Project Assessment Report, Phase 2

for the

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

conducted for the

Northeast Region Weatherization Program

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

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Program Manager, Client, and Auditor in New Hampshire

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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. Included in the contract scope of services was:

> [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] This approach corresponds with Weatherization *Plus* strategies.

As the project developed, it became larger in scope than defined initially. 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.

Phase 1 (pilot) of the project took place during 2003. At the end of this Phase, after the six New England states had received training, the seven state Weatherization Program Managers and US Department of Energy Boston Regional Office Weatherization Program Supervisors decided to fund a second year of training – Phase 2.[4] Rick Karg was again the only trainer. The budget for Phase 2 allowed at least five days of training in each of the six New England states, with the possibility of a day or two more.

The expected results of Phase 1 and 2 of the project were:

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[1] During Phase 1 of the project, New York was negotiating for in-house trainers, so they graciously opted out of the project, giving permission to allocate their training days to the remaining states.
[2] Source: O⁴S Project Proposal by R.J. Karg Associates, page 2.
[3] *Ibid*, page 2.
[4] Again for Phase 2, New York graciously opted out of the project, allowing their training days to be allocated to the six New England states,

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".
4. The O^4S Project is likely to help crew and contractor workers feel more a part of the weatherization process and network.[5]

Because the project has not been formally evaluated, it is not possible to determine if these results have been fully realized, however, it seems likely that Phases 1 and 2 of the project have achieved the expected results to a significant degree for the six affected weatherization programs.

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 12 or this report for more information.
2. Training needs of the weatherization personnel in the six New England States. Refer to page 15 of this report for a detailed list of training needs.
3. Suggested alterations to the six New England weatherization programs. Refer to page 17 of this report for more information on this topic.
4. The importance of region-wide initiatives. Refer to page 18 of this report for more information.

Suggested Training Formats for Phase 2

On April 26, 2004 Karg sent an e-mail message to the New England weatherization program managers that suggested four O^4S training formats or models for the Phase 2 round of training. These formats were based on the training experiences in the six states during Phase 1, but had not yet been identified or named. The formats suggested were 1) typical-work-day model, 2) gathering-of-contractors model, 3) gathering-of-auditors model, and 4) classroom training model. Karg hoped that identifying these models would help state managers select the most effective format – or formats – for the unique characteristics of each of their programs. During the Phase 2 sessions, these models were used in the following ways.

For the typical-work-day model, Karg spent the day with a contractor or agency-employed crew at a site. The people at the sites included auditors, monitors, and state managers. Karg discussed the work with the contractor and workers, discussed the work order with the auditor, critiqued the audit and work, helped with the tasks, and summarized at the end of the day. The number of people at sites varied from five to twenty. This model was used most during Phases 1 and 2.

The advantages of the typical-work-day model included:

- Each person on site got attention from instructor.
- There was usually adequate time to address details of work and methods.
- States were able to select needy contractors/crews for training.

[5] *Ibid*, page 3.

The major disadvantage was that a relatively small number of people were able to attend this type of training.

For the gathering-of-contractors model, Karg spent a day with a number of contractors at one job site. One contractor had the responsibility of making sure the job got completed according to the work order, but all or most of the others helped. The day usually included a walk-through discussion of the audit and work order, a group discussion of work strategy and methods, testing of the take-off pressure of the contractors' insulation machines, core sampling of insulation density in wall cavities, insulation blowing demonstrations, and installing weatherization measures. This model was used (and developed) in Maine with great success during Phase 1. At one site in Maine during Phase 1, six contractors/agency-employed crews attended. This model was used often during Phase 2.

The advantages of the typical-work-day model included:

- Information sharing among contractors and crews.
- Opportunity for contractors to get to know each other and share methods.
- Opportunity for experienced installers to train less experienced installers.

The disadvantages of the typical-work-day model included:

- Required a relatively high degree of planning (large house, access to house by all insulation trucks, electrical power coordination, etc).
- Possibility of ego problems among attending contractors, however, none were noticed by the trainer.
- It was challenging for trainer to keep all those attending on task.

The gathering-of-auditors model took place in Rhode Island during the Phase 1 and in Vermont during Phase 2. All the state auditors and the state monitors met at a house to discuss the house audit, work order, and unusual problems at the site. As a group, the work order was discussed (in Vermont during Phase 2, a work order was already written up by the job auditor) and critiqued. Auditors were then given the opportunity to request training topics addressed by the trainer during the remainder of the day. In Vermont the primary topic was worst-case draft testing.

The advantages of the gathering-of-auditors model included:

- An opportunity for auditors to have on-site training and discuss auditor issues without being distracted by crews or contractors.
- Acted as a good compliment to other training models during the Phase 2 training week.

The major disadvantage was that this model included auditors only.

Of course, the classroom training model is not new. Karg trained crew technicians, contractors, and auditors in a classroom setting during Phase 1 in Rhode Island. During Phase 2, Rhode Island, Maine, and Vermont selected this option for one day each.

The advantages of the classroom training model included:

- Some training topics can be delivered most effectively in a classroom, for example, going over detailed procedures in a step-by-step fashion or viewing photographs of a variety of methods to accomplish a task.
- Had the effect of equalizing the knowledge level of attendees, in other words, trainees left the classroom "sing from the same hymnal".

The disadvantages of classroom training included:

- Most field workers tend to learn better in the hands-on environment of a work site.
- Preparation time for the trainer can be lengthy, resulting in higher costs for the overall training.

During Phase 2, these models were used in combination in the six programs served. As already mentioned, the O^4S project began in 2002 with the idea of on-site one-on-one training. By the beginning of Phase 2, it had evolved into a training effort designed to meet the individual needs of the six weatherization programs taking part. This was a natural and productive evolution.

Number of Participants at Training Sessions, Phases 1 and 2

Two hundred thirty weatherization personnel were exposed to the O^4S training activities during Phase 2, a 35 percent increase over Phase 1. The training contact hours totaled 2244 and 2910 for Phases 1 and 2, respectively, representing a 27 percent increase. Please refer to Tables 1, 2a, and 2b for attendance tally and training dates.

Table 1
Number of Weatherization Personnel Attending an O^4S Training Event and Personnel Contact Hours at Training, Phase 1 / Phase 2

State	*Number of Personnel Attending Training**	*Number of Personnel Contact Hours at Training***
Connecticut (Phase 1 / Phase 2)	29 / 52	426 / 486
Maine (Phase 1 / Phase 2)	65 / 76	498 / 726
Massachusetts (Phase 1 / Phase 2)	40 / 76	264 / 510
New Hampshire (Phase 1 / Phase 2)	19 / 21	240 / 300
Rhode Island (Phase 1 / Phase 2)	25 / 54	492 / 570
Vermont (Phase 1 / Phase 2)***	52 / 41	324 / 318
Totals (Phase 1 / Phase 2)	**230 / 310**	**2244 / 2850**

* 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 average daily contact time with the instructor.
*** Vermont received five days of training during Phase 1, but only four days of training during Phase 2.

During Phase 1 of the project, 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. During Phase 2, the highest attendance for one day – 61 – again was in Maine, but was in a classroom session rather than in the field. New Hampshire and Maine each had one field training day with only eight trainees at the site. This was the lowest attendance during Phase 2.

Training Dates, Phases 1 and 2

The Phase 1 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 2a.

Table 2a
Training Dates for O^4S Project
and Number of Personnel Attending Each Day, Phase 1

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)*

The Phase 2 training dates began in June 2004 in Connecticut and ended in February 2005 in Vermont. The training dates, along with the number of participants attending each day, are listed in Table 2b.

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

State	**Training Dates in State, 2004 - 2005** ***(Number Attending Each Day)***
Connecticut	June 14, 15, 16, 17, 18, 2004 *(22, 13, 15, 16, 15)*
Maine	October 25, 26,27, 28, 29, 2004 *(61, 17, 12, 8, 13)*
Massachusetts	June 21, 22, 23, 24, 25, 2004 *(24, 16, 13,16 16)*
New Hampshire	September 27, 28, 29, 30, October 1, 2004 *(11, 10, 12, 9, 8)*
Rhode Island	September 13, 14, 15, 16, 17, 2004 *(39, 15, 15, 15, 11)*
Vermont	February 22, 23, 24, 25, 2005 *(12, 13, 15, 13)*

Evaluation of Training

The training for the pilot O^4S project, Phases 1 and 2, was evaluated by the participants at the end of the training day. A standard evaluation form was used in all states but Maine and Rhode Island.[6] This form is reproduced in this report on page 85. Table 4 on page 84 lists the number of training evaluations collected in each state. Please refer to pages 86 through 100 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.

The most favorable evaluations for Phase 2 were from Connecticut. A qualitative summary of the evaluations, Phase 1 compared with Phase 2, shows that in:

1. Connecticut, Phase 2 was evaluated significantly *higher* than Phase 1.
2. Maine, Phase 2 was evaluated slightly *higher* than Phase 1.
3. Massachusetts, Phase 2 and Phase 1 were rated *about the same*.
4. New Hampshire, Phase 2 was evaluated slightly *lower* than Phase 1.
5. Rhode Island, Phase 2 was evaluated slightly *lower* than Phase 1.
6. Vermont, Phase 2 was evaluated significantly *higher* than Phase 1.

A state program manager from each state wrote and submitted an overview and evaluation of the training in their state. Each of these reports for Phase 2 is included in this document. The report from Glenn Bernard and Tom Coker of Connecticut starts on page 31, that of Tony Gill of Maine starts on page 39, that of Ken Rauseo of Massachusetts starts on page 53, that of Andy Gray of New Hampshire starts on page 63, that of Rhode Island starts on page 75, and that of Dwight DeCoster of Vermont starts on page 82. These reports reflect a very positive response to the O^4S training experiences.

General Observations

During Phases 1 and 2 of the project, state monitors, agency weatherization directors, agency-employed installers, contractors, contractor-employed installers, and auditors/inspectors attended the training. 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 and safely.

[6] In Maine, two evaluation forms were used for Phase 1 and one for Phase 2, each made up by Tony Gill of Maine State Housing Authority. These forms are included in this report. Although the Rhode Island evaluation form used during Phase 1 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. During Phase 2, Rhode Island used the standard O^4S evaluation form. The filled in evaluation questionnaires for Phases 1 and 2 are available at the offices of R.J. Karg Associates.



Lois Pasquerella Visits Rhode Island Training

The auditors/inspectors were interested in diagnostic procedures, auditing methods, determination of the thermal envelope boundaries, 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, especially during Phase 1 of the project. During Phase 2, the instructor noticed significant improvement in communication among the personnel involved with the weatherization process.

Major Training Topics Addressed

As the O^4S project moved from Phase 1 to Phase 2, its definition continued to evolve. Although the format of the O^4S training was intended to be on-site, during Phase 1 Rhode Island introduced its week-long O^4S training with two days in the classroom. This served as an effective strategy for bringing uniformity of knowledge to the state's weatherization program personnel before training in the field.

During Phase 2, Rhode Island again introduced its week-long training with a classroom session (only one day); Maine did the same. These introductory days included all levels of weatherization personnel in each state. Using a different strategy, Vermont decided to have Karg present a day of classroom training to its crew technicians on the second day of a four-day training week. The following day the same crew technicians were in-field with Karg to put into practice many of the concepts discussed in the classroom.

The major training topic addressed during Phase 2 of the O^4S project was proper installation of dense pack cellulose. Although some contractors and auditors had not heard of dense pack cellulose installation during Phase 1, all appeared aware of these methods by the time of the Phase 2 training began.

Those attending came with the different job categories of crew worker, contractor, foreman, auditor/inspector, and state monitor, therefore, training needs varied.[7] 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 . . ."

Phase 2 training benefited from the training needs analysis that was possible during the Phase 1 training sessions. Just prior to the start of Phase 2, Karg requested and was granted funds for training equipment, including:

- Two insulation density cases designed and fabricated by Gary Roundy.
- Cellulose insulation core sampling kit.
- Magnehelic pressure gauge for insulation blower machine testing.
- Electric harmonic meter for electric generator testing.

Karg had acquired some of this equipment in 2003, so a few states visited at the end Phase 1 were exposed to core sampling and insulation machine testing.[8] During Phase 2, all were participants experienced this training equipment. A significant majority of the attendees felt that this equipment and the time spent with it during the Phase 2 training were very helpful.

