). Participants included three crew members, the crew chief, the company owner, two weatherization auditors from Citizens for Citizens (CFC), the WAP subgrantee in that area, David Fuller, from DHCD and trainer Rick Karg. After initial introductions, Mr. Karg and David Fuller outlined the goals of the training and some of the WAP program specific information. Much of the information communicated throughout the day was as valuable to the CFC energy auditors as it was to the EDI crew.

After an initial walk-through, the EDI crew set up their blower door to conduct a test. Mr. Karg provided information on the proper set-up and zeroing of the gauges on the blower door. After conducting the test and identifying some potential major air leakage areas the EDI crew prepared to complete air sealing, side- wall and eventually attic insulation. Throughout the work process, Rick discussed what the crew was doing and in some instances how the job may be done differently. Prioritizing and targeting areas for air sealing was discussed. Since the EDI crew was using a 2 1/8 inch/two hole accessing (with no fill tube) method to insulate the walls, Rick strongly encouraged the use of a fill tube to insulate walls to ensure complete, dense-packed coverage. This information was then used to determine the density of the insulation in the walls. By the end of the day the job was about half completed, but significant reductions in the infiltration rate had already been achieved. DHCD demonstrated the use of the infrared scanner as a quality control tool for wall insulation. The client expressed gratitude for the work completed so far. The company owner also expressed appreciation for the day spent with his crew.

The second day's training was conducted in a very similar manner to the first. The training was conducted in a single-family raised ranch in Medway. The contractor, Energy Guard Insulation was represented by a four-person crew including a crew chief and the company co-owner. David Fuller from DHCD and two energy auditors from South Middlesex Opportunity Council (SMOC) in addition to Rick Karg were also present.

During the blower door set-up, Rick observed that Energy Guard's blower door fan was in poor condition and that some of the pressure ports were covered with duct tape. He stated that it was impossible to get accurate readings with the door fan in this condition and requested that we find another fan to get accurate test results. Energy Guard was able to provide a fan in better condition within and "retired" the other fan to be sent off for repair or replacement. Rick's information about the accuracy of Energy Guard's defective blower fan proved valid. The undamaged door gave a significantly higher reading than the damaged one and was more consistent with the infiltration rate that was expected for the home.

During the installation of the wall insulation, Rick again stressed the value of using a fill tube and a single hole vs. the two-hole method. Based on Rick's bag count method, participants calculated the density of the wall insulation after each wall was completed. Rick offered suggestions on how to improve the density and the crew did get a greater density on each of the remaining walls. Simultaneous to the wall insulation, two members of the crew were completing air sealing in the attic in preparation for the attic insulation. Blower door tests conducted during the day provided information regarding the effectiveness of the work being completed and infrared scanning was used to demonstrate wall insulation quality control.

By the end of the day all the attic and wall insulation had been completed. Energy Guard was to return the next day to complete the remaining work.

The Thursday training was conducted at a small single-family cottage in North Attleboro. Borges and Sons Insulation was the contractor receiving the training. Weatherization auditors from SMOC and the subcontract agency Self Help Inc. were also present along with Wes James from DHCD and Rick Karg. The format and procedures used at the training were similar to the two previous days. The attic, sidewalls and crawlspace walls were insulated. Rick stressed the importance of using blower door directed air sealing and taking intermittent readings to determine effectiveness of the work completed. Job management and the importance of thoroughness and attention to detail were discussed with the contractor.

Friday's training was conducted on a single-family ranch in Dracut with the contractor Mass Weatherization. Auditors from Greater Lawrence Community Action and the subcontract agency Community Teamwork were present along with Wes James from DHCD and Rick Karg. Blower door directed air sealing, attic and sidewall insulation was completed on the home. Air sealing of a heated sunroom with a crawlspace was discussed. The contractor was very positive regarding dense pack insulation.

Overall the four days were a success. Contractors and energy auditors have submitted very positive evaluations of the trainings. It was clear to DHCD staff that both the contractors and agency staff learned valuable information from the day spent with Mr. Karg. It is our opinion that all contractors involved with the program should attend a similar training.

New Hampshire

These two days in New Hampshire, February 11 and 12, 2003 (the first training days of the pilot project), were used as a pilot for the other sessions, that is, a time to learn more about how the process would work with contractors.

Training in Swanzey, New Hampshire, February 11, 2003

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Technical Monitor
    c. Tim Cole, auditor for Southwest CA
    d. Contractor (Creative Construction) and two crew members:
        i. Mark Theiss (owner)
        ii. Mark Beaulieu (foreman)
        iii. Matt Giroux

Monitor, Client, and Auditor in NH

2. House in Swanzey, NH. Story and one-half, oil-fired boiler and DHW, crawl space, attached garage w/ entry, two people, about 1600 square feet of living space.
3. Topics addressed on first day of two days:
    a. Contractor just received a new Minneapolis Blower Door the day before the session. Spent an hour going over its use. Pre-test was about 6400 CFM_{50}. After some open blow in attics this was reduced by about 800 CFM_{50}. More work will be done tomorrow.
    b. Knob-and-tube wiring. Foreman has been blowing over this in attics. Subject house had one bay in attic with knob-and-tube. We had a lengthy discussion of the options including avoiding bay, Tyvek stapled to top of bay joists with blow over, damming bay for blow around, and subfloor over subject bay. Final choice was to remove the knob-and-tube and replace with Romex. Contractor had materials and knowledge for this work. Hand to replace only about six feet of knob-and-tube with Romex.
    c. Discussion of use of Tyvek to cover open cavities for cellulose blow. Potential moisture problems.
    d. Contractor used a recently purchased used Krendl 1000 blowing machine for the first time today. Worked just fine. Before this he used a Force II. Discussed the controls on the machine. Karg called expert in North Dakota regarding operation of some of the controls.
    e. Discussion of recessed lighting fixture in bathroom. It was mistaken at first for an IC type. Karg found it was not, so the fixture was dammed with fiberglass batt that was taken from the attic floor. A discussion ensued about the advantage of wood or other rigid material for a dam around the fixture.
    f. Discussion of blowing over fiberglass batts in attic. Often better to remove them so that air does not flow laterally under the newly installed cellulose.

Discussion also led to the facing on fiberglass batts and how to treat it if blowing over.

Training in Swanzey, New Hampshire, February 12, 2003

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Technical Monitor
    c. Lois Pasquerella from Boston Regional Office
    d. Tim Cole, auditor for Southwest CA
    e. Contractor (Creative Construction) and crew members:
        i. Mark Theiss (owner)
        ii. Mark Beaulieu (foreman)
        iii. Matt Giroux
        iv. Keith Hitchcock
2. Did two blower door tests, one in the morning before work began and one at the end of the work day. Reduced CFM_{50} for total job by about 2000. The foreman, Mark, seems to understand how to use the blower door.
3. During the morning blower door test, reduced house pressure to 30 Pascals and walked around the house to feel for leaks. Found many specific leaks, found that windows did not leak much, crawlspace was very leaky, etc.
4. Went through Karg sheets on insulation density for a small wall that was eight feet long by seven feet high. With their Krendl machine they achieved an installed density of almost 4 pounds per cubic foot.
5. Discussed that insulation should only be placed between conditioned and unconditioned areas.
6. During both blower door tests, we discussed dividing CFM_{50} by 10 to get the approximate square inches of leakage in the house envelope.

Training in Hampton, New Hampshire, September 3, 2003

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Technical Monitor
    c. Jerry Simms, Weatherization Director
    d. Matt O'Keefe, auditor from Rockingham Community Action
    e. Patrick Simms, auditor
    f. Jeff Davis, contractor
    g. Jeff Benson, contractor (Quality Insulation):
        i. Russ Barcomb
        ii. Bryce Clark
2. The house in Hampton was a one and one-half story of 1135 square feet with a hot water oil-fired boiler and hot water baseboard distribution. The CFM_{50} was 1400, very close to the calculated building tightness limit. The auditor for the job has specified additional attic insulation on top of the existing R-19 and an additional R-11 added to the existing R-11 already in the basement ceiling. The boiler with indirect-fired domestic hot water and the washer and dryer were located in the basement. We were not able to install any measures on this house. The auditor's specifications called for some, but by the end of the day we had decided that all but one would be cost-ineffective.

3. Topics addressed during training included:
    a. Spent much time discussing the thermal envelope of the house along with the basement wall vs. basement ceiling insulation conundrum. Karg stated that basements in New Hampshire should almost always be treated as part of the thermal envelope and we should, therefore, not be insulating basement ceilings, but basement walls to four feet below the basement ceiling.
    b. We discovered that there was access to the attic (the auditor missed this). Will it be cost-effective to add more insulation to an existing R-19? We discussed the difference between merely saving energy and saving energy in an effective manner (savings-to-investment ratio greater than one).
    c. Measurement of the static pressure at the takeoff of the contractor's Unisol Volumetric, PTO-driven insulation blowing machine. This machine produced a very high 5.7 psi or 160 inches of water column. A machine must be capable of producing 2.8 psi at the takeoff in order to adequately dense pack walls 3.25 to 3.75 pounds per cubic foot.
    d. We discussed their winter and summer tubes used for dense packing walls. We discussed the necessary rigidity of the tubes and the additional difficulties encountered when a wall cavity is wider than 16 inches (as discovered during the O^4S training in Maine).
    e. Did a blower door test using both the analog gauges and the DG-700 digital gauge. We discussed the differences between a depressurization and pressurization test. While the blower door was running, we walked around the house to look for leaks.
    f. Karg demonstrated core sampling cellulose in walls (did not actually take a sample). Karg gave Andy Gray two core sampling copper tubes and the corresponding density chart.
    g. Performed efficiency test on oil boiler.
    h. Demonstrated the North Dakota worst-case draft test procedure in the combustion appliance zone of this house. The draft was marginal and should be adjusted by an oil technician.
    i. Ended up cutting the auditor's work order back to a cleaning and tuning of the oil boiler.

Training in Franklin, New Hampshire, September 4 and 5, 2003

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Technical Monitor
    c. Dana Nute, Weatherization Director
    d. John Reifsnyder, auditor from Belknap-Merrimack Community Action
    e. Contractor, Thermal Fabrication
        i. Andrew Laliberte
        ii. Jason Lackrow
        iii. Tim Flanders (Friday, September 5 only)
2. The house in Franklin was a one story cottage that had been winterized. For space heating it had two direct-vent, propane-fired, wall heaters and one wood stove. The CFM_{50} was 2500 pre-weatherization and 1775 post-weatherization. The calculated building tightness limit for the house was 1387 CFM_{50}. The

auditor for the job specified attic insulation, dense-pack insulation in the walls, repair and covering the R-19 fiberglass in the floor (open underneath), glass repair, and necessary air sealing.