Contractors, Foremen, and Installers

During both phases of the O[4]S training, 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 Density Case Demonstration in Massachusetts

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. During Phase 1, installers working for programs in the southern New England states were less knowledgeable about dense packing cellulose than those in the northern states. The trainer found that this difference between the northern and southern states had all but disappeared during Phase 2.

Significant training time in the field was also spent on attic air sealing work during both phases. During Phase 2 the trainer discovered that as a standard practice (seemingly approved by the auditors writing the work orders), contractors and crews were installing

[7] The daily training notes by Karg list the training topics addressed for each of the twenty-nine days of Phase 2 of the project. In this document, these notes begin on page 23 for Connecticut, page 32 for Maine, page 43 for Massachusetts, page 55 for New Hampshire, page 65 for Rhode Island, and page 76 for Vermont.

[8] During Phase 1, core sampling was demonstrated in Maine and New Hampshire.

cellulose insulation under attic flooring without adequate inspection and air sealing. Karg preached to installers and auditors that attic flooring is no excuse for avoiding attic air sealing.

During Phase 2 the instructor continued demonstrating the proper setup and use of the blower door. Although attendees demonstrated a more thorough knowledge of blower door setup and use during Phase 2, most programs will still benefit by a broader distribution and use of this vital equipment.

When appropriate, the insulation density cases were used to demonstrate the density differences between tubing and nozzle use and the differing densities achieved from various blowing machine settings. At some sites this turned into a competition among the contractors and crews.

Additionally, the instructor demonstrated core sampling as a quality control technique and, more importantly, as a means of demonstrating that dense packing in a wall is not possible with a nozzle or with a tube that is too short or too flexible.

During Phase 2, Karg addressed some generator related topics, including output capacity, carbon monoxide (CO) emissions, and ear protection from generator noise. A number of crews and contractors use generators with inadequate capacity (voltage lower than 115); this may shorten the life of insulation machines and other electric tools. In addition, some generators demonstrated high levels of harmonic distortion, which can lead to the premature degradation of power tools. Weatherization workers often operate generators in the back of their box trucks where exhaust fumes vent into a partially confined space. Karg measured dangerously high levels of CO in a few cases. Finally, the instructor did not notice even one instance where weatherization personnel used ear protection when working close to an operating generator.

Auditors/Inspectors

During Phases 1 and 2 many of the auditor/inspectors demonstrated difficulty correctly defining the dwelling thermal envelope in basement areas and complex second- or third-floor areas (mixed conditioned and unconditioned areas on one level). The difficulty of proper treatment of a basement area was often made unnecessarily confusing by trainees using terms such as “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 diagnostics (ZPD). There were only a handful of dwellings that would have benefited from such diagnostic testing, but only one or two auditors understood the methods. Throughout the six-state area auditors demonstrated a general lack of knowledge or interest in ZPD during both phases of the project. Although ZPD requires a programmed calculator or complex tables and a thorough knowledge of the techniques, it can be an important tool for developing weatherization strategy and for determining the effectiveness of air sealing efforts.

During Phase 2, auditor/inspectors seemed to have a clearer understanding about their state's field standards than during Phase 1. A more intense focus on state weatherization standards as a result of Phase 1 training could be the reason for this improvement.

Observed Effects of Phase 1 Training

A number of improvements to the contractor/crew knowledge and methods were noticed by the trainer during Phase 2 visits. It is impossible to know if these changes were attributable to the O^4S Phase 1 training, but it is likely that some were.

In the Massachusetts evaluation of the Phase 2 O^4S training, it is stated: "Since the completion of the O^4S Training Project [Phase 1], the Department of Housing & Community Development (DHCD) has reviewed and amended its WAP Technical Manual to more clearly mandate the utilization of dense packing when insulating sidewalls."

Other states have also made changes to their weatherization standards. Rhode Island made alterations to its dense packing requirements in April 2004. Maine and New Hampshire each completed significant revisions to their weatherization standards in March 2005.

As of April 2005, all six New England weatherization programs are officially calling for the dense packing of walls. Table 3 indicates the wall density specification in each of the New England states, the specified methods of installation, the date the specification became effective, and whether the specification resulted from the Phase 1 O^4S training. All states but New Hampshire and Vermont reported that their wall dense packing specification resulted from the O^4S training.

Table 3
Wall Density Specifications for Six New England Weatherization Programs Including Date of Inception[9]

	Specified Wall Density	Specified Method of Installation	Date Specification became Effective	Specification Result of O^4S, Phase 1 Training
Connecticut	3.0 lbs/ft^3 min.	None	April 2005	yes
Maine	3.25 lbs/ft^3 min.	Tubing	May 2005	yes
Massachusetts	Dense pack	None	April 2005	yes
New Hampshire	3.25 lbs/ft^3 min.	Tubing	2001 or earlier	no
Rhode Island	Dense pack	Tubing or directional nozzle	April 2004	yes
Vermont	3.25 lbs/ft^3 min.	Tubing preferred	1993	no

[9] For the states of Connecticut, Massachusetts, New Hampshire, and Rhode Island, this information is based on telephone communications on April 8, 2005 with Glenn Bernard (CT), Ken Rauseo (MA), Andy Gray (NH), and Mike Snitzer (RI). For the states of Maine and Vermont, it is based on telephone communications on April 11, 2005 with Tony Gill (ME) and Jules Junker (VT).

Other likely positive results of the Phase 1 efforts include, but are not limited to:

- Greater general awareness of the complexities of and the necessary equipment required for successful dense packing of cellulose, including blowing machine characteristics, tube selection, and blowing techniques.
- More thorough knowledge of the process of defining the thermal boundaries of a dwelling.
- Better understanding of the operation and usefulness of blower doors.
- More thorough understanding of the importance of and methods for air sealing, especially in attic areas.

Program Changes Resulting from Phase 2 Training

A manager from each state program wrote an evaluation of the Phase 2 training. In most cases, these evaluations included comments regarding changes they intend to make to their programs as a result of the second round of O^4S training. The following are stated alterations likely to be made:

1. The program managers in Maine intend to convene quarterly subcontractor meetings to discuss ongoing issues and resolve problems as they may arise.
2. Massachusetts will distribute R. Karg's wall insulation density calculation sheet to all seventy-five Massachusetts weatherization contractors and give contractors the opportunity to officially request state sponsored training. Awareness of dense packing cellulose insulation in the state has caused Bonded Insulation, a New York cellulose insulation manufacturer, to initiate a financing program to assist new and existing contractors in purchasing cellulose insulation equipment.
3. The program manager from New Hampshire intends to revise the weatherization standards to include dense packing walls (tubing methods). The new standards will also clarify treatment of knob-and-tube wiring and will specifically address the use of zone pressure diagnostics and blower door guided air sealing. New Hampshire will also conduct more core sampling in the future to verify cellulose wall insulation density.
4. Rhode Island will reexamine their allowed option of using a directional nozzle to dense pack walls. They might decide to prohibit nozzle use, except in small framing cavities.
5. As a result of the success of the Phase 2 O^4S training, the Vermont program managers will organize in-state O^4S-type training sessions on a regular basis. They will also put new energy into exploring dense packing techniques and continue to try to improve program dense packing results.



Aluminum Siding Removal Instruction in Massachusetts

Overall Recommendations

These recommendations are intended to improve future O^4S-type 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

At the beginning of Phase 1, the trainer was concerned about more than one contractor being on-site at the same time. This concern faded as Phase 1 came to an end. By the end of Phase 2, it was found that a number of contractors (business owners) and contractor's employees felt the information shared with and by other contractors on-site was the most positive characteristic of the training. The ingredients for a successful on-site training including more than one contractor include:

1. Assigning one contractor as the "job contractor", making them responsible for getting all the work completed properly. This usually happens without verbalizing, but making it clear to all at the site is important.
2. Fostering a spirit of cooperation among contractors and crew technicians at the site. This should be done by the on-site program leaders, including state managers, but especially by the trainer.
3. Setting up a competitive activity, such as blowing the insulation density cases, in order to foster a spirit of light heartedness and fun. This channels competitive tendencies to a positive, rather than negative, end.

The anxiety the trainer felt about the lack of structure fostered by the extemporaneous nature of the training at the beginning of Phase 1 was eliminated by defining the daily activities at the beginning of each day. This introductory speech by the trainer was routine by the end of Phase 1. There were a few days during both phases when this speech was inadvertently not delivered, as a result, the quality of the training suffered.

As the training moved through the six states during Phase 1, 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 was for the contractors, crew workers, and auditors. Where preparation and/or communication was lacking, the training experience suffered.[10] The preparation during Phase 2 was generally better than during Phase 1. However, in order to ensure the highest quality training experience for future O^4S training, states and local agencies should remain diligent with their training preparation by:

1. Scheduling appropriate dwellings,
2. Telling clients what to expect during the training day,[11]

[10] 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 during Phase 1, the client died the day before the training was scheduled to take place at her home).

[11] At one site in New Hampshire during Phase 2, a tenant arrived home to find the trainer presenting blower door instruction in his kitchen. The tenant claimed he was not informed of the on-site training and promptly demanded, with expletives, that all leave his apartment. The trainer, all trainees, and the visiting DOE Northeast Regional Office Wx Program Manager, Eric Beaton, quickly vacated the apartment. The tenant later apologized for his impulsive overreaction.

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,[12]
6. Providing the trainer and others with printed directions to each training site, and
7. Supplying the trainer with a tentative roster of those expected to attend each training day.

In addition, the pre-training communication between the state manager(s) and 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.



Core Sampling Demonstration in Maine

A unique characteristic of the Phase 1 and 2 training 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 future O^4S training.

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 Phases 1 and 2 of the O^4S project will probably remain important topics for future O^4S training. These include:

1. Blower door operation.

[12] During Phases 1 and 2, 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, especially if they are contractors.

a. Proper use of manometers.
b. Baseline readings, if using digital manometers.
c. Blower ring use.
d. Can't-reach-fifty multipliers, if using analog or DG-2 or DG-3 manometers.
e. Use of blower door for finding leaks.
f. Blower door-guided air sealing.

2. Siding removal and replacement.
    a. Aluminum and steel.
    b. Asbestos.
3. Side wall insulation.
    a. General installation techniques.
    b. Dense-pack cellulose insulation.
        i. Insulation machines
            1. Proper maintenance.
            2. Static pressure and CFM.
        ii. Delivery system.
            1. Hoses.
            2. Tube sizes and rigidity.
            3. Transitions.
        iii. Installation methods.
4. Basement and crawl space wall insulation.
    a. When and where to insulate.
5. Air sealing methods.
    a. Attic air sealing.
        i. Chimney treatment.
        ii. Codes and regulations.
            1. Chimneys.
            2. Recessed lights.
            3. Electrical, including knob-and-tube wiring.
        iii. Methods for air sealing and code conformance in floored attics.
        iv. Treatment of existing fiberglass.
    b. Basement air sealing.
        i. Band or rim joist air sealing
        ii. When and where to air seal basement and crawl space ceilings.
6. Attic ventilation methods.
7. Zone pressure testing methods (this should probably be for crew leaders only).
8. Worst-case draft testing before and after weatherization work is complete (this should probably be for crew leaders only).

Auditors/Inspectors

The topics that were most often needed for auditors/inspectors during Phases 1 and 2 of the 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 (BTL).
        ii. Worst-case draft testing and Depressurization Tightness Limits.

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.
    iv. Should the basement or crawl space ceiling be sealed?
d. Cost-effective measures.
e. Discussion of the uniformity of the auditing and inspection process within a state.
    i. Methods of promoting uniformity among auditor methods, recommendations, and reports.
f. The responsibilities of the auditor/inspector.

2. Blower door operation.
    a. General setup and proper operation.
    b. Techniques for multi-family buildings.
3. Worst-case draft testing.
    a. Setup for and performance of test.
    b. Relationship between test and NFPA "confined space" specification.
    c. Solutions for houses that fail test.
4. Zone pressure diagnostic methods
    a. When and why to perform test.
    b. How to perform test.

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 training for such program changes.