3. Topics addressed during training included:
    a. Measurement of the static pressure at the takeoff of the contractor's generator-driven Krendl 2000 insulation blowing machine. This machine produced a very high 4.7 psi or 135 inches of water column. A machine must be capable of producing 2.8 psi at the takeoff in order to adequately dense pack walls 3.25 to 3.75 pounds per cubic foot.
    b. Blower door testing was done with contractor's blower door. Although the connection of the tube at the flow ring was broken, the blower door gave the same reading as a fan in very good condition (2500 CFM_{50} with the A-ring in place). This was quite puzzling to everyone. The contractor was advised to have the blower repaired. Used both the analog gauges and the DG-700 digital gauge for the tests. We walked around the house looking for leaks with the blower door running.
    c. We discussed open crawl space fiberglass treatment (holding the fiberglass up with either Tyvek or Typar or polypropylene fabric).
    d. The tongue-and-groove clapboard siding had no sheathing under it, so the tube insertion holes for the wall insulation tubes had to be face drilled and plugged. This was approved by the client.
    e. Inspected two separate attic areas. Pulled existing fiberglass back away from eaves so that cellulose is in contact with upper side of finished ceiling material.
    f. Discussed core sampling wall insulation. Did only two core samples because of having to face drill siding. Found a density of 3.5 pounds per cubic foot four feet above the fill hole and 2.5 pounds per cubic foot at two feet below the fill hole. The installer said he was pulling back below the fill hole for fear of blowing the wall out. There turned out to be a risk in most of the walls of blowing out the interior finish material, so it was not possible to dense blow the walls.
    g. Andy Gray and Rick Karg worked with the contractor's crew to get the job done ahead of the schedule he had planned.

General Observations and Recommendations for State of New Hampshire Weatherization Program

[These observations have been deleted from this document for general distribution]

Andy Gray Reports on New Hampshire Training

One-on-One On-Site (O^4S) Training #1
New Hampshire Summary Report
Governor's Office of Energy and Community Services (ECS)
February 24, 2003

The initial training for the O^4S Training (a pilot project funded by the US Department of Energy) occurred in Swanzey, NH on February 12th and 13th. This was the first of a series of trainings to be conducted specifically for Weatherization crews or contractors who are responsible for the actual installation of energy efficiency improvement measures.

ECS identified a contractor who was relatively new to the Weatherization program and was in need of and had requested additional training. Since this was an initial training, there was a steep learning curve for those planning and providing the training as to what is the most efficient, effective use of the limited time, money and resources budgeted for this project. The outline below is intended to relate NH's training encounter to the rest of Region One so that others in the network can draw upon our experience to develop their own agenda to suit their states' needs.

Background/preparation:
Southwestern Community Services energy auditor, Tim Cole, found a suitable training house during the course of his daily auditing schedule prior to the actual training. The house was deemed appropriate because, the client was exceptionally personable and cooperative and the house had many opportunities for Wxn installations – zero to minimal insulation in two attics, two sidewalls on an addition that were void of insulation, and numerous areas to air seal. The additional benefit was that the house was near the community action agency main office, which provided for a convenient meeting place.

The work order was given to the contractor. A copy was faxed to Andy Gray at ECS, Rick Karg at R.J. Karg Associates and Lois Pasquerella at the Boston Regional Office for review prior to the training. This enabled all parties to have a sense of the work to be performed on the training house

After receiving the work order, Rick Karg contacted Andy Gray to ascertain what expectations the NH Weatherization Program had, in general, of crews/contractors working within the program and in what specific areas this particular contractor needed training.

In attendance on site:
In addition to the homeowner, there were seven people attending the training:

Rick Karg (RK) - R.J. Karg Associates – Trainer
Creative Construction (CC) – Wxn Contractor – 3-person crew
Tim Cole (TC) – Southwestern Community Services (SCS) - Wxn Energy Auditor
Andy Gray (AG) – NH ECS – Weatherization Technical Manager

Day 1 (02/12/03)
RK, TC, AG met at SCS at 8:30 and caravanned to the job site approximately 15 minutes away.

CC was already on-site upon the group's arrival.

RK introduced himself and explained the purpose of the training, stressing that he was there to help them. CC had recently purchased their first blower door. The crew members had seen the SCS auditors use the tool, but had never used it themselves until this time. The next two hours were spent training the crew on the blower door – components, digital gauges (most auditors in NH use magnehelic gauges), proper set up, how to take, interpret and effectively use readings, safety precautions, and identifying key leakage areas. The initial blower door reading was over 5000 CFM_{50}.

RK and AG had anticipated the contractor would join them for lunch and the time would be used to discuss general Weatherization issues with them and identify other needs/expectations the contractor had. CC generally does not stop work for lunch and opted to stay behind and prep the attic for blown in insulation. After lunch, CC was ready to blow the attic above a converted year round enclosed porch and above the kitchen. After blowing the first attic and moving on to the second, some live knob &tube wiring was found that had been missed by the auditor during the initial audit. This provided an opportunity for excellent discussion between all parties. Ultimately a sensible solution was realized and CC was able to blow the attic with insulation completely.

Day 2 (02/13/03)
RK and AG met TC and CC on-site at 8:00 a.m.

CC was in process of preparing sidewalls for insulation by removing siding on the outside and water damaged drywall on the inside. RK distributed a formula for estimating the minimum number of bags of insulation that would be needed to achieve "dense pack" for the wall areas to be insulated. We also discussed methods of checking for dense pack by taking core samples. After the wall was fully insulated the bag count was higher than the estimate arrived at using the formula and slightly lower than what the foreman had predicted.

While the walls were being blown, RK, TC, and CC manager viewed slides of Wxn trailers from other states. CC is in the process of outfitting a truck that will be dedicated solely for Wxn work. We discussed the most efficient, safest way of setting up the truck.

A final blower door test was conducted to measure the effectiveness of the measures installed. We observed an approximate 2000 CFM_{50} reduction.

Lessons Learned/Recommendations:
Although preparation is paramount, flexibility is of equal importance in order to adapt the training to meet the specific needs of the contractors/energy auditors.

The state Wxn technical manager/monitor should work with the energy auditor to select the house to ensure that it is appropriate for the training. If possible the monitor and auditor should conduct a thorough audit and know as much as possible about the house before the contractor and trainer arrive on-site. Questions such as the following should be addressed prior to the actual training:

- Does the house have enough areas to do a thorough training or is it too basic?
- Are there issues beyond the scope of Wxn that need to be addressed by another source before Wxn can proceed?
- Can those be addressed prior to the training?

It was very useful to have the work order clearly developed and sent to all parties a few days in advance. Specific contractor and general state expectations should be forwarded to RK so he is prepared to train to the state and contractor needs and expectations.

Although the potential for overcrowding and disturbing the client is high, it is useful to have the agency auditor and the state monitor in attendance. While RK was the instructor, it was beneficial for the other two to offer their input especially since the contractor will have an on-going relationship with the agency auditor and state. In this instance, it was particularly helpful that TC had years of experience on a Wxn crew.

It is recommended that after reviewing the state, auditor, and contractor expectations and the proposed work order, RK provide a tentative agenda to the above parties so that everyone has a generally clear understanding of how the days will proceed. As part of the agenda it may or may not be useful to explicitly state that a "working lunch" will be taken. Often times a casual conversation can identify other areas to focus on. In addition, it is important for the local agency to negotiate with the contractor prior to the training how they will be reimbursed for the additional time that is inevitably going to be incurred by asking:

- Will the contractor be reimbursed for the actual hours spent on-site?
- Or will they only be reimbursed for a "normal" job and take the free training as compensation?

This should be worked out in advance so that the crew is comfortable and not pressured to rush.

It is NH's opinion that training and keeping quality contractors is worth the investment of paying the additional costs associated with the time accrued above and beyond "normal" Wxn activities.

As much as possible, avoid having auditor, state staff, and/or trainer becoming passive, silent observers. All participants should be ready to get dirty and work alongside the contractor and assist as needed to keep the job moving. All parties having a clear understanding of the work order and the contractor's willingness to "share" might achieve this.

All possible tools and necessary materials should be available on site to handle all parts of the job.

A training survey has been drafted by RK and sent to the contractor to be filled out. It will be returned to auditor and then returned to RK.

The general feedback from the contractor during the training, was that it was a worthwhile event as they learned how to operate the blower door correctly, identified a policy previously unknown to them, and learned what "dense pack" means and how to confirm whether they achieved dense pack through a formula.

One-on-One On-Site (O^4S) Training #2
New Hampshire Summary Report
Office of State Planning and Energy Programs
September 24, 2003

The Office of State Planning and Energy Programs (OSPE) utilized the three remaining days of training with Rick Karg to complete the first phase of the O^4S project in New Hampshire on September 3, 2003 through September 5, 2003.

NH chose to spend one day in Hampton in Rockingham Community Action's territory with two contractors. The first contractor is relatively new to the Weatherization program and was hired by the local agency to install base load measures for the electric utility program, which Weatherization collaborates with, and to perform general air sealing. The second contractor was hired by the local agency to install the insulation only and is a veteran of the Weatherization program.

The following two days were spent in Franklin, NH in Community Action Programs of Belknap-Merrimack Counties' territory with a veteran contractor that is shared by most of the Community Action Agencies in NH.

As in our initial two days of training, there was an excellent exchange of information between all individuals involved and the days were a very productive learning experience.

Hampton, NH - 09/03/03:
An energy auditor from Rockingham Community Action selected the house for the day of training in Hampton, NH. A complete audit had been conducted and work order faxed to the contractors prior to the training itself. The auditors and I met the contractors and Rick Karg at the site.

After reviewing the work order with the auditors and contractors, the group descended to the basement where insulation work had been called for. The ensuing exchange proved to be one of the two most informative conversations of the day, particularly for the less experienced people in the audience. The work order had called for additional insulation to be added to the basement ceiling. However, the basement was a dry, poured foundation and already had R-11 fiberglass insulation in the ceiling. Rick skillfully facilitated a lengthy discussion as to why the measure called for was completely unnecessary. He recommended that if any insulation was to be added to the basement in this case it should be on the foundation walls. As Rick pointed out, the R-value of poured concrete is less than a single pane window, therefore there is greater heat loss through the foundation walls above grade than through the floor between spaces. Ultimately, it was decided that the home should be modeled in the audit tool again with this foundation insulation as a proposed measure to determine its cost effectiveness.