Recommended State Program Changes

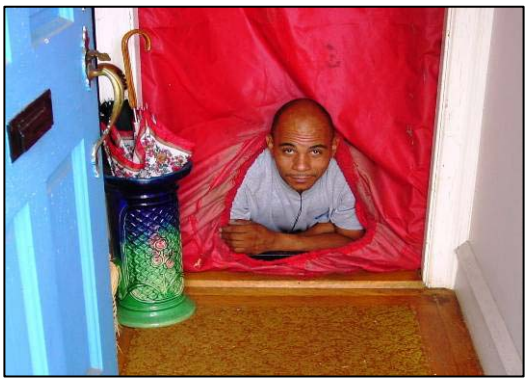
During the thirty days of Phase 1 training and twenty-nine days of Phase 2 training in the six New England states, the trainer had the opportunity to listen to state monitors, energy auditors/inspectors, contractors, and crew workers talk about their work, their opinions of the weatherization field standards, and their relationships with personnel working at other levels of their state programs. Although most of this information was subjective, it was valuable for establishing a snapshot view of the health of the weatherization program in each of the states.

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 the region 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 poor 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 standards, 3) poorly enforced weatherization standards, or 4) confusion arising from differing WAP and utility program standards within a state?

The recommended programmatic changes suggested 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 Northeast weatherization region.



Blower Door Setup in Rhode Island

These suggested state program changes are not needed by every state.[13] The spirit of these recommendations is not intended to be negative, but to suggest methods for making state programs more effective, productive, and professional, while accomplishing the valuable societal mission of the low-income weatherization program. These recommendations are:

1. Develop and maintain vital state weatherization field standards.[14] 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.

[13] For observations and recommendations for each of the six state programs, see page 31 for Connecticut, page 39 for Maine, page 53 for Massachusetts, page 63 for New Hampshire, page 75 for Rhode Island, and page 82 for Vermont.

[14] Since the end of Phase 1 of the O[4]S project, Massachusetts and Rhode Island have made alterations to their weatherization standards. As of March 2005 Maine and New Hampshire engaged in and completed total overhauls to their weatherization standards.

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 education.
k. Electric baseload measures.
l. Best practices for testing and diagnostics procedures.
   i. Blower door use.
   ii. Blower door guided air sealing.
   iii. Building tightness limit calculation to ensure that all houses are in compliance with ASHRAE 62 or 62.2.
   iv. Duct leakage testing.
   v. Duct blower use, if required in state.
   vi. Room-to-room pressure testing.
   vii. Zone pressure diagnostics.
   viii. Worst-case draft testing.[15]



A Light Moment in New Hampshire

2. Procure better tools and introduce better methods for ensuring high quality installation of weatherization measures.
   a. If not already doing so, use infrared technology on a broader scale for quality assurance.
   b. Perform spot core sampling of wall insulation to check for installed density.
   c. Perform spot static pressure testing of insulation blowing machines.

[15] This important health and safety test is not required in all of the weatherization programs in New England.

   d. Promote the use and enforcement of state weatherization standards. Make sure that all weatherization personnel have the opportunity to become aware of the installation standards.
3. Promote more frequent blower door testing during the weatherization process. This will advance the important objective of blower door guided air sealing and increase the quality and effectiveness of air sealing efforts.
4. Devise financing and other procurement strategies to help contractors obtain blower doors and commercial grade insulation machines.
5. If not already in place, form a technical committee that meets regularly and ensure that all important stakeholders are represented. The tasks and functions of this committee might include:
   a. Periodic review of the state weatherization standards.
   b. Assessment of the training needs of auditors/estimators, contractors, and crew workers.
   c. Discussion of 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.[16]
   e. Development of a minimum standard for a energy audit and job inspection.
   f. In states where low-income weatherization workers (contractor or crew) are also installing conservation measures for utility programs, develop and recommend uniform installation standards that can be used by low-income weatherization *and* the utility programs. If this is not possible, attempt to maximize uniformity as much as possible to the various installation standards with in the state.



The Trainer Core Sampling In Massachusetts

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. Recommendations for region-wide initiatives are:

1. Set up a regional task force with representatives from each of the Northest 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 might offer the advantages of economies of scale and avoidance of redundancy and others will lead to market transformation. These initiatives should include:

[16] 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.

a. Establish boiler plate, best practices field standards document (see number 2, below).
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.[17]



Tubing a Wall in Rhode Island

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 2.9 pounds per square inch (80 inches of water column) if the machine is to have the capacity to dense pack cellulose in a cost-effective manner.[18]
    ii. Develop a method of rating and listing a rigidity rating for wall insulation insertion tubes. 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.

[17] Experiments during the O⁴S 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.
[18] 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.

f. Devise financing and other procurement strategies for the programs in the Northeast Region to help contractors obtain blower doors and commercial grade insulation machines.

2. The Northeastern 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.[19] There are climatic and geographical variations within the Northeast Region, but not enough to warrant significant standards differences from one state to another. The majority of weatherization measures performed in any one of the northeastern states is also performed in each of the other states. As a result of these similarities in required program standards, such a region-wide effort would save precious resources and foster uniformity and cooperation among the six state programs.



Weighing an Insulation Density Case in Connecticut

[19] 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.

Notes from each Training Day[20]

Connecticut

Training in Bridgeport, Connecticut, Monday, June 14, 2004

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. Federico Sanchez, ABCD energy auditor and coordinator
    f. Aubyn Clarke, ABCD energy auditor
    g. Nick Resto, ABCD crew
    h. Vincente Roman, ABCD crew
    i. George Perrin, ABCD energy auditor
    j. Ray Perrault, ABCD crew
    k. Eric Salter, ABCD crew
    l. Ben Cross, ABCD crew
    m. Richard Peeples, ABCD crew
    n. Fred Rosado, New Haven agency, NOW
    o. Bob Anders, New Haven agency, NOW
    p. Antoine McCray, New Haven agency, CAANH
    q. Attending contractor, Energy Resources Group
        i. Dan Pease (owner)
        ii. Russ Trombly
        iii. Marc Weber
    r. Attending contractor, CRI working for CAANH
        i. Robert Bostrom
        ii. Jeff Page
    s. Attending contractor working for CAANH
        i. Eddie Pennyman
        ii. Zena Pennyman
2. Training was at the home of Aubyn Clarke, the ABCD energy auditor. The house is 2660 square feet on the two main floors. The Victorian style house with a round tower in street-side left corner is a full two-stories with a full basement and a dormered third floor that includes three bedrooms and four knee wall areas. The pre-weatherization blower door test yielded a CFM_{50} of 10,260 with the basement door closed and a CFM_{50} of 12,200 with the basement door open (the CFM_{50} value with the door to the third floor closed and the basement door closed was 9,400). The basement is unfinished. The ABCD agency usually installs the attic cellulose and a contractor installs the wall cellulose.[21] The agency does all air sealing work. The house is balloon framed with the basement ceiling joist cavities closed to the wall cavities.
3. Topics addressed at ABCD agency before going to work site.

[20] These notes were written by Rick Karg at the end of each training day.
[21] In Connecticut, the agency usually installs attic flat and slope insulation and a subcontractor is hired to insulate walls if blowing is required.

a. Use of the blower door.
    i. Karg demonstrated blower door testing with the Energy Conservatory DG-3 and DG-700 digital gauges.
    ii. Later t the site, did blower door test with:
        1. Basement door open and closed.
        2. Third floor door open and closed.
    iii. Discussed dividing CFM_{50} by 10 to approximate square inches of air leakage.
    iv. Used Retrotec smoke tube.
    v. Before blower door test, walked around house. Four knee wall accesses had already been opened on third floor.
b. Discussion of air leakage.
    i. Stack effect.
    ii. Seal at top of house first (attic).
    iii. Sealing attic helps prevent moisture problems.
    iv. If attic is sealed, less air leaks into lower areas of house.
    v. Must have a hole and a pressure difference for air leakage to take place.
    vi. Special treatment of Cape style house with cellulose to stop airflow through second floor bays.
    vii. Air sealing around chimney and plumbing stacks.
    viii. Discussion of blowing cellulose over fiberglass batts in attic. Often better to remove them within foot or so of eaves and at gable end joist bays so that air does not flow laterally through the fiberglass under the newly installed cellulose.
    ix. Discussion of duct sealing, the difference between doing for energy savings or for health and safety.
c. Lengthy discussion of conditioned and unconditioned basements and crawl spaces.
    i. Idea of thermal boundary.
    ii. Idea of thermal envelope.
    iii. Treat basement wall OR ceiling, but not both. Might need to seal ceiling for health and safety reasons (IAQ problems in basement).
d. Karg handed out the J & R Products and Applied Energy Products catalogs to contractors and others.

4. Measured the pressure difference in the third-floor floor cavity. With the house at -20 Pascals of pressure difference, -12 Pascals of pressure in floor cavity. Told the crew to perform this test again after weatherization was completed. The floor cavity pressure should approach zero after weatherization.
5. Because of access to top of open exterior walls from third floor knee wall areas, discussed the possibility of insulating many wall cavities from third floor. If this is done, the end of the insulation hose must extend all the way down to basement ceiling before wall blow begins.
6. The ABCD crews prepared the floors behind the knee walls for cellulose and insulated the back of the knee walls with fiberglass.
7. Ran blower door in pressurization mode to keep third floor area cooler and to reduce dust.

8. Karg tested the ABCD Force 2 insulation machine for takeoff pressure. Found a pressure of 74 inches of water (should be at least 80).
9. Tested the ABCD electric generator for voltage output. The output was fine.
10. Talked with a few of the ABCD energy auditors about bringing a higher degree of professionalism to auditing. Mentioned the Maine senior auditor certification.

Training in Mansfield, Connecticut, Tuesday, June 15, 2004

1. Attending session:
    a. Rick Karg
    b. Glenn Bernard, CT Technical Monitor
    c. Tom Coker, CT Technical Monitor
    d. Mike Bernier, ACCESS weatherization coordinator
    e. Michael Guimont, ACCESS auditor
    f. Dorothy DelValle, ACCESS operations assistant
    g. Mike Schoeplein, CL&P and WRAP
    h. Michael Russi, attending contractor, R & R
    i. John Naumec, attending contractor, J & M Weatherization
    j. Attending contractor, American Energy Savers
        i. Herminio Alvarez
        ii. Ismael Corichi
        iii. Hector Ortiz
    k. Attending contractor, MRP
        i. Michael Pelletier
        ii. Carol Shea
2. Training was at a ranch style house with a shed addition that was not used in the cold months. House located on Circle Drive. The house had aluminum siding with no insulation in the 3 ½ inch walls. The attic had approximately an R-11 in the attic before more insulation was added. CFM_{50} before weatherization was 2100, after weatherization it only was reduced to 2000. The house was built in 1955.
3. Met at ACCESS agency office in Willimantic before going to site. Karg gave an overview of day and invited comments and questions.
4. From ACCESS office went to site.
5. Checked attic ASAP because the day was going to be hot.
6. Did abbreviated blower door test so contractor and crew could get started in attic.
    a. Used Energy Conservatory DG-3 gauge.
7. Told installers to cut back existing fiberglass insulation in attic by one foot at eaves and remove entirely at each gable end bay (only if there is ceiling strapping below joists) to prevent air from flowing laterally through the fiberglass after the cellulose is blown above it.
8. Inspected the basement and talked about rim joist and wall insulation. Also mentioned the issue of the thermal boundary. Suggested that the auditors run basement wall insulation – four feet done from top of wall – through their energy audit to determine if the SIR is viable for this measure. They said they never insulate basement walls.
9. The job contractor, American Energy Savers, was using a flexible 1 ½ inch tube about five feet long to blow walls.

10. Karg took core samples at four spots (the contractor mentioned that their PTO-driven machine was not working properly):
    a. Fill hole, 3.4 pounds per cubic foot.
    b. About seven feet up, 1.1 pounds per cubic foot.
    c. About seven feet up in another bay, 2.5 pounds per cubic foot.
    d. About seven feet up in a third bay, 1.8 pounds per cubic foot.
11. After this core sampling, continued with blower door instruction. Demonstrated the analog gauges, the DG-3 and the DG-700.
    a. Walked around the house with the blower door running.
    b. Discussed CFM_{50} divided by ten.
12. Handed out J & R Products and Applied Energy Products catalogs to contractors.
13. Showed fill tubes from Applied Energy Products.
14. Just after lunch, showed a slide show on Karg computer screen of the Maine dense wall blow experiments. All were interested in this.

Training in Vernon, Connecticut, Wednesday, June 16, 2004

1. Attending session:
    a. Rick Karg
    b. Glenn Bernard, CT Technical Monitor
    c. Tom Coker, CT Technical Monitor
    d. Mike Bernier, ACCESS weatherization coordinator
    e. Michael Guimont, ACCESS auditor
    f. Pam St. John, ACCESS assistant director of housing
    g. John Naumec, attending contractor, J & M Weatherization
    h. Attending contractor, American Energy Savers
        i. Herminio Alvarez
        ii. Ismael Corichi
        iii. Hector Ortiz
    i. Attending contractor, MRP
        i. Michael Pelletier
        ii. Carol Shea
    j. Attending contractor, R & R
        i. Michael Russi
        ii. Al Robillard
        iii. William Pinkston
        iv. Don Davis
2. Training was at winterized cottage on Juniper Lane. The house had a number of additions and a full basement, most of which was finished as living space. Pre-weatherization blower door test yielded a CFM_{50} of 2260; the post-weatherization test yielded 1931 CFM_{50}. The house had 6 inches of fiberglass in the attic, but no insulation in the walls. There were six recessed lights in the ceiling.
3. Started with a meeting outdoors. Inspected house.
4. Found a number of attic bypasses in attic. Discussed the proper sealing of these, including chimney, plumbing stack, and recessed lights.
5. Just after the initial blower door test, Karg talked about division of labor and making certain that no measures were forgotten.

   a. American Energy Savers blew attic and wall insulation, but did no air sealing.
   b. MRP did air sealing and installed fiberglass insulation, but did not blow insulation.
   c. It was mentioned that the insulation contractor sometimes arrived at the job to insulate the attic before the air sealing crew. This has caused some problems.
   d. Karg mentioned that best practices are not only technical, they also have to do with the order of work and task responsibilities. The work must be structured so that the probability of missing tasks is minimized. The division of work in Connecticut could lead to overlooking tasks.[22]
6. Did testing of insulation blowing machines (takeoff pressure should be 80 inches of water or greater with the blower and agitator running).
   a. R & R Force 2 machine at takeoff had a pressure of 90 inches of water.
   b. American Energy Savers PTO-driven machine (Unisul Volu-Matic) had a pressure of 110 inches of water.
7. Tested the R & R generator output. For their 9000 Watt generator, they had an 82 to 92 volt output. This is too low.
8. Did core sampling with R & R and American Energy Savers.
   a. With R & R using two-hole method, Force 2 machine and a directional nozzle. Altering the air/material ratio on the machine, as predicted, altered the insulation density in the wall.
      i. With six holes exposed on Force 2 feed gate, 2.8 pounds per cubic foot and mid-wall height, 1.9 pounds per cubic foot at low-wall height.
      ii. With four holes exposed, 2.8 pounds per cubic foot at mid-wall height.
      iii. With two holes exposed, 3.5 pounds per cubic foot at mid-wall height.
      iv. With three holes exposed, 3.6 pounds per cubic foot at mid-wall height.
   b. With American Energy Savers, took a core sample about four feet above their flexible tube fill hole (one-hole method) and found 2.5 pounds per cubic feet.
9. Used the insulation density cases, made by Gary Roundy, for the first time. There was a great deal of interest in these cases.
   a. With R & R Force 2 insulation machine, air wide open and three holes exposed on the feed gate, case right-side up (fill hole near bottom), achieved 3 pounds per cubic foot. Used directional nozzle. Took thirteen minutes to fill (0.96 pounds of cellulose per minute).
   b. With R & R Force 2, this time with the case upside down, machine settings the same, achieved 3 pounds per cubic foot. Used directional nozzle.

[22] On this job, the blowing insulation contractor (American Energy Savers) covered over two recessed lights with cellulose because they were covered with fiberglass batts before we arrived. The air sealing contractor (MRP) found these while air sealing. Cellulose and fiberglass was then removed from over these light fixtures.

c. R & R machine again, six holes exposed on feed gate, air wide open, case upside down, achieved 3 pounds per cubic foot. Used directional nozzle. Took four and one-half minutes to fill box (2.7 pounds of cellulose per minute).
d. R & R machine again, six holes exposed on feed gate, air wide open, case right side up, achieved 2.7 pounds per cubic foot. Used directional nozzle.
e. American Energy Savers used their 1 ½ inch flexible nozzle to blow the insulation case. Achieved 2.5 pounds per cubic foot in two and one-half minutes (2.2 pounds of cellulose per minute).

10. Spoke with the people of R & R Insulation and American Energy Savers about using 1 ¼ inch tubes (winter and summer) from Applied Energy Products.
11. R & R Insulation was running a generator in the back of their box truck while insulating the house walls. Measured the carbon monoxide concentrations in box area up near cab and found 410 ppm! Discussed this with group.
12. As most were leaving, Karg went back into house to check basement work and see if boiler had been turned back on after blower door test. The agency air sealing contractor had insulated the boiler room ceiling (the only room in the basement that is not nicely finished and lived in) with six inches or 3 ½ inches of fiberglass. This had been done at the recommendation of one of the agency auditors. Karg spoke with the auditor privately about this mistake (wrong definition of thermal boundaries) and then the auditor and Karg spoke with the two state monitors, Tom Coker and Glenn Bernard. The auditor justified the task because of fifteen or more degrees temperature difference between boiler room and room above. Karg felt the insulation had been put between two conditioned spaces – the boiler room and the living room above. Karg was told the next day by Glenn Bernard that the insulation would be removed to correct the mistake. The auditor mentioned that he was taught in a training that if there was a temperature difference is such a situation of fifteen degrees or more, insulation was called for. Karg felt this task would not show a savings-to-investment ratio above one.

Training in New Britain, Connecticut, Thursday, June 17, 2004

1. Attending session:
    a. Rick Karg
    b. Glenn Bernard, CT Technical Monitor
    c. Tom Coker, CT Technical Monitor
    d. Ed Williams, CRT weatherization coordinator
    e. Evelyn Claudio, CRT analyst, auditor
    f. Julie Saimininkas, CRT program coordinator, auditor
    g. Byron Peart, CL&P and WRAP program manager
    h. Jerry Ketron, CL&P and WRAP
    i. Mike Schoeplein, CL&P and WRAP
    j. Attending contractor, American Energy Savers
        i. Herminio Alvarez
        ii. Steve Ouellet
        iii. Hector Ortiz
    k. Attending contractor, East Coast Contractors
        i. Paul Paris, Sr

   ii. Paul Paris, Jr
   l. Attending contractor, Gagnon Remodeling
      i. Moe Gagnon
   m. Attending contractor, Comfort Zone
      i. Bob Francis
      ii. Felix Valentine
   n. Attending contractor, Tony Johnson
   o. Attending contractor, Dan Pease, Energy Resources Group
2. Training was on Griswald Street in a two-story house with a walk up attic and a full basement. The attic was floored with one layer of tongue and groove wood. The pre-weatherization CFM_{50} was 5,700 with the attic and basement doors closed. The post-weatherization CFM_{50} was 3900 with the attic door closed (but attic windows open) and the inside bulkhead door in the basement not yet build or sealed. American Energy Savers was the job contractor. The house had aluminum siding that was going to be replaced soon by another contractor, so the Wx contractor could remove it without replacing.
3. Karg started with a meeting outdoors to inform all of the day's activities.
4. Did a blower door test using the DG-3 and the DG-700. Discussed walking around house to look for leaks with the blower door running and dividing the CFM_{50} by ten to find the approximate square inches of air leakage.
5. Karg gave talk in attic about air sealing and its importance.
   a. Attic was floored so flooring was removed were necessary to get at possible air leaks in ceiling below. This removal was sometimes not done by this agency's contractors.
   b. East Coast Contractors did the attic air sealing work.
      i. Chimney chase.
      ii. Plumbing stack.
      iii. Bathroom exhaust fan.
      iv. Knob-and-tube wiring.[23]
6. In the basement, had a discussion about weatherization strategy.
   a. Discussed thermal boundaries, conditioned space, and where insulation and air sealing should be done.
   b. Karg suggested an agency auditor determine the SIR for installing foundation insulation.
   c. Basement ceiling insulation should not insulated in most basements in Connecticut for energy reasons, but may air seal them if there are IAQ reasons.
   d. Discussion of inner bulkhead door. Seems that this agency does not often install inner bulkhead doors, but it was a good solution at this house.
   e. This was a good discussion, there was even some disagreement.
7. While the attic was being air sealed and insulated, the blower door was run in pressure mode to keep the attic cooler, keep the dust from coming downstairs, and keep the air cleaner in the attic while the insulation was being installed.
8. Julie and Evelyn did the post-weatherization blower door test.

[23] The Connecticut weatherization program requires an electrician to sign off on knob-and-tube wiring, verifying it is safe. This had not yet been done in this house, so it was decided that the knob-and-tube wiring should not be covered by cellulose insulation. Insulation blocks were installed so the attic floor could be insulated.

9. American Energy Savers, a contractor that was at each site since Tuesday, was improving the wall insulation density by leaving his 1 ½ inch flexible tube in the wall longer. The foreman asked Karg to do a core sample test to check density. A core sample was taken between the first and second floors in the balloon framed wall that yielded a density of 3.0 pounds per cubic foot. This was the best he had achieved during the week.
10. Karg mentioned the importance of ordering and structuring the work so that nothing is forgotten.

Training in West Hartford, Connecticut, Friday, June 18, 2004

1. Attending session:
    a. Rick Karg
    b. Glenn Bernard, CT Technical Monitor
    c. Tom Coker, CT Technical Monitor
    d. Ed Williams, CRT weatherization coordinator
    e. Evelyn Claudio, CRT analyst, auditor
    f. Julie Saimininkas, CRT program coordinator, auditor
    g. Mike Lee, CRT
    h. Byron Peart, CL&P and WRAP program manager
    i. Attending contractor, American Energy Savers
        i. Herminio Alvarez
        ii. Steve Ouellet
        iii. Hector Ortiz
    j. Attending contractor, East Coast Contractors
        i. Paul Paris, Sr
        ii. Paul Paris, Jr
    k. Attending contractor, Gagnon Remodeling
        i. Moe Gagnon
        ii. Chris Gagnon
    l. Attending contractor, Comfort Zone
        i. Bob Francis
    m. Attending contractor, Tony Johnson



Just after a Blower Door Test on a Hot Day in Connecticut

2. Training took place on Laurel Drive at a split level house with vinyl siding and a tuck-under garage. The house had a working whole-house fan and related large gable end vent. The accesses to the two attics were in the same bedroom closet. The pre-weatherization CFM_{50} was 3100; the post-weatherization CFM_{50} was 2400. The larger attic with the whole-house fan had a large opening in the floor just above the stair well. This opening – about three feet by four feet – was covered with ¾ inch plywood and then sealed before the cellulose was blown in this area. The smaller attic (and lower roof line) was insulated against the main part of the house with fiberglass. The fiberglass was black at the lower part of the

batt that was in line with the smaller attic floor. Pulling these batts out of their bays at the lower part revealed that the common wall below was open to these bays. This is a common detail for split level homes. The contractor filled these common wall cavities with cellulose when the small attic was being insulated with cellulose.

3. Karg started with a discussion of the day's events and then explained the blower door test.
    a. Used analog gauges and talked about zeroing.
    b. Used DG-3 and talked about need to record baseline pressure.
    c. Walked about house with blower door running to find leaks.
4. American Energy Savers, the job contractor and East Coast Contractors insulated the house. The vinyl siding had a layer of thin rigid insulation under it.
    a. At the back of the house, did a core sample to test the density of East Coast machine, delivery system, and fill method. They used a six to eight foot long corrugated vacuum cleaner tube for filling. Found a core sample density of 3.7 pounds per cubic foot.
5. Tested the East Coast Contractors takeoff pressure on their Force 2 insulation machine. This new machine had a pressure of 115 inches of water.
6. The main attic was air sealed at plumbing pipes and above stair well. Left the whole house fan in place. Glenn Bernard mentioned that Window Quilts can be made and put fan opening on the inside of the house with Velcro.
7. Filled insulation density cases a few times with East Coast Contractors. With their new Force 2 machine with four holes exposed on the feed gate and the air wide open, achieved a density of 3.5 pounds per cubic foot.