We then moved to the second floor where further exploration of the attic space, which was previously assumed to be inaccessible, led to another lengthy debate. The auditor had initially called for insulation to be added to the attic, however there was already R-19 existing. Rick questioned the cost-effectiveness of this measure as well. It was agreed that there would be energy savings from adding insulation but the measure's cost-effectiveness was not certain. Rick suggested that the measure be run through the audit

tool again. He suggested that if adding insulation to the attic came up as cost-effective the calculations in the tool should be reviewed for accuracy.

After lunch, Rick led us through a demonstration of the Energy Conservatory's DG-700 gauges with the blower door. The home was considerably tighter than we expected which raised further questions as to the cost-effectiveness of the above requested measures

We descended to the basement once again for a demonstration of worst-case depressurization testing. Rick provided handouts that described, step by step, the proper way to ensure that the heating system was still drafting safely in the worst-case scenario.

To close out the day Rick also tested the crew's blowing machine for its ability to achieve dense pack. The machine was PTO driven so it far exceeded the minimum pressure requirements. Rick also distributed a chart for calculating the density of installed insulation through core sampling.

Even though on this day we did not actually install any measures we covered a lot of important material and clarified a number of misconceptions that may not have otherwise been identified until after the fact. It was a very productive day.

Franklin, NH - 09/04/03:
As above, an auditor from Community Action Programs, Belknap-Merrimack Counties conducted an initial audit on this home and faxed the work order to the contractor. Rick and I met the auditor and contractor at the site.

On this day we began with a blower door test using the contractor's blower door. After the contractor set up their blower door, Rick observed that the tap on the fan inlet housing was broken and the hose that should connect it to the pressure gauges was disconnected. We conducted a test with the hose on and with the hose off. We expected to see a significant difference, however on this occasion there was only approximately a 50 CFM variance. Still, all agreed, given the age and condition of the fan, a new fan inlet housing or new fan entirely was needed.

All four walls and the attic of this home needed insulation. We began with the attic after we discovered that the siding was actually also the sheathing. Therefore, we needed the owner's permission to drill through the siding. When the owner returned later that day the procedure was approved and we were able to dense pack a section of wall before the end of the day.

As on the first day in Hampton, Rick tested the pressure on the contractor's blowing machine. This contractor utilized a generator for power and was able to achieve the necessary pressure easily. Additionally, we were able to take core samples of the wall section that had been insulated in order to measure the installed density of the insulation. All of the samples were within the acceptable range for cellulose of 3.25 lbs/ft^3 to 3.75 lbs/ft^3 as specified in the NH Weatherization Policy and Procedures Manual. However, we also observed that on this particular home it was prudent to install the insulation at a density less than the standard in order to avoid blowing the wallboard off of the interior walls.

Franklin, NH – 09/05/03:
On the final day, Rick and I were able to work side by side with the contractor to finish insulating the walls. This was an excellent opportunity to establish a good working relationship with the contractor and to encourage them to utilize techniques or address certain measures that the contractor presumed were not worthwhile or had not considered. Specifically, the contractor did not think that there was enough room to install insulation above the windows on this single story home. However, with Rick's prompting and guidance a significant area of the home was insulated which may not have been otherwise. Working with the contractor allowed the job to be finished in a reasonable amount of time and meant that they could move on to another job starting the following week. From a program manager perspective, I was also able to identify areas of both strength and weakness that can be further addressed through additional monitorings and trainings.

Lessons Learned/Recommendations:
As was identified in NH's initial O^4S report, preparation is paramount, but flexibility is of equal importance in order to adapt the training to meet the specific needs of the contractors/energy auditors. This was especially true on the first day. Due to summer vacation schedules and the National Weatherization Conference I was unable to conduct an audit on the training houses prior to the start of the training to ensure that there was work that could be done. In the case of the Hampton house, we were very fortunate that we had only scheduled one day because it was not likely that any significant weatherization measures would ultimately be installed. However, this day provided for some of the most useful and interactive discussions of the three days and was invaluable for the new auditors and contractor.

Rick's introduction at the beginning of each training is essential to setting the right tone for the days' trainings. It clearly outlines the purpose and expectations of the training and puts the contractor at ease that this is intended to enhance their skills and productivity and should not be viewed as punitive. Working alongside the contractor is always a positive experience, particularly in establishing good relationships between the contractor, auditor, and state manager/monitor.

It was another successful training event.

Rhode Island

Classroom training at the W. Alton Jones campus of the University of Rhode Island, West Greenwich, RI, July 21 – July 22, 2003.

The program managers in Rhode Island requested that their five days of training begin with two days of classroom training for auditors/inspectors. These two days served as an important introduction for the on-site training.

1. Attending classroom training session:
    a. Rick Karg
    b. Mike Snitzer, Program Manager
    c. Bob Swift, auditor
    d. Jon Cass, auditor
    e. Darlene Lemoi, auditor
    f. Bill Laracque, auditor
    g. Ron Fortier, auditor
    h. Mike Lapee, auditor
    i. Paul Warrener, auditor
    j. Charlie Edwards, auditor
    k. Sol Mochtader, auditor
    l. Mike Dooley, auditor
    m. John Costello, state monitor
    n. Dennis Lopes, state heating system specialist
    o. Chris Johnson, auditor
    p. Holly DiCenzo, auditor in training
    q. Bill Gill, state monitor

Wall Blow in Rhode Island

The agenda for this two-day classroom training session:

Monday, July 21, 2003

9:00 **General Introductions/Housekeeping**
Who's who, experience levels, trainer and participant introductions.

9:30 **Overview of training plan by Rick Karg**
Topics, goals, and objectives.

9:35 **The House as a system**
An integrated approach to energy auditing and weatherization.

12:15 **Lunch**

1:00 **Heating Systems, types, safety, proper testing**
Operation, testing, code issues, depressurization tightness limit, and worst-case draft testing. Measurement of carbon monoxide.

4:00 **End of training day**

Tuesday, July 22, 2003

9:00 **Quick review of previous day**

9:15 **Pressure diagnostics**
Quick overview of blower door testing, zone pressure testing in primary and secondary zones.

12:15 **Lunch**

1:00 **Installing high-density cellulose wall insulation**
Characteristics of high-density cellulose, high-density techniques, siding removal methods, requirements for proper installation, verification of high-density installation.

3:45 **Wrap Up**

4:00 **End of training day**

Training on July 23 – 25 will take place in the field.
Times on the above agenda are approximate, except for starting, lunch, and ending times.

Field Training in, Saunderstown, Rhode Island, July 23, 2003

1. Attending session:
    a. Rick Karg
    b. Mike Snitzer, Program Manager
    c. Bob Swift, auditor
    d. Jon Cass, auditor
    e. Darlene Lemoi, auditor
    f. Bill Laracque, auditor
    g. Mike Lapee, auditor
    h. Paul Warrener, auditor
    i. Charlie Edwards, auditor
    j. Sol Mochtader, auditor
    k. Mike Dooley, auditor
    l. John Costello, state monitor
    m. Dennis Lopes, state heating system specialist
    n. Holly DiCenzo, auditor in training
    o. Bill Gill, state monitor
    p. Richard Battisa, contractor, Beneficial Energy Products, contractor
        i. Salvatore Cartagena, crew
        ii. Ed Diaz, crew
2. Jon Cass had performed an audit on house. The ranch style house had a basement level that was, on average, four feet below grade. The pre-weatherization blower door test gave a CFM_{50} of 2580 with the basement door open and a CFM_{50} of 1680 with the basement door closed. The basement is lived in to some degree and should be considered part of the occupied thermal envelope. The house had vinyl siding, an oil-fired boiler (number 2 oil with tank outdoors), baseboard distribution, no insulation in walls, and 3 ½ inches of fiberglass in the attic.
3. Topics addressed during training:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Proper use of rings in blower.
        v. Walking around house looking for leaks with blower door running.
        vi. Contractor's blower door flow ring was damaged. This gave a blower door reading 200 CFM_{50} less than a well maintained blower door.
        vii. They almost always do a blower door test with the basement door open and closed. Discussed degree to which the connections between the basement and the attic through chases will impact this basement-door-open reading. This could be misleading.
    b. Discussion and calculation of density in one blown wall. Beneficial Energy Products had a Force 2 blower that they were not using because they were fearful of blowing out walls. They used in attics, but not walls. We used it in wall for first time. They were using a tube, but it was too short for many of their jobs. Also, the tube was too flexible for the hot weather; it was bending and crimping often. They did not blow down from

the hole, only up. Then they would finish off the blow with the nozzle alone at the hole. They could not get the settings right to get dense blow, so we were never able to calculate density, although the auditors present did calculate the cubic feet in the wall.

c. Air sealing around chimney and plumbing stacks. *The contractor was using bubble wrap around chimneys, a flammable material!* They removed this and changed to metal flashing.
d. Importance of plugging holes at the top of the house first.
e. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They have been typically insulating ducts and hot water distribution pipes in basements. They were (the auditors) going to insulate the hot water pipes in the basement. Karg changed their minds.
f. In attic, pulled R-11 fiberglass a foot or two away from eave and totally at each gable end so that the cellulose could seal the top of the ceiling.
g. Discussed type IC fan/light fixture in bathroom that the homeowner had installed a month before.
h. Although we could not actually perform a worst-case draft test, we discussed how to do one.
i. The house had a tuck-under garage. They were going to insulate with fiberglass and then drywall the ceiling. Because of its air-sealing characteristics and the CO hazard in the garage, they instead will drywall the ceiling and blow with dense cellulose.
j. Suggested they pressurize the house with the blower door and open the attic pull-down stairs a foot or two to keep dust in attic and keep it cooler up there while the cellulose is being blown. This worked for them.
k. Karg calculated the BTL for the house. Rhode Island is using a standard 1250 CFM_{50} for the BTL in all houses.