General Observations and Recommendations for Connecticut Weatherization Program

[Because this document is intended for general distribution, these observations have been deleted]

Glenn Bernard and Tom Coker Report on Connecticut Training

During this second round of training, Rick worked with the three programs that did not receive training last year. All are contractor-based programs. Last year, Rick worked with our two crew-based programs. All training took place on-site, with a mix of insulation contractors and general weatherization contractors. All agency Weatherization Coordinators, Energy Auditors and both State Monitors were also present.

Overall, we were very pleased with this training and the feedback that we received from everyone involved was very positive. As we discovered last year, the on-site, hands-on, training that Rick provided, has been very beneficial to our program. The written report that we received was also very helpful and we intend to implement Rick's recommendations.

Once again, we would like to thank Rick and everyone else involved with this project. We would also like to thank the Boston Regional Office, Eric and Lois in particular, for their support for this training.

Maine

Classroom Training in Waterville, Maine, Monday, October 25, 2004

1. Attending session:
    a. Rick Karg
    b. Eric Beaton, Boston DOE Program Manager
    c. Tony Gill, state monitor, MSHA
    d. Ed March, MSHA
    e. Ken Feller, CED Housing Director
    f. Hal Barter, CED auditor
    g. Charles Ripley, CED auditor
    h. Larry Horvath, WCAP auditor
    i. Bill Trufant, CED auditor
    j. Ed Turner, WHCA auditor
    k. Allan Slater, WHCA auditor
    l. Todd Anges, PROP auditor
    m. George Duranleau, PROP auditor
    n. Nick Clark, PROP auditor
    o. Paul Shepherd, CCAP auditor
    p. Bruce Mathews, CCAP auditor
    q. Randy Burguess, WMCA auditor
    r. Diane Haley, WMCA auditor
    s. Mike Kneeland, KVCAP auditor
    t. Daryl Carr, KVCAP auditor
    u. Mike Butler, KVCAP auditor
    v. Rob Hersey, PCAP
    w. Skip Butler, PCAP auditor
    x. Ron Pasquale, PCAP auditor
    y. Michael Caruso, PCAP auditor
    z. Tom Brown, PCAP auditor
    aa. ACAP weatherization crew
        i. Barry Clark, ACAP crew chief
        ii. Detlef Ouellette, ACAP crew
        iii. Rodney Roy, ACAP crew
    bb. Jim's Home Improvement
        i. Jim Collins, owner
        ii. Roy McIntosh
    cc. All That Contractors
        i. Charles Gallagher
        ii. Michael Gallagher
    dd. Paul Jameson, Frye Mountain Weatherization
    ee. R.E. Skigell and Sons
        i. Raymond Skigell, owner
        ii. Erik Skigell
    ff. Triple-D Builders, contractor
        i. Dan Hood
        ii. Lisa Hood

gg. Erlene Morgan, Morgan Enterprises
hh. Total Home Improvements, Inc.
    i. Jeff Nichols, owner
    ii. Richard Swift
    iii. Jeremy Wills
    iv. Mike Kelley
    v. Ken Swift
ii. T & M Exteriors Plus
    i. Mike Daniels
    ii. Tom Henderson
jj. WHCA Crew 041
    i. Craig Smith, foreman
kk. WHCA Crew 941
    i. Mason Phillips, foreman
    ii. Cecil Cates
ll. WHCA Crew 943
    i. Randolph Look, foreman
    ii. Timothy Tuttle
mm. Costal Mobile Mechanics
    i. Sandra Van Wart
    ii. Art Van Wart
nn. Hollis Construction, contractor
    i. Hollis Micklon, owner
    ii. Hollis Miklon, Jr
oo. Jim Micklon Construction
    i. Jim Micklon
pp. F & E Builders
    i. Frank Stevens, owner
    ii. Everett Conkey, owner
    iii. Mike Waven
    iv. Richard Wilcox ("Radar")
    v. Dale Ouellette
    vi. Dan Agren
    vii. Jay Scribner

2. Classroom training at the Elks club in Waterville, Maine included the topics of dense-pack insulation methods, blower door guided air sealing, and an update of the progress on the revision of the Maine Weatherization Standards.
    a. There were many good questions and comments regarding the proper methods of insulating dwellings. A number of important topics were raised about items that will be included in the revised Maine Weatherization Standards.
3. After the formal classroom training was completed, the group went out to the parking lot to view a demonstration of a) insulation machine takeoff pressure testing and b) cellulose blowing methods using the insulation density cases.
    b. The Krendl 2090 insulation machine owned by F & E Builders measured 145 inches of water column with only the air on and 135 to 140 inches of water column with the air and agitator operating.
    c. The results of the demonstration for the insulation density cases was:

i. With the machine settings at 6 for air and 3 for material feed, using a straight nozzle, 2 pounds per cubic foot.
ii. With the machine settings at 6 for air and 3 for material feed, using a 1 ¼ inch i.d. fill tube, 3.6 pounds per cubic foot.
iii. With the machine settings at 7 for air and 2 ½ for material feed, using a 1 ¼ inch i.d. fill tube, 4.0 pounds per cubic foot.

Training in Appleton, Maine, Tuesday, October 26, 2004

1. Attending session:
    a. Rick Karg
    b. Eric Beaton, Boston DOE Program Manager
    c. Tony Gill, state monitor, MSHA
    d. Ed Marsh, MSHA
    e. Ken Feller, CED Housing Director
    f. Hal Barter, CED auditor
    g. Charlie Ripley, CED auditor
    h. Paul Shepherd, CCAP auditor
    i. Bruce Mathews, CCAP auditor
    j. Mike Kneeland, KVCAP auditor (morning only)
    k. Daryl Carr, KVCAP auditor (morning only)
    l. Mike Butler, KVCAP auditor (morning only)
    m. Triple-D Builders, job contractor
        iii. Dan Hood
        iv. Lisa Hood
    n. Total Home Improvements, Inc.
        v. Jeff Nichols, owner
        vi. Richard Swift
        vii. Jeremy Wills
        viii. Mike Kelley
        ix. Ken Swift
2. When all had arrived at the site, Karg gave an introductory talk. The house was empty of clients and furniture.
    a. Total Home Improvements, Inc. owner, Jeff Nichols, was an experienced contractor, but had never done weatherization work before. He was very desirous of information about insulation blowing methods and equipment.
    b. The job contractor Triple-D Builders – Dan and Lisa Hood – were very helpful passing useful information on to Jeff Nichols.
3. The Cape Cod style house on Sennebec Road owned by CCAP had a tested pre-weatherization blower door test of 4900 CFM_{50} with the basement door closed and 5750 CFM_{50} with the basement door open.
    a. During the blower door testing, Karg demonstrated the use of both the analog and the DG-700 manometers.
    b. Karg demonstrated the titanium tetrachloride smoke from Retrotec to the group.
4. After recording the blower door readings, the group walked around the house to hunt for leaks with the blower door running.
    a. Tony Gill demonstrated the infrared camera while the blower door was operating.

   b. There was a lengthy discussion about how to insulate the knee wall area on the second floor, either insulate the back of the knee wall and the flat floor behind the knee wall or insulate the roof slope all the way down to the eave area. The pros and cons of each method were discussed.
   c. Discussed the causes of ice dams and the need to perform effective attic bypass sealing before attic insulation installation.
   d. This was a good house for the discussion of the thermal envelope boundaries. We decided that the basement, including the portion under the ell, should be considered within the thermal boundary.
5. Had a discussion in the basement about the furnace and the duct leakage. Karg mentioned that ductwork should not be sealed unless it is in an unconditioned area or unless its leakage is responsible for health and safety problems.
6. Karg tested the takeoff pressure on the Krendl 590 used by Triple-D Builders. This machine has two blowers. With both blowers operating, Karg found 80 inches of water column, air only. With the agitator operating, Karg found 55 inches of water column.
7. Triple-D Builders were able to do some wall blowing in the back wall of the ell (this was one of the few walls that had no insulation in it). Dan Hood of Triple-D Builders first blows down a wall cavity with a 1 inch i.d. tube and then up. Ed Marsh did core sampling in these wall cavities with the guidance of Karg.
   a. In two cavities, Marsh found 3.7 and 3.6 pounds per cubic foot about three feet above the fill hole and 1.8 and 2.6 pounds per cubic foot about three feet below the fill hole.
      i. Nobody had a good theory for the reason the density above the fill hole was so much higher than the density below the hole.
8. Near the end of the day, two of the workers cut back the floor board closest to the knee wall at the front of the house. There were 6 inches of fiberglass installed under the floor. Karg demonstrated the use of this fiberglass as a stop for dense packing cellulose under the floor boards toward the conditioned space of the house.
9. Karg finished off day with a wrap-up talk in the upstairs bedroom.

Training in Ellsworth, Maine, Wednesday, October 27, 2004

1. Attending session:
   a. Rick Karg
   b. Tony Gill, state monitor, MSHA
   c. Ed Marsh, MSHA
   d. Ed Turner, WHCA auditor
   e. Allan Slater, WHCA auditor for this job
   f. WHCA Crew 041
      i. Craig Smith, foreman
      ii. Douglas Downing
   g. WHCA Crew 941
      i. Mason Phillips, foreman
      ii. Cecil Cates
   h. WHCA Crew 943
      i. Randolph Look, foreman
      ii. Timothy Tuttle

i. All That Contractors
    i. Charles Gallagher
    ii. Michael Gallagher

2. This balloon-framed story-and-one-half (not a Cape Cod) house in the center of Ellsworth had a pre-weatherization CFM_{50} of 6500. After gross air sealing was completed (two ceilings patched and an attic hatch panel closed) the CFM_{50} dropped to 5200. WHCA uses crews – they have three – and, sometimes, contractors. All That Contractors had much experience in the building business, but none in weatherization.
3. Karg gave an introductory talk with all present. Allan Slater, the job auditor reviewed the work order for the three WHCA crews present.
    a. Karg demonstrated the use of the blower door.
        i. Use of the new DG-700 digital gauge.
        ii. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        iii. The group inspected the house looking for leaks with blower door running.
4. Discussed attic bypasses and the correct way of treating. Nobody went into attic because the access was too small. The WHCA will frame and finish a new, larger attic access before treating the attic.
5. Tested the three WHCA Krendl 450a blowing machines for static pressure at the takeoff. Also, tested the WHCA generators for voltage.
    a. Equipment on truck 041
        i. Takeoff pressure, air only, was 92 inches of water column. With the agitator operating, 80 through 90 inches of water column.
        ii. The 5200 Watt-rated generator had a no-load voltage output of 119.
    b. Equipment on truck 941
        i. Takeoff pressure, air only, was 64 inches of water column. With the agitator operating, 55 through 78 inches of water column.
        ii. The 6500 Watt-rated generator had a no-load voltage output of 118.
    c. Equipment on truck 943
        i. Takeoff pressure, air only, was 72 inches of water column. With the agitator operating, 55 through 83 inches of water column.
        ii. The 5000 Watt-rated generator had a no-load voltage output of 104 through 118.
6. Karg discussed the potential hazards of generator use (noise and carbon monoxide).
7. Allan Slater used one of Karg's insulation density cases to test the new Krendl 450a machine (truck 041). He found, with the use of a tube, that he achieved 3.25 pounds per cubic foot in the density case. He is not satisfied with the performance of the Krendl 450a; he would prefer to have his crew using a Krendl 2000.
8. Karg discussed the bag or bladder method at the second floor in balloon framed dwellings like this one. The crews at WHCA had not used this method.
9. Karg did some core sampling after one wall was blown.

   a. For the settings on a Krendl 450a of air at 5 ½ and material at 2 ¾, the sample density was 1.5 pounds per cubic foot. This was much below the recommended minimum of 3.2 pounds per cubic foot. This sample was at the top of a first floor window in a story and one-half wall with an open second-floor cavity.
   b. In another wall cavity in the same wall surface with the machine settings of air at 7 and material at 3 ½, the samples were 3.7 pounds per cubic foot at 16 inches below the fill hole and 1.8 pounds per cubic foot at the top of a first floor window in a story and one-half wall with an open second-floor cavity.
10. The Gallagher brothers had the opportunity to tube the walls with the instruction of the WHCA crews.
11. Karg checked the correspondence of Allan Slater and Ed Turner's DG-700 manometers. The readings from each gauge agreed to within one Pascal.
12. At the end of the day, the WHCA crews mentioned that they would like to have a training session about weatherizing mobile homes. A very high percentage of their weatherization jobs are mobile homes. They agreed to be a part of the training team.

Training in Sanford and Waterboro, Maine, Thursday, October 28, 2004

1. Attending session:
   a. Rick Karg
   b. Tony Gill, state monitor, MSHA
   c. Todd Anges, PROP auditor
   d. George Duranleau, PROP auditor
   e. Nick Clark, PROP auditor
   f. Hollis Construction, job contractor
      i. Hollis Micklon, owner
      ii. Hollis Miklon, Jr
   g. Jim Micklon Construction
      i. Jim Micklon
   h. Dave Mullen, contractor
2. This balloon-framed story-and-one-half (not a Cape Cod) house in the center of Sanford had a pre-weatherization CFM_{50} of 3400 with the basement door closed. Hollis Construction has already completed the air sealing and insulated the attic before we arrived. The blower door readings now showed a CFM_{50} of 2050 with the basement door closed and 2300 with the basement door open. The house has a boiler with baseboard hot water distribution.
3. Karg demonstrated the proper use of the blower door.
   a. Using the DG-700 digital manometer.
   b. Dividing CFM_{50} by 10 to get approximate square inches of leakage in dwelling.
   c. Walking around house looking for leaks with blower door running.
4. Tested contractor's blowing machines for static pressure at the takeoff.
   a. Hollis Construction's Krendl 1000 produced 125 inches of water column just before one of the two blowers stopped running. ***As a result of this insulation machine breakdown, the group decided to have lunch together and then conduct an informal audit at the home of Dave Mullin***

in Waterboro, Maine. However, the Michlons went back to their shop to repair their insulation machine. They replaced both of the machine's electric motors, although only one was defective.

5. The Mullin house is a contemporary, two-story clapboarded house with a part of the house on a full basement and part on a slab-on-grade. The house has clearstory windows on the second floor and two skylight shafts in each of the second-floor bathrooms.
    a. A blower door test was done with the results of 2800 CFM_{50} with the basement door open and 2200 CFM_{50} with the basement door closed.
    b. With the blower door operating, we walked around the house to find leaks.
    c. Nick Clark, a new auditor, was given the task of conducting an informal energy audit.
    d. In the attic, we found a rodent problem and six inches of fiberglass. The two skylight shafts were not insulated and showed mold and mildew on the attic side between the drywall and the polyethylene vapor barrier.
    e. The group discovered a hidden closet area on the second floor that bordered the stairwell wall. This area was connected to a vented eave area. We discussed the best method for treating the area.
    f. After the walk-around inspection, we discussed the work order.

Training in Phillips, Maine, Friday, October 29, 2004

1. Attending session:
    a. Rick Karg
    b. Tony Gill, state monitor, MSHA
    c. F & E Builders
        i. Frank Stevens, owner
        ii. Everett Conkey, owner
        iii. Mike Waven
        iv. David Lisherness
        v. Richard Wilcox ("Radar")
        vi. Dale Ouellette
        vii. Dan Agren
        viii. Jay Scribner
    d. Randy Burguess, WMCA auditor
    e. Diane Haley, WMCA auditor
    f. Gary LaGrange, WMCA auditor (attended for about one hour)
2. This balloon-framed story-and-one-half (not a Cape Cod) house in the center of Phillips had a pre-weatherization CFM_{50} of 5385 with the basement door open and 5200 with the basement door closed. At the end of the day after much of the air sealing had been completed in the attic, second floor, and the crawl space, the blower door reading dropped to 3950 CFM_{50}.
3. Karg demonstrated the Energy Conservatory DG-700 digital manometer during the blower door test.
4. Karg tested the output of the Krendl 450 and 2090 owned by F & E Builders.
    a. The 450 had a takeoff static pressure of from 105 to 150 inches of water column, depending on where the agitator seals stopped. With the agitator operating, the average reading was 100 inches of water column. For the

first time, the no-load air flow was measured and found to be 84 CFM at the machine takeoff.

b. The Krendl 2090 machine had a takeoff static pressure of 145 inches of water column with one and two blowers operating. With two blowers and the agitator operating, the takeoff pressure ranged from 135 to 140 inches of water column. The no-load air flow was 90 CFM with one blower operating and 180 CFM with both blowers operating.

5. This contractor had an interesting method of patching plaster. He used metal lathe – sometimes two layers – and then Durabond 90 as a fill material. They find this is much easier than using drywall to patch plaster.
6. They also have an interesting method of patching the fill holes for interior wall blowing. They use a 6-inch square piece of drywall. With an appropriately sized hole-saw and NO pilot bit, they cut a plug through the back the square of drywall, but not through the face paper. The plaster and back paper surrounding the round plug at the center is them removed, leaving the six inch square face paper with a circle of complete drywall material in the center of this square. The plaster around the hole in the wall is mudded with joint compound, this plug with a paper flange in inserted into the hole and then mudded to the plaster.
7. Approximately one-half of the front of the main house was blown with dense-pack cellulose. The crew demonstrated the bag method of plugging the second-floor cavity that is usually open to the wall cavities in balloon framed houses. An empty fifty pound woven grain bag was stuffed into the 2 ½ inch hole drilled at the floor cavity. The bag is filled with cellulose. Then the wall cavity is filled upward and then downward to complete the blow.
8. Three or four members of the F & E Builders crew asked Karg to conduct a training session in the basement about worst-case draft testing. We were not able to do an actual test because the house was not completely weatherized and the basement door was not hung, so Karg explained each step of the test after handing out copies of the worst-case draft form used by the North Dakota Weatherization Program (Karg authored this form). There was an interesting discussion about putting the house in worst-case. However, frustration followed when Karg reminded all present that in Maine one must be a licensed oil burner technician to measure the draft of an oil boiler or furnace. The draft measurement when the house is in worst-case condition (highest negative pressure in the combustion appliance zone) is the most important part of this vital worst-case draft test. Until this restriction is removed by the Maine Oil and Solid Fuel Board, a thorough worst-case draft test cannot be done.

General Observations and Recommendations for Maine Weatherization Program

[Because this document is intended for general distribution, these observations have been deleted]

Tony Gill Report on Maine Training

Report Summary:
As always, Rick Karg provided excellent training. He easily adapts himself to any situation that presents itself and makes the most of it. Maine used this training opportunity to reinforce previous training, introduce new contractors to the WAP and continue the information sharing between (often otherwise competing) sub-contractors. Sixty plus field staff – auditors, inspectors and installers, both crew & sub-contractor - attended one or more days of this very successful initiative. The overall response of attendees was extremely positive with comments like, "Good job!", "Nice training…Lots of information", and, "I thought the workshop was excellent." Maine wishes to again thank the DOE Northeast Regional Office for continuing to sponsor this innovative field staff training opportunity.

Funding:
This year's O^4S Field Staff training was funded by the DOE Northeast Regional Office with a significant contribution from Maine's DOE WAP T&TA Grant.

Background:
Last year Maine used this DOE funded training opportunity to address perceived inconsistencies in dense-blow cellulose standards and installation practices among our weatherization crews and sub-contractors. As a result of that effort, Maine was able to establish uniform insulation blower requirements and density standards across the state. Per the attendees the methods and technique sharing resulting from having several contracting firms present at each field location proved to be the most valuable feature of the training. Maine is in agreement with that opinion.

Present Effort:
For PY '04 Maine had several ambitious goals; we wished to demonstrate basic dense blow cellulose installation methods both to contractors new to the program and potential contractors, reinforce last years dense blow training for veteran installers and increase awareness of House as a System Science for everyone involved. (We were laying the ground work for the anticipated PY '05 O^4S effort which will center on installer requirements arising from Maine's new Weatherization Standards Manual.) Lastly, we wanted to facilitate continuation of the sub-contractor interaction which previously proved so successful.

We started this year's effort with a centrally located one-day interactive classroom session for all Auditor/Inspectors, sub-contractors and crew members. In an attempt to build on the very successful information sharing we experienced last year between sub-contracting firms, we followed with four individual one-day hands-on field sessions across the state. (Everybody was required to attend Monday's centrally located classroom session. All then had the opportunity to attend a localized hands-on field session of their choice.) The Monday classroom session included reviews of dense blow techniques and requirements, the treatment of knob-and-tube wiring, House as a System science – presented as the logic behind our actions - and an open forum where Rick and MSHA staff fielded questions about a host of issues brought up by attendees. We ended the day

with a series of hands-on dense blow demonstrations in the parking lot led by one of Maine's more experienced sub-contractors.

The following four days were taken up with onsite visits to client homes located across the state. While the four homes we used for the field sessions had obvious differences, each client home session included a walk-through audit with blower door testing and work order creation, a group discussion on work strategy and methods emphasizing the reasons behind the choice of measures, testing of the take-off pressure of the contractors insulation machines, a "real world" insulation blowing demonstration and core sampling of insulation density in wall cavities using different machine settings.

Attendee Evaluations:
Forty two of the sixty plus attendees at the classroom session completed evaluations. Results were as follows:

- 40 scored the content value as "Good to excellent".
- 2 scored it as average.
- 36 said the session interaction was "Good to excellent".
- 5 said the session interaction was "average".
- 1 said the session interaction was "average to poor".
- 26 scored the dense blow demonstration content value as "Good to excellent".
- 1 scored it as "poor".
- 39 would definitely recommend the classroom session to a colleague.
- 2 probably would.
- 1 would not. (Interestingly, the same person rated content & session interaction as "Good to excellent")

Fifteen people attended the Union session. All completed evaluations. Results were as follows:

- All scored the content and session interaction value as "Good to excellent".
- All would definitely recommend the classroom session to a colleague.

Nine people attended the Ellsworth session. All completed evaluations. Results were as follows:

- 7 scored the content and session interaction value as "Good to excellent".
- 2 scored the content and session interaction value as "Average to fair".
- 7 would definitely recommend the classroom session to a colleague.
- 1 would probably recommend the classroom session to a colleague. (This person also said, "Overall well worth the time spent."
- 1 left the question blank (and made no comments.)
- The homeowner – who closely followed our activities through the day - insisted on completing an evaluation. She rated everything "excellent" and promised to "Think of us often as we will be warm." (She is not included the above attendee evaluation count.)

Seven people attended the Sanford session. All completed evaluations. Results were as follows:

- All scored the content and session interaction value as "Good to excellent".

- All would definitely recommend the classroom session to a colleague.

Ten people attended the Phillips session. All completed evaluations. Results were as follows:

- All scored the content and session interaction value as "Good to excellent".
- All would definitely recommend the classroom session to a colleague.

Contemplated Program change:
Probably the most important initiative arising from this year's O^4S sessions is Maine's plan to convene quarterly evening sub-contractor meetings to discuss ongoing issues and resolve problems as they arise. We are trying this in response to a suggestion presented during the Monday classroom session that was seconded by numerous attendees. We may use the sessions for brief trainings on things like basic blower door use. Meetings will be held on a regular schedule in different locations to cover the entire state, hopefully starting in April of 2005.