Field Training in, Cranston, Rhode Island July 24, 2003

1. Attending session:
    a. Rick Karg
    b. Mike Snitzer, Program Manager
    c. Bob Swift, auditor
    d. Jon Cass, auditor
    e. Darlene Lemoi, auditor
    f. Bill Laracque, auditor
    g. Ron Fortier, auditor
    h. Mike Lapee, auditor
    i. Charlie Edwards, auditor
    j. Sol Mochtader, auditor
    k. Mike Dooley, auditor
    l. John Costello, state monitor
    m. Dennis Lopes, state heating system specialist
    n. Holly DiCenzo, auditor in training
    o. Bill Gill, state monitor
    p. Russ Thrilford, contractor, Cross Insulation
    q. Norm Giulford, crew
    r. Adam Comire, crew

s. Dan Brown, crew
t. Jay Szpila, crew
u. Steve Girouard, crew

2. Mike Dooley had performed an audit on house. This was a two-story house with a full basement and a hip roof. The blower door test gave a pre-weatherization CFM_{50} of 3310 with the basement door closed and a post-weatherization CFM_{50} of 3080. The house had vinyl siding, an oil-fired boiler, baseboard distribution, no insulation in walls, and approximately 8 inches of blown fiberglass in the attic. The post-weatherization blower door test result was a big disappointment. The drop of less than 300 CFM_{50} was probably due to the poor job of sealing attic bypasses in the balloon-framed house and a substandard cellulose density in the walls.
3. Topics addressed during training:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
        v. They almost always do a blower door test with the basement door open and closed. Discussed degree to which the connections between the basement and the attic through chases will impact this basement-door-open reading. This could be misleading.
    b. With all the auditors, critiqued the audit that Mike Dooley did on this house.
        i. They are often sealing basement ceilings. Unless this is for IAQ reasons, this should not be done.
        ii. They are often putting reflective panels behind steam radiators. Karg suggested that this is probably not cost effective.
        iii. Adding cellulose to 8 to 10 inches of fiberglass already in the attic is probably not cost effective.
    c. Discussion and calculation of density in one blown wall. Cross Insulation had a Force 2 blower that they were not using because they were fearful of blowing out walls. They used in attics, but not walls. For this job, they used a Giesken 510 and 610 (Karg doubts that either of these machines has the capability of achieving dense pack). They were using a tube, but it was too short for many of their jobs. Also, the tube was too flexible for the hot weather; it was bending and crimping often. They did not blow down from the hole, only up. Then they would finish off the blow with the nozzle alone at the hole.
    d. Air sealing around chimney and plumbing stacks. The contractor was using two-part foam around chimneys, a flammable material. They removed this and changed to metal flashing.
    e. Importance of plugging holes at the top of the house first.
    f. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They have been typically insulating ducts and hot water distribution pipes in basements. They were (the auditors) going to insulate the hot water pipes in the basement. Karg changed their minds.

g. In attic, many of the interior wall cavities were open to the attic (balloon framing) and all of the second floor closets had dropped plaster ceilings. The contractor did a poor job of treating these bypasses. The dropped closet ceilings should have been blown full of cellulose (accept for the one that intersected with the chimney) and all interior wall tops should have been inspected more thoroughly and sealed more effectively.
h. Karg calculated the BTL for the house. Rhode Island is using a standard 1250 CFM_{50} for the BTL in all houses.
i. Had a chat with the contractor foreman and crews about their faulty blowing machines and techniques at the end of the job.

Field Training in Lafayette, Rhode Island, July 25, 2003

1. Attending session:
   a. Rick Karg
   b. Mike Snitzer, Program Manager
   c. Bob Swift, auditor
   d. Jon Cass, auditor
   e. Darlene Lemoi, auditor
   f. Bill Laracque, auditor
   g. Mike Lapee, auditor
   h. Paul Warrener, auditor
   i. Charlie Edwards, auditor
   j. Sol Mochtader, auditor
   k. John Costello, state monitor
   l. Dennis Lopes, state heating system specialist
   m. Holly DiCenzo, auditor in training
   n. Bill Gill, state monitor
2. Jon Cass had performed a preliminary audit on this house. The two-story, raised ranch house had severe mold problems and had been treated for the fungi before we arrived. The bathroom and first-floor (basement) drywall had been removed and all the framing members had been treated. The blower door test gave a CFM_{50} of 2570 with the basement door closed and a CFM_{50} of 3600 with the door to the basement open. The house had a furnace with exposed ductwork in the first-floor ceiling and a gas-fired water heater. There were no contractors at this site; it was intended to be a time for the auditors to experience some for the diagnostics tests discussed in the classroom early in the week.
3. Topics addressed during training:
   a. Use of the blower door.
      i. Zeroing properly.
      ii. Using the analog and new digital gauges.
      iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
      iv. Walking around house looking for leaks with blower door running.
      v. They almost always do a blower door test with the basement door open and closed. Discussed degree to which the connections between the basement and the attic through chases will impact this basement-door-open reading. This could be misleading. There was a significant connection in this house.

b. Building tightness limit calculation with ZipTest Pro software.
c. Depressurization tightness limit with ZipTest Pro software.
d. Zone pressure testing from house to basement (basement door as temporary hole) and from house to attic (attic hatch as temporary hole).
e. Cost-effective guidelines for effective air sealing with ZipTest Pro software.
f. Responsibilities of auditors:
    i. Inspect job for energy and health and safety.
    ii. Write up job order.
    iii. Train contractor and crew, if needed.
    iv. Quality control.
g. Holding contractors accountable, for example, to a wall insulation density of 3.5 pounds per cubic foot.
    i. Must put specifics in bid specification.
    ii. State of Rhode Island must put in field standards.
    iii. Must test for density with core sampling.

General Observations and Recommendations for State of Rhode Island Weatherization Program

[These observations have been deleted from this document for general distribution]

Mike Snitzer Report on Rhode Island Training

One-on-One On-Site and Classroom Training (O^4S)
Rhode Island Summary Report
State Energy Office

September 30, 2003

The RI State Energy Office utilized five days of training with Rick Karg July 21st-25th, 2003. Rhode Island's approach varied somewhat from the other New England States in that we held two days of classroom training followed by three days of field training, this was our choice. A copy of the agenda is attached.

The classroom training went very well, Rick covered the topics thoroughly, had good handouts and made a good power-point presentation.

The field training put into practice the subjects covered in the classroom.

Saunderstown, RI
The home was selected by South County Community Action, the energy auditor had done an audit on this ranch and it needed attic and wall insulation, air sealing, venting and sill insulation. The contractor met us at the site and was already setting up for the walls. All our contractors are required to dense-pack walls and slopes, it soon became clear that this was an area that needed further training. Although the contractor tubed the walls the tube was not of sufficient length and the wrong type for summer, too soft. Rick explained that unless the tube goes all the way to the top plate and is properly withdrawn you cannot

have a satisfactory dense-pack. The pressure of the blowing machine is also very important. The contractor was reluctant to increase the pressure for fear of popping the interior plaster, Rick was confident this would not happen. Unfortunately after several bays there was a loud pop and one bay in the stairs to the cellar did crack. There was no reoccurrence of this problem for the rest of the job, but it made it very clear that further training an experience was needed for the contractors to use the proper length and type of hose and the proper air pressure settings for different types of homes.

Cranston, RI
The second day we met a second contractor at a large Colonial selected by Comprehensive Community Action, a neat audit had been performed and the home required wall insulation, sill insulation and extensive air sealing. This contractor also tubes the walls for dense pack and although better that the previous days contractor still was not using a tube of sufficient length. At this job we used the bag count system developed by Rick to verify if we were getting a satisfactory dense-pack. The problem with this system is that it is difficult to get an accurate bag count when the contractor is working on several different parts of the house. We feel that the best way to verify dense-pack is to take core samples.

Rick took pre and post blower door reading and instructed the auditors in zone pressure diagnostics, this training was very well received by the energy auditors.

Warwick, RI
The final home was a raised ranch with severe mold problems, we were unable to weatherize it due to the severity of the mold but used it as a training site to determine cause of the problem. All the sheetrock and paneling had been removed from the first floor and the bathroom ceiling was removed from the second floor. Rick proceeded to perform both whole house and zone blower door testing. He was able to demonstrate how to determine the cause of the mold. The first floor was extremely wet do to several factors, the high water table in the area, trees around the property and probably the type of fill used around the foundation. The damage to the second floor was caused by a large thermal bypass in the bathroom. When the bathroom fan was used the moisture from the first floor was brought to the second. Although we did not do any Weatherization work on this home it was an excellent training for the auditors.

Lessons Learned/Recommendations:
Preparation is paramount and we would definitely not schedule a training of this type in the summer. Due to staff and client vacations it was difficult to secure appropriate site locations.

The combination of classroom and on-site training worked very well for Rhode Island. Rick did an excellent job at both, the best part was Rick going over the procedures in the classroom and then demonstrating those procedures in the field.

Vermont

Training in Rutland, Vermont, June 9, 2003

1. Attending session (all BROC personnel are from Rutland office, none attended from the Bennington office):
    a. Rick Karg
    b. Jules Junker, state weatherization director
    c. Dwight DeCoster, VT Technical Monitor
    d. Ed Fuller, weatherization director for local agency, BROC
    e. Mike Brookman, energy coordinator
    f. Trevor LaPine, auditor
    g. Jay Muratorri, auditor
    h. Doug Baker, foreman
    i. Russ Champine, foreman
    j. Mike Hanlon, foreman
    k. Rick Brown, crew technician
    l. Rip Quimby, crew technician
    m. Charles Murphy, crew technician

Site Inspection in Vermont

2. Training took place at a six-unit apartment in Brandon, Vermont. The historic, but run down building was two full floors with a full basement over the main building section and a crawl area under three conditioned shed additions to the rear of the main building. The 3400 square foot building also had a third floor in the main section of the house that was being renovated for more apartments. The CFM_{50} for the entire building was 15,100 (five blower doors were used to determine this value). The building has a number of furnaces (with much ductwork) and water heaters in the basement. Found that the ACH (which is calculated on most jobs in Vermont) was 2.4 pre-weatherization, assuming a volume of 29,000 cubit feet and an LBLn of 13. The tenants had not been properly informed of the weatherization activity that was to take place, so there was much difficulty with gaining access to some of the apartments. This slowed the progress of the work and training. No weatherization work had been done by the end of the day. There was no work order prepared for this training.
3. Topics addressed during training included:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. Did a demo of the new DG-700 gauge and showed then how to check for correspondence between gauges.
        iv. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        v. Walking around one unit that was unoccupied looking for leaks with blower door running.
        vi. Use of many blower doors simultaneously in a building (we used five).

vii. Importance of creating the same pressures in all the units simultaneously to eliminate air leakage between units whenever the entire building cannot be opened up to connect all parts of each unit.

b. Discussion of density of insulation in one blown wall. Handed out density calculation sheet but did not go through an example. Could not get their Krendl blower going because of wiring limitations in apartment unit.
c. Air sealing around chimney and plumbing stacks. They have been using aluminum flashing and doubling it up to get the two-inch setback around chimneys. I mentioned that the metal against the chimney should be 26-gauge galvanized tin.
d. Lengthy discussion of conditioned and unconditioned basements and crawl spaces. They do not insulate basement walls on the interior very often. They sometimes insulate these walls with rigid insulation on the exterior. They usually include the basement in the volume for the calculation of ACH. I mentioned that this was not correct.
e. They often do a blower door test with the basement door open and closed. This is good.
f. Importance of plugging holes at the top of the house first and most importantly.
g. Discussion of duct sealing, the difference between doing for energy savings or for health and safety. Lately they have sealed all joints in ductwork.
h. Discussion of using two-part foam in a crawl space for air sealing and R-value. In a basement, can be used for air sealing, but not spread continuously over interior wall unless covered with a fifteen-minute flame-spread rated material.
i. Strategized about the most productive order of work. Discussed blowing the walls that were accessible from the attic with the largest hose that would fit down the wall.
j. With a flip chart, did some instruction about zone pressure testing and the difference between pressures and flows.
k. Talked a bit about outfitting trucks for maximizing productivity.

Training in Bellows Falls, Vermont, June 10, 2003

1. Attending session:
    a. Rick Karg
    b. Lois Pasquerella, Boston DOE Office
    c. Dwight DeCoster, VT Technical Monitor
    d. Harald Schmidtke, weatherization director for local agency, SEVCA
    e. Brian LaFlam, energy coordinator
    f. Peter Bilodeau, auditor
    g. Mike Kohler, auditor
    h. Earl Niles, auditor
    i. Jay Miles, foreman
    j. Harold (Hap) O'Brien, foreman
    k. Pat Laduc, foreman
    l. Tony Coyne, crew technician

m. John Young, crew technician
n. Gary Roundy, crew technician
o. Dave Mack, crew technician
p. Keith Slobodnjak, crew technician
q. Todd Clark, crew technician
r. Maggie Kelly, office administrator
s. Winston Merrill, office administrator

2. Training was at house that had been converted to three apartments in Bellows Falls, Vermont. The pre-weatherization blower door test was 8194 CFM_{50} with the use of two blower doors (this closely corresponded to the auditor's single door test a few weeks earlier with a house pressure of 35 Pascals). The post-weatherization test yielded 6509 CFM_{50} at the end of the training day (not all planned work had been completed). House had two oil-fired boilers and separate direct-fired water heaters. These systems were in the full basement; the apartment units were on the first floor, second floor, and most of the converted attic space. House had vinyl siding and a ruble and brick foundation with a poured concrete slab. A detailed work order with drawings was done for this job/training.
3. Topics addressed during training included:
    a. Blower door
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
        v. Method of performing multifamily blower door testing so that leakage between apartments is eliminated.
    b. Discussion and calculation of density in one blown wall. Calculated the density of an open gable end wall in the third floor. Used Typar and strapping to treat inside of wall. Made small slits in Typar for insertion of tube for blowing from inside. Calculated a density of about 3.2 pounds per cubic foot.
    c. Air sealing around chimney and plumbing stacks.
    d. Importance of plugging holes at the top of the house first.
    e. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
    f. Basement air sealing. They put pieces of fiberglass in 13 gallon kitchen garbage bags and stuff them into the rim joist area.
    g. They removed fiberglass from the back of a knee wall in third floor, installed Typar and strapping, and then dense packed with cellulose.
    h. They usually seal the knee wall floor connection to the eave with fiberglass and cellulose.
    i. Talked with a large group of attendees about worst-case draft testing. They do not do this test very often.
    j. Talked with two auditors about zone pressure testing.
    k. Showed three auditors how to adjust defrost timer on refrigerator. They are not using a high/low thermometer to detect defrost cycle when they test refrigerators.

l. Gary Roundy demonstrated his two blowing boxes to show the difference in density between dense pack at 3.5, bad machine settings for 1.75, and nozzle blow (machine set up right) for 2.75 pounds per cubic foot.
m. Gary also showed his machine pressure gauge and his electrical connections for the blowing machine (for hooking up to different appliances in the house).

Training in Burlington, Vermont, June 11, 2003

1. Attending session:
    a. Rick Karg
    b. Jules Junker, state weatherization director
    c. Dwight DeCoster, VT Technical Monitor
    d. Elizabeth Chant, weatherization director for local agency, CVOEO
    e. Wayne Thompson, auditor
    f. Greg Wigginton, auditor
    g. Mark MacDurmon, crew technician
    h. Delano Bransfield, crew technician
    i. Larry Martell, crew technician
    j. Doug Dow, crew technician
2. Training took place at a three-unit apartment house in Burlington. Elizabeth Chant wanted to cover auditing procedures (spent few hours on this topic), advanced zone pressure testing (house not appropriate), air sealing (covered this in detail), and heating systems (did not do much with this topic). No weatherization work was done on the house while we were there. We conducted a blower door test with three doors used simultaneously, one in each apartment so that we could eliminate leakage between units. With the basement door closed we got these results: apt. 1, 6750 CFM_{50}; apt. 2, 1769 CFM_{50}; apt. 3, 1710 CFM_{50}. With the basement door open we got these results: apt. 1, 6291 CFM_{50}; apt 2, 4111 CFM_{50} (basement door was in this apartment); apt. 3, 1247 CFM_{50}. Although we were not able to reach 50 Pascals, all these values are extrapolated to 50 Pascals. Apartment 1 was on the second and third (finished attic) floors of the main house; apartment 2 was on the first floor of the main house; and apartment three was the first and second floors of the back addition.
3. Topics addressed during training included:
    a. Blower door
        i. Zeroing properly.
        ii. Using the analog and new digital gauges.
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running.
        v. Method of performing multifamily blower door testing so that leakage between apartments is eliminated (did this in the conference room at the office before going to the site).
    b. Conducted an energy audit together at the three-unit house. There was much discussion about the audit process.
    c. At lunch at local restaurant, spent time strategizing about work order for house.

d. Spent much time discussing air sealing, including around chimney and plumbing stacks.
e. Much time was spent walking around house while the blower doors were running to find leaks.
f. Importance of plugging holes at the top of the house first.
g. Discussed the issue of conditioned and unconditioned basements.
h. Discussed thermal envelope issues using basement and front porch as examples.
i. Knob-and-tube wiring was found and discussed.
j. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
k. Basement air sealing was discussed.

Training in Barnet, Vermont, June 12, 2003

1. Attending session:
   a. Rick Karg
   b. Dwight DeCoster, VT Technical Monitor
   c. Jim Ryan, energy coordinator, Newport
   d. Gene Tessier, foreman
   e. Gordon Brown, foreman
   f. Bruce Rowe, foreman
   g. Joel Penucci, foreman
2. Training took place at a single-family residence in Barnet. Most of the time at the house was spent with four foremen, just one level of weatherization staff. This worked quite well (first time this had happened during this pilot O^4S project). Did an audit-like inspection of the house. We first looked over the exterior and then the interior. House had some challenges presented by part that was being renovated with open connections to the other conditioned part of the house. Most ceilings were suspended. Almost all the ductwork in the basement (connected crawl under the kitchen) was disconnected for some reason. Blower door test revealed a CFM_{30} of 5400 and a CFM_{50} of 7560. No weatherization work was done to the house during day, but we did cut access to the attic and inspect.
3. Topics addressed during training included:
   a. Blower door
      i. Zeroing properly (they were zeroing the analog gauges with the outdoor hose disconnected).
      ii. Using the analog and new digital gauges (demo of DG-700).
      iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
      iv. Walking around house looking for leaks with blower door running.
   b. Conducted an energy audit-like inspection with foremen.
   c. Spent much time discussing air sealing, including around chimney and plumbing stacks.
   d. Much time was spent walking around house while the blower doors were running to find leaks.
   e. Importance of plugging holes at the top of the house first.
   f. Discussed the issue of conditioned and unconditioned basements.

g. Discussed thermal envelope issues using basement as example. Looked like basement floods regularly, so this brought up IAQ issues with duct sealing.
h. Discussed perimeter wrap on interior of basement wall. They do not do this much in at this agency or in Vermont.
i. In basement CAZ, measured CAZ WRT outdoors while air handler was running. Thought we might find high negative pressure because of all the duct disconnects. Found little pressure change when air handler came on (probably because of equal supply leakage). Had a good discussion about worst-case draft testing. They do not do this much in Vermont or at this agency.
j. Knob-and-tube wiring was found and discussed.
k. Discussion of duct sealing, the difference between doing for energy savings or for health and safety. They seal most duct joints.
l. Cut access into attic. Once we got up there, we found another access hidden by the suspended ceiling below. Found a few inches of rock wool in attic. Discussed the addition of cellulose and the dense packing of some walls with open tops in attic.
m. Went over the insulation density calculation sheet together in detail. Discussed the importance of method with tube and equipment in truck.

Training in Barre, Vermont, June 13, 2003

1. Attending session:
   a. Rick Karg
   b. Jules Junker, state weatherization director
   c. Dwight DeCoster, VT Technical Monitor
   d. Bill Hulstrunk, weatherization director for local agency, CVCAC
   e. Dave Oszajca, energy coordinator
   f. David Smith, auditor
   g. Geoff Wilcox, auditor
   h. Randy Bright, auditor
   i. Bob Johnson, subcontractor
   j. David Plante, subcontractor
   k. Michael Plante, subcontractor
   l. Kevin DuPont, subcontractor
   m. Raymond Spenser, crew technician
   n. Jen Phips, crew technician (volunteer)
2. Training took place at a very old single-family residence in rural Barre. Addition and conditioned section of house was built in 1830; the unconditioned section of the house was much older. Blower door readings were 3350 CFM_{50} with the basement door closed and 4650 CFM_{50} with the basement door open. The full basement in the addition section of the house has a ruble foundation that has been studded out and dry walled. The ceiling is dry walled also. There is much mold, rot, and mildew at this wall, especially at its lower sections. Removing this is beyond the scope of weatherization, so if the elderly couple cannot get it removed in some other way, the house will be a "walk-away", in other words, no weatherization will be done. There is also an open concrete cistern in the basement with paint chips and fiberglass above it and rat poison in two or three

places around it. During the day at the house we did no weatherization, but only did testing and strategized about the possible weatherization work.

3. Topics addressed during training included:
    a. The training day began in the office for a few hours because we could not get into the house until 10:00. At the office we discussed ductwork sealing and insulating, worst-case draft testing, and the importance of defining the thermal boundary correctly (using the basement as an example).
    b. At lunch we went back to the office and discussed the weatherization strategy for the house and Karg gave an introduction to zone pressure testing. We did a bit of zone pressure testing at the site after lunch.
    c. Went back to the office for a wrap-up at the end of the site visit in late afternoon.
    d. Blower door
        i. Zeroing properly.
        ii. Using the analog and new digital gauges (demo of DG-700).
        iii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iv. Walking around house looking for leaks with blower door running. This seemed to be very helpful. Discussed methods of determining whether leaks are to the outdoors or to the basement (used kitchen base cabinets as example). Opened the basement door and the leakage slowed significantly.
    e. Spent much time discussing air sealing, including around chimney and plumbing stacks.
    f. Discussed the issue of conditioned and unconditioned basements.
    g. Discussed thermal envelope issues using basement and front porch as examples.
    h. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
    i. Basement air sealing was discussed.