Massachusetts

Training in Greenfield, Massachusetts, Monday, June 21, 2004

1. Attending session:
    a. Rick Karg
    b. Wes James, MA Technical Monitor
    c. Bob Guenthner, MA Technical Monitor
    d. Mark Maynard, Program Manager, Franklin Community Action Corp. (FCAC)
    e. Frank Picard, auditor, SPLA
    f. Butch Winter, auditor, BCAC
    g. Ed Schwabe, auditor, FCAC
    h. Attending contractor, Eastern Insulation
        i. Patrick Smith, owner
        ii. Jacob D'Lugosz
        iii. Andre Agapov
        iv. Kenneth Prevett
        v. Christopher Parda
        vi. Matthew McMallan
    i. Attending contractor, Higginbotham
        i. Joe George, owner
        ii. Harry Mundell
        iii. Dave Hmieleski
    j. Attending contractor, Hilltown
        i. Shane McClaflin
        ii. Heath McClaflin
    k. Attending contractor, Northeast Weatherization (attended for a few hours)
        i. Todd Burke, owner
        ii. Leo Cervantis
    l. Attending contractor (attended morning only)
        i. Herb Prizl, owner
        ii. Jay Pirzl
        iii. Shanna Pirzl
        iv. Jason Lebarrou
        v. Matt Newton
2. House on Chapman Street was a two story home with a full basement. The house had old aluminum siding that was a challenge to remove and replace without damage. The McClaflin brothers trained the other contractors how to remove and replace this siding without damage. Their method was very effective. We could not perform a blower door test because a pellet stove was operating in the house
3. Spent time in attic with group.
    a. Plan was to blow under existing floor boards and blow above them.
    b. Talked about the importance of removing boards before blow to find air leaks around plumbing stacks, chimneys, etc. Some contractors are not searching for leaks before blowing.

   c. Karg discussed proper method of sealing chimney chase with galvanized tin at chimney and high temperature caulk. The aluminum flashing can be used to keep cellulose at least two inches away.
   d. We found knob-and-tube wiring so we could not proceed blowing the attic until an electrical inspection.
   e. Discussion of type IC recessed lighting fixtures and fan/light combinations.
4. McClaflin brothers taught other contractors how to remove and replace the old aluminum siding without damage.
   a. One contractor mentioned that he was face drilling aluminum siding and plugging the holes with plastic plugs. Karg and state monitors said this was a substandard practice.
   b. Also discussed asbestos siding. Some contractors present were face drilling asbestos siding and plugging it. Karg and state monitors said this was a substandard practice and hazardous for the workers.
   c. Most of the contractors had the opportunity to remove and replace the old aluminum siding during the day.
5. Installed insulation in driveway-side wall of house. Did some core sampling here to demonstrate the technique.
   a. With a Force 2 insulation machine with air wide open and six holes exposed on feed gate, two-hole, straight nozzle, got 1.6 pounds per cubic foot.
   b. With the same Force 2, the feed gate closed to five exposed holes, using Karg's 1 ¼ inch tube, one-hole method, got 3.2 pounds per cubic foot density.
6. Karg tested the insulation machines for takeoff pressure (should be at least 80 inches of water pressure).
   a. Eastern Insulation Force 2, first machine, 85 inches of water.
   b. Eastern Insulation Force 2, second machine, 125 inches of water.
   c. Higginbotham Force 2, first machine, 98 inches of water (with agitator operating, the pressure went down to 60 inches of water).
   d. Higginbotham Force 2, second machine, 125 inches of water.
   e. Northeast Weatherization Force 2 machine, 80 inches of water.
7. Used the insulation density cases with good success. All involved were intrigued with the cases and process.
   a. Eastern Insulation's Force 2 insulation machine, air wide open and four holes exposed on the feed gate, achieved 2 pounds per cubic foot. Used straight nozzle to fill without pointing nozzle up or down during fill. Took 2:25 minutes to fill (3.2 pounds of cellulose per minute).
   b. Same machine as above with same settings. This time the straight nozzle was pointed at an angle upward for the fill. Achieved 2.5 pounds per cubic foot. The fill time was 4:40 minutes (2.1 pounds of cellulose per minute).
   c. Same machine as above with same settings. This time Karg's 1 ¼ inch inside diameter tube was used to achieve a case density of 3.5 pounds per cubic foot. The time to fill was 8:00 minutes (1.75 pounds of cellulose per minute).
   d. The final case test was with the same Force 2 machine, but the material feed gate was opened to six exposed holes and Karg's tube was used again. The density was 3.2 pounds per cubic foot in 2:40 minutes (4.8 pounds of

cellulose per minute). Karg mentioned that this was a very good delivery system and machine setting for achieving a dense pack in a short period of time.

Training in Webster, Massachusetts, Tuesday, June 22, 2004

1. Attending session:
    a. Rick Karg
    b. Wes James, MA Technical Monitor
    c. Bob Guenthner, MA Technical Monitor
    d. Peter Wingate, auditor and weatherization director, WACA
    e. Marge Gianaetti, energy director, MOC
    f. Art Firl, auditor, WACA
    g. Joe Nierodzinski, auditor for WCAC
    h. Attending contractor, Fournier
        i. Pat Fournier, owner
        ii. Jason Allen
    i. Attending contractor, Northeast Weatherization (attended for a few hours)
        i. Todd Burke, owner
        ii. Leo Cervantis
    j. Attending contractor, Housewarmers Insulation (job contractor)
        i. Bob Fingon, owner
        ii. Tom Smith
        iii. Matt ??
    k. Contractor's Cooperative
        i. Steve Bowie, owner
        ii. Mike O'Neill
        iii. Scott Lawson
2. House on High street was a two story home (one apartment unit per floor) with a full basement and a full walkup attic. The siding was asbestos with wood clapboards underneath. The job contractor had to close up the doorway to the third floor with plastic before we could perform a blower door test. The pre-weatherization CFM_{50} was 8000 with the attic area closed to downstairs. The house weatherization was not finished in time to perform a post-weatherization blower door test.
3. After all had arrived at the site, Karg introduced the training, mentioned the funding, and what he expected to do during the day.
    a. Talked about removal of asbestos siding.
    b. Discussed removal of aluminum siding.
4. Karg conducted blower door test.
    a. Demonstrated analog gauges for Minneapolis Blower Door.
    b. Demonstrated DG-700.
    c. Talked about use of blower door to find leaks and using blower door to keep attic cool and dust-free during attic weatherization.
5. Spent time in attic with group.
    a. Talked about the need to remove flooring to inspect for attic bypasses.
        i. Plumbing stacks.
        ii. Chimney chases (there was a large one in attic).
        iii. Open-partition walls.

   b. The knob-and-tube wiring in attic was already inspected by an electrician.
6. Job contractor tubed walls with 7 foot, 1-inch inside diameter braided tube.
   a. Contractor also tried Karg's 1 ¼ inch inside diameter tube.
   b. We also tried Contractor's Cooperative nozzle method in wall.
7. Karg measured the takeoff pressure at the insulation machines on the site (pressure should be at least 80 inches of water with agitator operating).
   a. Fourneir, Force 2 machine, 50 inches of water with agitator operating.
   b. Housewarmers, Force 2 machine, 105 inches of water without agitator and 90 inches of water with agitator operating.
   c. Contractors Cooperative, National Fiber 510 machine (not sure of this), 55 inches of water with agitator operating (agitator cannot be shut off, always runs with blower).
8. Karg took some core samples to check wall density. The machine setting on the Housewarmers Insulation Force 2 machine were the same for all these tests.
   a. 1-inch, 7 foot tube, five feet above fill hole, 3.8 and 1.9 pounds per cubic foot.
   b. 1 ¼ inch, 10 foot tube, five feet above fill hole, 1.8 and 1.8 pounds per cubic foot.
   c. Two-hole nozzle method, 1.4 and 1.4 pounds per cubic foot.
9. Used insulation density cases at end of day. These were very helpful for the contractors who were still on the site.
   a. Housewarmers Insulation Force 2 machine, air wide open and about the equivalent of four holes exposed in the feed gate (this older, green-body, machine actually has no holes in the feed gate, so this "four holes" is just an estimate. This might not compare well to the newer blue-body machines). Nozzle used to fill case. Case had density of 1.8 pounds per cubic foot in 1:25 minutes (4.8 pounds of cellulose per minute).
   b. Same machine with same settings, but with 1-inch inside diameter tube. Case had density of 2.5 pounds per cubic foot in 2:35 minutes (4 pounds of cellulose per minute).
   c. Same machine with same settings, but with 1 ¼ inch tube. Case had density of 3.1 pounds per cubic foot in 2:35 minutes (4.9 pounds of cellulose per minute).
   d. Same as "c" above but closed the feed gate by one inch. Case was now 3.3 pounds per cubic foot (this is dense packed) in 5:25 minutes (2.4 pounds of insulation per minute).
   e. Contractors Cooperative machine wide open with straight nozzle (this is what they always use). Case had density of 1.8 pounds per cubic foot (forgot to record time).
   f. Contractors Cooperative machine wide open with 1 ¼ inch tube on the end of their nozzle. The tube was inserted into the insulation case. Case had a density of 3.0 pounds per cubic foot in 6:20 minutes (1.9 pounds of cellulose per minute). This was a significant difference over the previous test, showing that even with a substandard machine (this machine was 55 inches of water at the takeoff), a good density can be achieved with a tube.
10. After the insulation density case demonstration, Karg held a wrap-up meeting.

Training in Marlborough, Massachusetts, Wednesday, June 23, 2004

1. Attending session:
    a. Rick Karg
    b. Dave Fuller, MA Technical Monitor
    c. Bob Guenthner, MA Technical Monitor
    d. Steve Antonini, Technical Manager, SMOC
    e. Mike Child, auditor/inspector
    f. Ed Cripps, auditor/inspector
    g. Will Roman, auditor/inspector
    h. Tim Brady, auditor
    i. Ward Wrzenski, auditor
    j. Attending contractor, Yates Insulation (attended for a few hours)
        i. Jay Yates
        ii. David Yates
    k. Attending contractor, Andy Insulation (job contractor)
        i. Andres Baez, owner
        ii. Jose Lopez
        iii. Andres Laureano
2. House on Water street was a two-story home with a full basement and an attic with access by a hatch. The siding was vinyl, then ¼ inch rigid insulation and then double-nailed (blind-nailed) asbestos underneath. Although some of the wall area was insulated during our session, it was decided that removing the siding was too difficult to insulate the walls thoroughly on all sides of the house.[24] A blower door test could not be done because of friable asbestos in the basement. The house was heated with a hot water system.
3. Karg and others inspected the attic. There were a few inches of loose rock wool. Air sealing was needed around chimney and a few other places. The attic was not insulated during our time at the site.
4. Our inspection of the basement revealed many scores of feet of asbestos insulation on the hot water heat distribution pipes. Most of this was covered with duct tape, but some that was not covered was very delicate. Avoidance of a blower door test was a prudent choice.
5. Because we could not perform an actual blower door test, Karg demonstrated it in the front yard. One of the auditors present held the frame and fan while Karg talked about the gauges, finding leaks with the blower door, and using it to cool the attic and reduce dust while the attic is being insulated.
6. The conditions at the house would not allow core sampling, so Karg decribed the method.
7. Tested the Andy Insulation National Fiber 510 insulation blowing machine for pressure at the takeoff. This was the only machine on the site. The machine yielded 55 inches of water, significantly less than the 80 inches required for dense packing cellulose in walls efficiently.

[24] Three courses of vinyl siding would have had to be removed to get proper access to the asbestos siding. Because the vinyl siding and rigid insulation was nailed through the asbestos siding, the asbestos was already cracked in many places, making it rather hazardous to remove.

8. Used the insulation density cases with Andy Insulation National Fiber 510 machine. They normally use a 1-inch inside diameter tube about six feet long for walls.
    a. With Andy Insulation National Fiber 510 machine and their tube, the case density was 2.5 pounds per cubic foot. The fill was not timed.
    b. Then we used a nozzle instead of the tube with the same machine and found the case had a density of 1.2 pounds per cubic foot. The top sections of the case did not fill.
9. Karg had a sit-down chat in the shade with the auditors at the end of the work day.
    a. Discussed the importance of their good relationship with their contractors.
    b. They said they always know when their contractors were on one of their jobs so that they could visit them and inspect the work in progress. This is good.
    c. They spoke of the difficulties of the many weatherization standards and prices to keep track of in Massachusetts.
    d. Karg spoke of the importance of air sealing and how he thinks it is being forgotten on some jobs.
    e. The auditors think it is fine if the contractors do the blower door testing.
    f. They mentioned that they are all doing worst-case draft testing after all weatherization work is complete.
    g. We had a short discussion about carbon monoxide testing protocols and talked about the difficulties of testing gas ranges in the field. Karg directed a few of them to the gas range testing protocol he wrote for the Chicago Weatherization Region a few yeas ago at www.karg.com/rangeprotocol.htm.