General Observations and Recommendations for State of Vermont Weatherization Program

[These observations have been deleted from this document for general distribution]

Dwight DeCoster Report on Vermont Training

One-on-One On Site Training with Rick Karg
June 9th through the 13th, 2003
Vermont Summary Report

June 30, 2003

The State of Vermont's Weatherization Assistance Program hosted a weeklong training with Rick Karg of R.J. Karg Associates. Vermont has four Community Action Programs (BROC, CVCAC, CVOEO and SEVCA) and one non-profit organization (NETO) that deliver the weatherization service. Out of these five, three agencies are crew-based and two are a mix of crew and subcontractor delivered services.

Vermont chose to offer each of the five agencies one day of training during this training period. Vermont's program has many long time employees with very little turnover of staff. This provided a challenge in that more advanced training was necessary in order to be of value to our crews and auditors. Dwight DeCoster of the Office of Economic Opportunity worked closely with both Rick Karg and each of the agencies Weatherization Directors to ensure that the training provided during the week would be quality training that would raise the bar for Vermont's program.

What came out of the many discussions that occurred prior to the training taking place was that the Weatherization Directors wanted to utilize this training for all their crews and auditors rather than a few people. As such this training took on a slightly different look than what had been done in the other states.

The first day of training was held in Brandon, Vermont with Rick Karg, Dwight DeCoster, 3 auditors and 6 crewmembers from Bennington-Rutland Opportunity Council's Rutland office. The training was held at a six unit multi-family that was undergoing major rehabilitation work with funding from a number of sources. The training that took place was:

- Basements – in or out of the conditioned space
- Multi-family Blower door testing
- Blower door assisted air sealing
- Pressure diagnostics as an installer tool
- Dense Pack cellulose installation and density calculations

The participants gained a great deal of training from this day. There was a strong connection made between what the auditor's job and the crewmember jobs were and a greater understanding was brought out. All participants' felt that they had learned a great deal from Rick's visit and were eager for him to come back for another day if possible.
Visitors for the day included Ed Fuller, BROC Weather Director and Jules Junker, Vermont Weatherization Program Manager.

Important lessons learned for future training were:

- Ensure that back up generator power is available if there is any doubt about the structures power system.

- Ensure that all tenants in building are aware of training and that appropriate arrangements are made for those tenants unable to leave the building.

The second day found Rick and Dwight traveling to Bellows Falls, VT, in the southeast corner of the state, to work with SEVCA's three auditors and seven crewmembers. Also present for a good portion of the day were Harald Schmidtke, Weatherization Director and Brian Laflam, Coordinator.

Once again the focus of the training was centered on a large two unit multi-family building with many issues on both the weatherization side as well as the health and safety side. Training for the day consisted of:

- Multi-family blower door testing
- Dense pack Cellulose installation and density calculations
- Pressure Diagnostics
- Blower door assisted air sealing

This training went well with all participants agreeing that the day had gone almost to plan and that it was a worthwhile venture. Our lone visitor of the day was Lois Pasquerella from DOE Boston Region Support Office.

An important lesson learned for the future training was that if Blower Door Assisted Air Sealing is a major subject it would be better to train on a building that was already partially weatherized with the insulation and the major air sealing done prior to the training. This would enable the training to be more productive when attempting to show how to look for those sneaky air leaks that can be hard to find.

The third day of training found Rick and Dwight traveling to Burlington to visit with CVOEO's three auditors and four crew chiefs and CVOEO's Weatherization Director, Elizabeth Chant. Once again we had a large Victorian multi-family to train on. The day started out with a walk-through of the house. A major goal of this training was to improve the understanding of the crew chiefs in regards to the process the auditor's go through. Rick then spent considerable time working with everyone on:

- multi blower door tests
- combustion safety
- blower door assisted air sealing.

This house was another of those where the blower door assisted air sealing piece would have been more effective had the house been further along in the weatherization stage. As this house was extremely leaky, in the range of 13,000 CFM_{50}, it still had many opportunities for blower door assisted air-sealing training.

Jules Junker visited for some of the day and participated in the multi blower door training as well.

NETO was the beneficiary of the fourth day of training. Rick and Dwight met four crew chiefs from NETO's Newport and St. Johnsbury offices in Barnet, VT in the northeastern corner of the state. This was to be our first non-multi-family training of the week as we were working with an old farmhouse that had many issues to be resolved. The training

began with a reading of the job specifications with everyone listening in. The training then progressed to:

- Blower door maintenance and testing
- Attic prep
- Creating a thermal boundary where none exists
- Combustion Safety testing
- Worst case draft testing
- Duct work repair and balancing
- Dense pack cellulose density calculations

The training went very well with the entire group saying that the time was the best training that they had ever been through. This compliment says a lot as this group of crew chiefs is one of the most experienced in the state. One of them has 24 years of experience with the Vermont Weatherization program!!

The final day of training was located in Barre, VT. Bill Hulstrunk, Weatherization director from CVCAC had a large group of 3 auditors, one crewmember and 3 different subcontractors present at this training. The training got off to a slow start as at the last minute the client whose home we were going to be working in called and said we would not be able to arrive until 10 am. Not wanting to sit idle and wait, Rick used the time for a question and answer period so that we could get some of the simple questions out of the way first. At 10 am we arrived at the clients home and immediately began to train on:

- Blower door testing and maintenance
- Pressure diagnostics for the installer
- Moisture mitigation
- Blower door assisted air sealing
- Worst Case draft testing.

The training went very well. An issue with one of the subcontractors blower doors was discovered and is being remedied. Jules Junker visited the site and spent a good time visiting with the client waiting for us to return from lunch and then joined in the remaining afternoons training.

The overall reception to the O^4S training was very positive. Every one appeared to get a lot out of the training. Some of this knowledge was new while other information was a refresher. It is always an advantage to have a trainer of Rick Karg's knowledge on site in an almost one on one situation. The Office of Economic Opportunity staff and the rest of the Vermont WAP Network are looking forward to the second phase of O^4S training.





Upper Left: Six unit multi used for BROC's day of training
Upper Right: Rick Karg leads a discussion on "Is the basement in or out of the conditioned space and how do we treat that space."
Middle Left: The group listens while Rick talks about the different gauge options for the blower door testing.
Middle Right: Rick explains to Trevor that he needs to clean his window.

Lower Left: Just one of the many health and safety issues that were discovered in this building. This is an atmospherically vented LP gas hot water heater that is situated in a box that can only be accessed from the attic. The huge uninsulated bypass to the second floor is minimal compared to the fact that this unit could not be maintained in the current situation.

Clockwise from upper left: #1 Rick discusses dense pack cellulose with installers from BROC. #2 Rick discusses the finer points of blower door maintenance and testing with the SEVCA crew members. #3 Gary Roundy displaying all of his time-saving gadgets and techniques to Rick #4 The CVOEO Weather staff eagerly await Rick's training in Burlington.
#5 Rick and Greg Wigginton from CVOEO's southern office discuss how to handle this unvented gas kitchen range. #6 The reading of the job specifications prior to beginning work in Barnet, VT with the crew chiefs of NETO.

Bruce Rowe seems to be enjoying Rick's demonstration of DG700 when utilized to do worst case draft testing.

Appendix

Training Evaluation Questionnaire Results

The number of evaluations collected varied widely from on state to the next. This was because some did not get turned in by local or state administrators and in a few cases the trainer forgot to ask the attendees to complete an evaluation form. The number of evaluations collected from each state is listed in the table below.

Table 3
Training Evaluations Collected from
Participants Attending an O^4S Training Event

State	*Evaluations Collected*
Connecticut	16
Maine	57*
Massachusetts	13
New Hampshire	6
Rhode Island	5
Vermont	37

* The evaluations from the Maine trainings were recorded on the Maine State Housing Authority (MSHA) standard evaluations form rather than the form drawn up by Karg for the O^4S training. The MSHA for is different than the form made up by Karg.

Recommended Additions to Evaluation Questionnaire

Comments regarding the state weatherization program would be useful to collect from auditors, crew members, and contractors. This might yield useful information regarding barriers and problems with the various state protocols and administration. The following three questions are recommended as an addition to the evaluation questionnaire used for this pilot project (Please see the blank questionnaire on the next page).

1. What is the biggest problem you have with the weatherization program in this state?
2. How can the Wx program in this state improve?
3. What is the best thing about the Wx program in this state?

These questions are intended as short-answer questions rather than requiring circling a rating number between 5 and 1.

Training Evaluation Summaries

The summaries of the participant evaluations are listed on the following pages. The answers to the 5-to-1 rating questions have been averaged. The answers to the short-answer questions have been recorded in the appropriate section of the questionnaire for that state. The original participant questionnaires are available for examination at the office of R.J. Karg Associates.

The fifty-seven evaluations from the Maine training participants were recorded on the Maine State Housing Authority (MSHA) standard evaluations form rather than the form drawn up by Karg for the O^4S training. The MSHA for is different than the form made up by Karg. The Maine evaluation responses are summarized on the MSHA form.

Training Evaluation Form

By taking a few minutes to evaluate the training experience on _____in _____, _____, you will help us improve future training sessions. Please be honest about the experience; don't be afraid to offer constructive criticism. Thank you.

	Circle Number				
Training Topics	**Good**				**Bad**
1. The training covered the topics I wanted.	5	4	3	2	1
2. It taught me useful methods and skills.	5	4	3	2	1
3. It provided me the chance to ask questions.	5	4	3	2	1
4. Do you think you will have fewer re-works or call-backs as a result of this training?	5	4	3	2	1
Trainer					
5. He was knowledgeable about the topics discussed.	5	4	3	2	1
6. He presented information so that I could understand it.	5	4	3	2	1
7. He gave me the answers I needed.	5	4	3	2	1
Overall Training Experience					
8. How do you rate the overall training experience?	5	4	3	2	1
9. Will the training help you do your job better?	5	4	3	2	1
10. Was the training worth your time and attention?	5	4	3	2	1

11. What did you like BEST about this training?

12. What was the LEAST IMPORTANT topic covered?

13. What topics should be ADDED?

14. How will this training HELP YOU in your weatherization work?

15. How do you think this training can be IMPROVED?

Training Evaluation Form, Connecticut Summary, 16 Respondents

By taking a few minutes to evaluate the training experience on _____in _____, _____, you will help us improve future training sessions. Please be honest about the experience; don't be afraid to offer constructive criticism. Thank you.

	Circle Number	
Training Topics	**Good**	**Bad**
1. The training covered the topics I wanted.	4.1	
2. It taught me useful methods and skills.	4.6	
3. It provided me the chance to ask questions.	4.8	
4. Do you think you will have fewer re-works or call-backs as a result of this training?	3.9	
Trainer		
5. He was knowledgeable about the topics discussed.	4.6	
6. He presented information so that I could understand it.	4.4	
7. He gave me the answers I needed.	4.4	
Overall Training Experience		
8. How do you rate the overall training experience?	4.3	
9. Will the training help you do your job better?	4.5	
10. Was the training worth your time and attention?	4.3	

11. What did you like BEST about this training?
"Hands-on approach; all contractors were involved; zone testing; teacher showed good methods; don't know what all topics were; blower door and free lunch; good atmosphere and trainer was complete and thorough; everybody had a chance to give opinions; food; I had the opportunity to ask; able to close up areas where it counted most; we covered areas that we don't usually cover; insulation in basement; finding areas that were leaky as far as heat loss; the opportunity to ask questions; the simple methods, techniques, and materials to use when air-sealing a home."

12. What was the LEAST IMPORTANT topic covered?
"Everything was useful; none; in my opinion all topics were of essence; everything was important; what was 4 lunch; everything was important; safety; safety and ventilation; bathroom venting; air seal; safety; there was none in my opinion;?"

13. What topics should be ADDED?
"More on infrared usage; none; different approach in weatherization based on climatic conditions; I think that he covered all the topics that we really need; a complete list of structure; to do the job better; more on safety with power tools; more about air sealing in unheated areas where there is a washer and dryer or both; none; safety and power tools; insulating duct work?"

14. How will this training HELP YOU in your weatherization work?
"Understanding different house pressure techniques; this training will help auditors especially on how to do this evaluation; it will make my job easier; to be more thorough doing my audits; do a better job; it has provided helpful and useful information that is practical; Job be easier; it won't; they have different methods; to do the job better; more knowledge in tightening up area of concern; making me more aware of places to look for leaks where I never would have looked; none; able to tighten the envelope; it will help me understand the scope of the job; to understand the importance and impact of blower-door air-sealing."

15. How do you think this training can be IMPROVED?
"More videos; regular updating information on house tightness, airflow/changes per hour, etc.; it was good; more regularity, especially in the zoning technique; if a person is scheduled for training, let him attend the session instead of sending them to work at other houses; I really don't know; I think the training met all requirements to my standards; stop having different people with different methods come teach us, it turns everything around; more hands on; more hands on; more training; any question asked was answered; more hands on; devote more time to the insulation/cellulose portion; more time per agency

Training Evaluation Forms, Maine Summary, 48 Respondents

MAINE STATE HOUSING AUTHORITY
EVALUATION FORM
Dense Blow Cellulose for Installers
August 25, 26, 27, 28, 2003

Please take a moment to fill out this evaluation. Your feedback is important. Comments received will help us plan future training events. Completed evaluation forms should be turned in before leaving.

Please circle the number which best describes your response to the following:

		Scale: (Excellent)	(Fair)	(Poor)
1.	Value of information for you		4.3	
2.	Effectiveness of presenter	4.4		
3.	Value of session interaction		4.5	
4.	Content	4.3		
5.	Rate the increase of your knowledge on the subject matter			
6.	as a result of this discussion		4.2	

7. What, if anything, will you do differently as a result of this training?
"Attic bypass walls, dense pack walls better; buy a newer blowing machine; nothing; pay more attention to the process of dense blowing walls; assess dense pack; nothing; more maintenance on blower machine and do more extensive observations on job; pop more siding on post wx inspections; observe contractor dense pack closer; test density of cellulose; I would like to start core sampling; keep equipment better maintained; make sure tube is in place before blowing; lunch; try harder to properly dense pack; nothing; issues need to be addressed before future training, what are we doing, is it really dense packing; try to dense pack better; more air and less feed and take more time on filling voids; it still leaves questions to be answered; higher air pressure on machine; has not changed anyway I already do things; buy a new blower; purchase a new insulation blowing machine; not much overall; spend more time evaluating job/pay more attention to applications of product; watch for density of cellulose; nothing; make sure the dense pack is consistent in entire cavity; do more measurement, experiment with dense blow; pay more attention to details of envelope; dense pack for effectively; drill more holes and check more often; N/A; not sure."

		Too long	Just Right	Too Short
8.	Length of workshop/session	4	42	2
		Yes	Probably	No
9.	I would recommend this workshop to a colleague	38	10	0

10. What is the most important knowledge or skill gained?
"New Krendl blower is inadequate; depressurizing the house; none; can't assume anything; density core sampling; accuracy of dense packing cellulose; realizing the ways things are being done; how to do core sampling; maintenance; dense blowing is difficult and the one-hole method doesn't always work; effectiveness; testing the density of blown insulation; densities needed in walls; keep equipment better maintained; different drills used to drill walls and dense pack; none; seal stuff; amount of insulation in wall cavity; better ways to blow; how to dense pack and how to maintain blower; methods; a number of things need to be investigated; dense packing; principles and theory of dense pack; density, what to try and accomplish; core samples (density a different machine settings); control of blow for max density, drill bits; understanding the value of properly dense packing structure; application techniques and end product status desired; product application; core samples need to be done; knowing our contractor does dense pack blowing; better understanding of dense packing; maintain your equipment, you can't dense pack if your equipment can't do it; what dense pack is; do we really do dense blow, found every machine is

different; dense pack; dense pack procedure; machines need updating; N/A; overall function of units; pressure test results."

11. How could the training/workshop be improved?
"T shirts, sweatshirts, free lunch; use tow or more homes in session, newer and older ones to get different results; fine on-site; keep it the same; better testing equipment; fine the way it is; see-through walls; smaller group; closer to home; be more organized; it couldn't; note sure; more visual training, something clear so you see how it all works; more stuff; need to learn more about the proper dense packing methods, what works, what doesn't; more problem solving; N/A; should have class before workshop; different homes; work on different types of walls; mock walls; more time to complete a whole house; nothing noted; don't need to do the entire house to understand the principles required; different sites for same people; steak dinner; I think it was fine; I thought is was fine; try houses with different width bays; closer to Milbridge; perfect; note sure; more trainings."
12. What specific issues/subjects would you like to see covered in future trainings? "Cellar walls; more dense blowing; R-values; envelope trainings; none; same training on newer house; have training aids like simulated walls; blowing fiberglass in trailers; how to achieve dense pack; we need to address dense pack first; more floor and attic work; equipment usage; slants; dense packing walls; more innovative ideas on all aspects of weatherization; interested in understanding all issues concerning weatherization; more instrument training; instrument training time; none; this one was fine; more on dense packing; further results; N/A."
13. Other comments? "Good job; it was a very informative workshop and I'm looking forward to the next one; good training overall; have another training – correct problems; where was lunch; we had a lot of fun; testing seems to be in development stages and somewhat imperfect; none this time; all really keen about dense packing; I like learning more and more every day; N/A; I am new to the company and I'm very impressed with sense of knowledge, you showed me the thermal imager; great training."

Training Evaluation Forms, Maine Summary, 9 Respondents

MAINE STATE HOUSING AUTHORITY
EVALUATION FORM
Dense Blow Cellulose - Rick Karg
10/14/03

Please take a moment to fill out this evaluation. Your feedback is important. Comments received will help us plan future training/workshops. For each component, please circle the number which best describes your response to the following:

Dense blow demonstration (in shed)	Excellent……..…….Poor		
1. Value of content/information for you	4.9		
2. Effectiveness of training/workshop presenter	4.8		
3. Value of session interaction	4.7		
4. Rate the increase of your knowledge on the subject matter as a result of this workshop/session	4.4		
5. Length of workshop/session	Too long	Just Right	Too Short
	0	7	1

Hands-on cellulose installation (Main house)			
1. Value of content/information for you	4.6		
2. Effectiveness of training/workshop presenter	4.6		
3. Value of session interaction	4.6		
4. Rate the increase of your knowledge on the subject matter as a result of this workshop/session	4.6		
5. Length of workshop/session	Too long	Just Right	Too Short
	0	7	1

Blower door demonstration			
1. Value of content/information for you	4.5		
2. Effectiveness of training/workshop presenter	4.8		
3. Value of session interaction	4.5		
4. Rate the increase of your knowledge on the subject matter as a result of this workshop/session	4.3		
5. Length of workshop/session	Too long	Just Right	Too Short
	0	6	1
I would recommend this workshop to a colleague	Yes	Probably	No
	8	0	0

What is the most important knowledge or skill gained?
"Demo of bay filling with blower door operation; what happens in the wall cavities with different methods; seeing how the hose and insulation worked in the demonstration; dense blow demo in shed, different ways to run the hose; blower door, wrong ratings on blowers; the proper density and how it can be checked; most about dense pack blow."

How could the training/workshop be improved?
"None; longer, more methods; put obstacles in bays; just right."

If another training/workshop was offered in the future, what specific issues/subjects would you like to see covered?
"Not much, very thorough as is; materials that work, what doesn't work; slopes; more about dense fill."

Additional Comments: "Great job; good day."

Training Evaluation Form, Massachusetts Summary,13 Respondents

By taking a few minutes to evaluate the training experience on _____in _____, _____, you will help us improve future training sessions. Please be honest about the experience; don't be afraid to offer constructive criticism. Thank you.

	Circle Number	
Training Topics	**Good**	**Bad**
1. The training covered the topics I wanted.	4.5	
2. It taught me useful methods and skills.	4.2	
3. It provided me the chance to ask questions.	4.7	
4. Do you think you will have fewer re-works or call-backs as a result of this training?	4.2	
Trainer		
5. He was knowledgeable about the topics discussed.	4.8	
6. He presented information so that I could understand it.	4.8	
7. He gave me the answers I needed.	4.8	
Overall Training Experience		
8. How do you rate the overall training experience?	4.6	
9. Will the training help you do your job better?	4.5	
10. Was the training worth your time and attention?	4.6	

11. What did you like BEST about this training?
"Interacting with the contractors and higher brass, this would help contractors understand what we expect of them; it showed the contractor exactly what we expect as far as dense packing walls and sealing attic chases, etc.; it was done with just one contractor at a time; the experience; got to learn things I did not know; I was able to ask questions; how the trainer went step by step; more information; learned a little more; very informative/useful towards future work; chance to see output of blower; lots of good information; very informative."

12. What was the LEAST IMPORTANT topic covered?
"Every topic was very informative, I don't think any topic was the least important!; none; everything was vary important; minor air sealing; none, they were all important; everything was important; nothing/everything was useful; none; voltage on generator."

13. What topics should be ADDED?
"More on health and safety issues; fire safety; a hands on for everyone with blower door; fire safety; not sure; ventilation; N/A; none; ventilation."

14. How will this training HELP YOU in your weatherization work?
"This will help us with the contractor to reduce call backs, because if they know what we expect then they'll know exactly what they have to do; should help in reducing contractor call backs; it will help the crew (especially the newer workers) understand why things are done the way they are – it will also help us determine when our equipment is not up to par and needs servicing; shows how to do better and faster; to improve our working skills; performance; it will help me make my job better; a hole lot more; to do it right; it will give me more knowledge on different types of jobs; N/A; it will help me do the work more efficiently; every person ends up on the same page."

15. How do you think this training can be IMPROVED?
"All contractors should be required to have one of these trainings; should be required for all contractors; a training manual that can be left with the crew; more time; none, I feel it was successful; I can't think of how it can be improved; not sure; inspectors at every job; every employee doing weatherization should be certified; having actual classes on these topics."

Training Evaluation Form, New Hampshire Summary, 6 Respondents

By taking a few minutes to evaluate the training experience on _____in _____, _____, you will help us improve future training sessions. Please be honest about the experience; don't be afraid to offer constructive criticism. Thank you.

	Circle Number	
Training Topics	**Good**	**Bad**
1. The training covered the topics I wanted.	5	
2. It taught me useful methods and skills.		4.8
3. It provided me the chance to ask questions.	5	
4. Do you think you will have fewer re-works or call-backs as a result of this training?	4.7	
Trainer		
5. He was knowledgeable about the topics discussed.	5	
6. He presented information so that I could understand it.		4.7
7. He gave me the answers I needed.		4.8
Overall Training Experience		
8. How do you rate the overall training experience?	5	
9. Will the training help you do your job better?		4.7
10. Was the training worth your time and attention?		4.8

11. What did you like BEST about this training?
"Great training, went further than we need; allowing for questions; blower door; air sealing topics; the hands on training and seeing all the testing, the open discussion on all parts of the house; it was informative about air sealing the envelope."

12. What was the LEAST IMPORTANT topic covered?
"N/A; furnace; furnace related topics; lunch; what is for lunch."

13. What topics should be ADDED?
"Dependent on situation; none; dense pack related location; how often should we calculate worse-case draft; what is for lunch."

14. How will this training HELP YOU in your weatherization work?
"Increase the efficiency of auditing work and more understanding of weatherization topics; more knowledge; overall performance; makes me more experienced, a much better understanding of SIR, the definition of the thermal envelope of the house; trains you to evaluate area better before work."

15. How do you think this training can be IMPROVED?
"N/A; more hands on work; more trainings; find worst-case scenarios."

Training Evaluation Form, Rhode Island Summary, 5 Respondents

By taking a few minutes to evaluate the training experience on _____in _____, _____, you will help us improve future training sessions. Please be honest about the experience; don't be afraid to offer constructive criticism. Thank you.

	Circle Number	
Training Topics	**Good**	**Bad**
1. The training covered the topics I wanted.	4.8	
2. It taught me useful methods and skills.	4.8	
3. It provided me the chance to ask questions.	4.7	
4. Do you think you will have fewer re-works or call-backs as a result of this training?	4.6	
Trainer		
5. He was knowledgeable about the topics discussed.	4.9	
6. He presented information so that I could understand it.	4.8	
7. He gave me the answers I needed.	4.8	
Overall Training Experience		
8. How do you rate the overall training experience?	4.9	
9. Will the training help you do your job better?	4.8	
10. Was the training worth your time and attention?	4.7	

11. What did you like BEST about this training?
"Group size made it ideal to conduct and interesting training session (class room and site), informative regarding dense-pack and pressure diagnostics; class room training, trainer very good; hands-on approach in the field is always the best way for all to learn; answered some of my questions; we had enough time to cover the subjects in depth."

12. What was the LEAST IMPORTANT topic covered?
"It would have been more interesting with actual CETs included in the in-field portion; field training, too much down time; too time consuming; moving around could have been more planned."

13. What topics should be ADDED?
"More on siding removal and reinstallation, gas leak detection and consideration of purchase of CGI meters and periodic inspection of same; on-site mobile home work; none at the moment; have equipment standards, train with what we use in the field."

14. How will this training HELP YOU in your weatherization work?

15. How do you think this training can be IMPROVED?
"It's interesting to note other states' parameters for home audit, such as Maine's policy of not testing heating units; having qualified trainer is important; instructor was well informed and made a good presentation, I enjoyed it."

Training Evaluation Form, Vermont Summary, 37 Respondents

By taking a few minutes to evaluate the training experience on _____in _____, _____, you will help us improve future training sessions. Please be honest about the experience; don't be afraid to offer constructive criticism. Thank you.

	Circle Number	
Training Topics	**Good**	**Bad**
1. The training covered the topics I wanted.	3.5	
2. It taught me useful methods and skills.	3.7	
3. It provided me the chance to ask questions.	4.5	
4. Do you think you will have fewer re-works or call-backs as a result of this training?	3.3	
Trainer		
5. He was knowledgeable about the topics discussed.	4.8	
6. He presented information so that I could understand it.	4.7	
7. He gave me the answers I needed.	4.2	
Overall Training Experience		
8. How do you rate the overall training experience?	4.1	
9. Will the training help you do your job better?	3.8	
10. Was the training worth your time and attention?	4.0	

11. What did you like BEST about this training?

"Availability to relate to Rick one-on-one and in group sessions as needed; ability to ask and receive answers; talking with Rick; communication of ideas; able to ask Rick questions one-on-one; exchange of ideas and experience; blower door testing; gave me better understanding of blower door test; Gary Roundy's boxes; being able to ask questions; the engagement of all staff, interest shown; pressure testing; it was actually on a job, would have been helpful if we had a second day, one day for the crew workers and for auditors and supervisors, really useful info, but with the combo of crew and office staff, the topics and info were too generalized; diagnostic approach; that it was on the job on a job site instead of in a room somewhere being lectured; it was very informative training; saving crew people and auditors together so crews can see job from auditors perspective and vice versa; it was good to get some different views on how to do things differently; ways to save us time at certain things and the things to concentrate on; the info on heating ducts; got some questions answered; multi-blower door testing; Rick was helpful about training; multi-blower door testing; interaction between subcontractors, crew, auditing staff and trainer, he involved all people and made all of us feel a part of a team; on site session was very helpful, although classroom session was very helpful, too; the honest knowledge, no BS answers; bringing the trainer to the homes we work on."

12. What was the LEAST IMPORTANT topic covered?

"Figuring density by math; math questions; dense pack; none; N/A; ?; all topics were equally important; I think because we had the whole staff at the training that all went well, there are some things that I thought were unimportant to me, but I am positing it was very important for crew workers, very happy with the training; the actual setting up of blower doors because there was no follow-up info gathered; pressure testing; were none that I could think of; how to seal the bottom of the walls; blowing walls; none that I can think of; the part of what to do in the attic; how to use the new blower door high tech gadget; electrical; none; none; N/A; some of the pressure diagnostics too in depth, would have been good if not other things more important to go over; the pizza for lunch; cannot think of any."

13. What topics should be ADDED?

"Blower door assisted air sealing; more on heating; trapping moisture when home is too tight; CAZ testing and heating systems; pressure diagnostics; heating systems, especially duct work; heating systems, how they work; Gary Roundy's test boxes; mold issues; heating systems; duct work sealing; more targeted air sealing; air sealing techniques; more actual hands on, pressure diagnostics, its not that the info given wasn't good, but a lot of times learning how and why things happen is easier by actually doing it; we never really got to pressure testing as a diagnostic tool; dense pack cellulose; because of time constraints, could not do

more about actual on the job training; none; attacking air sealing; I think that more of the stuff we were showed needs to be explained to some of our top decision makers in the state; should we do windows or leave them alone; electrical work; carbon monoxide numbers and how and when to test ovens; more hands on training; did a fine job with all the topics that I wanted covered; our training needs are in other areas; depends on the training; a hands on furnace training, on a short cycling furnace; moisture and mold; more diagnostic and troubleshooting of furnaces."

14. How will this training HELP YOU in your weatherization work?

"More knowledge; raised more questions than it answered; better evaluate air leakage opportunities; better understanding of blower door evaluation; finding the problems easier; adds to the overall understanding of things; help me be more thorough; we didn't really get into what to do and not to do on audits, we touched on some or a few small topics but nothing elaborate; now I know not to use Insul-Shield up to chimneys; has made me more aware of finer points; it has made me realize more about the home and how it works sometimes; I don't know if it will; defining work areas and making a plan of attack; it gave me some more insight on different ideas; more specific on things to do and not to do; understand more about the heating system; blower door test; when to decide not to do some testing and when it is needed; it will help us to find leaks to tighten a house; I have a better understanding of multi-blower door testing; pass the information on to others; not at all, sorry; as a coordinator, this training will help pick out possible measures that, depending on circumstances, should or should not be done, having a clearer picture of building needs on an individual basis makes for more effective weatherization; pressure diagnostics, furnace diagnostics; pinpoint where to air seal; by answering questions and helping us promote our work better."

15. How do you think this training can be IMPROVED?

"House needs to be brought down to tighter CFM before hand, make the big hits first; more use of Gary Roundy's density box; several point specific rather tan general broad topics; need to better prepare the site; Gary Roundy's test boxes; getting more knowledge on how blower door works; have a prepared house; have a house ready and do the small-stuff air sealing; better site preparation for the blower door directed air sealing; make it longer!; better coordination with owners and proper operation of insulating machine should have been done prior to arrival on site; the training should be extended to two days; spend more than one day; I am not sure; possibly another day; more hands on training; have the people that make the decisions here; have crew and crew chiefs go through it; how can you improve on Rick Karg; more than one day of training; better knowledge of training site before class begins; the cart came before the horse on this one, first identify the need, then train to it; perhaps by very specific and detailed trainings on singular issues – i.e., using blower door or air sealing or heating system diagnostics – relative to improving weatherization techniques; fewer people and less unrelated questions by them; have more trainings; by having ongoing trainings on a periodic basis."