Training in Wareham, Massachusetts, Thursday, June 24, 2004

1. Attending session:
    a. Rick Karg
    b. Dave Fuller, MA Technical Monitor
    c. Bob Guenthner, MA Technical Monitor
    d. John Quintal, auditor
    e. Kerrie Lee Armstrong, program assistant/consultant
    f. Attending contractor, Thermco Home Improvement
        i. Brian Smith
        ii. Brian Perry
    g. Attending contractor, All Cape Energy (job contractor)
        i. Dan White, owner
        ii. Rich Laine
        iii. Shayne DeWitt
    h. Attending Contractor, Energy Doctor (attended for one-half day)
        i. Charlie Delisle, owner
        ii. Chris Ripanti
        iii. Jeff Machado
    i. Attending Contractor, Pro Insulators
        i. Shawn Gillette
        ii. Wayne Campbell

iii. Jim Harrold
iv. Chuck Costa

2. House on Sandwich Road was a two story home with a crawl/basement and an attic with no access from inside the house. Gained access to the attic by cutting in a few roof vents. The siding was vinyl with wood shingles underneath. The house was heated with a furnace located in the crawl/basement. The pre-weatherization test with a Minneapolis blower door yielded a CFM_{50} of 4100.
3. Day began with a meeting where Karg informed attendees about funding for training and what we would cover.
4. After we inspected the house, did a blower door test at the front door.
    a. Used Analog gauge.
    b. Demonstrated the DG-700.
    c. Use of blower door to find leaks.
    d. Use of blower door to cool attic.
5. Karg tested the insulation machines for pressure at the takeoff (need at least 80 inches of water for capacity to dense pack cellulose in walls).
    a. All Cape Energy, Force 2 machine, 70 inches of water.
    b. Thermco Home Improvement, Force 2, 105 inches of water without agitator, 75 inches of water with agitator.
    c. Thermco Home Improvement, Krendl 200 (externally mounted blower and no control for just air), 48 inches of water.
    d. Energy Doctor, Force 2, 85 inches of water with air only, 77 inches of water with agitator running.
    e. Pro Insulators, Krendl 2000 with a total of four blowers, 125 inches of water with one blower and no agitator, 110 inches of water with one blower and agitator running. Running two blowers gave 140 inches of water and three blowers 145 inches of water.
6. All Cape Energy used a two-hole/nozzle method. On one wall we tried their methods and Karg tried his 1 ¼ inch tube. Core samples were taken to determine the installed insulation density.
    a. With All Cape Force 2 machine, found 0.5 and 0.3 pounds per cubic foot between their fill holes. These are very poor results.
    b. With the same machine and the same settings, using the tube method with fill hole at the bottom of the windows, found a density of 2.0 and 1.4 at about two-feet down from top of cavity. These were not great results, either.
7. Had a good discussion of tube method of insulating walls.
    a. Labor saving (takes longer to blow in insulation, but open-up and close-up time is reduced because of one fill hole per cavity per floor).
    b. Safer because less time on ladders or staging.
    c. No settling of cellulose.
    d. More even density throughout the height of the wall cavity.
    e. Significant reduction of air leakage through wall.
    f. Slight reduction in R-value with a denser pack, but not significant.
    g. Must be careful not to damage interior wall surfaces.
    h. For dense packing walls properly, need:

i. An insulation machine with the proper capacity (at least 80 inches of water pressure at takeoff or 2.9 pounds per square inch of pressure).
ii. The proper machine settings. For dense packing, the air-to-material ratio must be high enough for a cellulose density of at least 3.2 pounds per cubic foot. On the other hand, if this ratio is too high, the job of insulating will take much longer. A balance must be found for each machine, delivery system, and wall.
iii. A good delivery system from insulation machine to the end of the wall tube.
    1. No leaks in hose or at joints.
    2. Delivery system should be as short as possible for the job.
    3. All reductions/transitions in delivery system should be gradual to minimize clogging.
    4. Open end of tube should be cut at an angle to facilitate inserting the tube into the wall cavity.
iv. A tube operator that used an effective technique.
    1. The tube should be inserted all the way up to the top plate and then pulled down just less than one foot before the machine is turned on. [Core sampling has demonstrated that the end of the tube must be within one foot of the area to be insulated to achieve an acceptable density.]
    2. As the flow in the hose and tube slows and stops from increasing resistance in the cavity, the tube should be pulled out of the fill hole by just less that one foot at a time. If the tube is pulled out too soon, the density will decrease.
    3. After the wall cavity is filled upward from the fill hole, the tube should be inserted downward through the fill hole. Inserting the tube with just the air running will help "drill" through the cellulose that has fallen from the upward fill. This will help achieve a higher density in the downward fill.
    4. Plug the fill hole with a wood or rigid insulation plug or spray foam or piece of fiberglass batt.

8. Handed out J & R Products and Applied Energy Products catalogs to contractors who wanted them.
9. Used the insulation density cases near the end of the day.
    a. All Cape Energy Force 2 machine, 80 percent air and 6 holes exposed on the feed gate, use of Karg's 1 ¼ inch tubing. Case density was 3.5 pounds per cubic foot in 4:00 minutes (3.5 pounds of cellulose per minute).[25]
    b. All Cape Force 2, same settings, using straight nozzle. Case density was less than 2 pounds per cubic foot in 2:40 minutes (2.8 pounds of cellulose per minute).

[25] Although this machine was found to have the slightly substandard takeoff pressure of 70 inches of water, it was able to achieve a good dense pack in the insulation density case.

c. All Cape Force 2, same settings, using directional (cup) nozzle. Case density was 2.25 pounds per cubic foot in 2:25 minutes (3.6 pounds of cellulose per minute).
d. Pro Insulator's Krendl 2000 machine, one blower on, feed at 3, with a directional (cup) nozzle. Case density was 2.0 pounds per cubic foot in 1:40 minutes (4.8 pounds of cellulose per minute).
e. Thermco Home Improvement Krendl 200 with gate wide open and a directional nozzle. Case density was less than 2.0 pounds per cubic foot in 3:43 minutes (2.0 pounds of cellulose per minute).
f. Pro Insulator's Krendl 2000 machine, one blower on, feed at 3, with the 1 ¼ tube. Case density was 2.6 pounds per cubic foot in 2:20 minutes (4.5 pounds of cellulose per minute).[26]
g. Pro Insulator's Krendl 2000 machine, three blowers on, feed at 3, with the 1 ¼ tube. Case density was 4.85 pounds per cubic foot in 3:20 minutes (5.8 pounds of cellulose per minute).

10. Used Pro Insulator's Krendl 2000 machine to wet spray a framed box with fabric on the back. After the insulation had fully dried (about four to five days) the density of the dry wet spray cellulose was about 3.5 pounds per cubic foot.
11. Karg closed day with a summary of what we had discovered.
    a. To get a uniform and complete blow in a wall, must use a tube.
    b. Uniform R-value and no damage to walls is most important. The next level of best practice is dense packing walls to at least 3.2 pounds per cubic foot to stop air flow and settling.
    c. Contractors must work with energy auditors and visa-versa.

Training in Milton, Massachusetts, Friday, June 25, 2004

1. Attending session:
    a. Rick Karg
    b. Lois Pasquerella, Weatherization Program Manager for Northeast Regional Office (MA, CT, VT)
    c. Dave Fuller, MA Technical Monitor
    d. Bob Guenthner, MA Technical Monitor
    e. Phillip Chwalek, auditor
    f. Sonny Morgan, auditor
    g. Attending contractor, New England Insulation (job contractor)
        i. Dennis Chicoini, owner
        ii. Damien Vadnais
        iii. Chris Martley
        iv. Charles Drish
        v. Todd Hamilton
        vi. Bob Warchal
    h. Attending contractor, Metro Insulation
        i. Eric Johnson
        ii. Jack Doolan

[26] Karg noticed that this superior machine was not performing as it should have been. After mentioning this to the operators, they discovered that they had only one blower running rather than the assumed three or four blowers. After a repair to get three blowers running, the next insulation density case test was performed with very good results.

iii. Rich Pettengill
iv. Shayne DeWitt

i. Attending Contractor, Kelly Insulation
i. Jack Kelly, owner
ii. Jason Guerra

2. House on McKinnon Avenue was a Cape Cod style house with large dormers in the back and two small dormers in the front. The siding was wood shingles with vinyl over the wood shingles on the front of the house. The house had a full basement. The pre-weatherization test with a Minneapolis blower door yielded a CFM_{50} of 3300. A post-weatherization blower door test was not done during the training.
3. After everyone arrived, Karg started with a chat to explain the funding and training and what we would do during the day.
4. Conducted insulation machine pressure tests at takeoff.
    a. New England Insulation number one Force 2 machine, 112 inches of water with blower only, 95 inches of water with blower and agitator on.
    b. New England Insulation number two Force 2 machine, 80 inches of water with blower only, 70 inches of water with blower and agitator on.
    c. Metro Insulation Force 2 machine, 105 inches of water with blower only, 85 inches of water with blower and agitator on.
5. Inspected attic before blower door test.
    a. Plumbing stack needs air sealing.
    b. Found large area of sunken attic floor over the stair area. Karg recommended that this be covered and sealed with plywood, drywall, or rigid insulation.
    c. Karg discussed removing existing batts (these were one-inch cellulose batts with felt paper on each side) about a foot at eaves and removing at gable end bay if the ceiling is strapped. This prevents air from flowing laterally under batts after cellulose is installed.
    d. There was no chimney in attic, but Karg talked about proper chimney treatment.
6. Two knee wall areas in master bedroom had three built in drawers in each. Discussed the best method of treating this difficult problem. Final strategy was to access through drawer area to insulate and seal slope and walls, bringing the drawers into the conditioned area.
7. The basement ceiling was finished with plaster, so very little work could be done in the basement.
8. Karg did blower door test with Infiltec blower door (all the contractors present used Infiltec doors). Found a pre-weatherization CFM_{50} of 3300.
    a. Covered zeroing and use of rings (contractor did not have rings with him).
    b. Covered finding leaks with blower door running.
    c. Using door to cool attic during work and reduce dust.
9. New England Insulation started blowing the walls in the back of the house first. They used their number one Force 2 machine and used a two-hole/nozzle method for walls. Karg had them prepare three bays for use of the 1 ½ inch tube. Dennis Chicoini, the owner of New England Insulation, used the tube to fill these three bays. Karg did some core sampling with their method and the tubing method.

   a. Three core samples one-half way between the two fill holes used for the nozzle fill found:
      i. One hole was completely empty, so no density was calculated.
      ii. 2.25 pounds per cubic foot.
      iii. 1.45 pounds per cubic foot.
   b. Two core samples were done to test the tubing method. These samples were done just below the top of the windows with the fill hole just under the windows.
      i. 2.35 pounds per cubic foot.
      ii. 2.85 pounds per cubic foot.
10. Used insulation density cases at the end of the day. For both tests, we used the New England Insulation number one Force 2 machine with the air wide open and the feed gate set at five exposed holes.
   a. Use of straight nozzle. Case density was 1.9 pounds per cubic foot after 4:10 minutes (1.8 pounds of cellulose per minute). The top sections of the insulation density case were empty.
   b. Use of 1 ¼ inch tube. Case density was 2.75 pounds per cubic foot after 7:20 minutes (1.5 pounds of cellulose per minute).

General Observations and Recommendations for Massachusetts Weatherization Program

[Because this document is intended for general distribution, these observations have been deleted]

Ken Rauseo Report on Massachusetts Training

General evaluation of the training experience
The training project was rated as very good to excellent by the seventeen (17) private sector contractors, eighteen (18) weatherization subgrantee energy auditors and three (3) state technical monitors who attended the 5 field based training sessions. The investment of time by those in attendance was considered well spent and very productive. The gathering of contractors model worked extremely well for our network and contributed to a very positive group dynamic atmosphere. Prior to each training session, Rick Karg fully and clearly outlined the goals for the day and sought input from those in attendance regarding special training needs. And finally, the inclusion of additional training tools added to the value of the training experience for all those in attendance.

Appraisal of the value of the training to the auditors and contractors
The feedback received during and after the training sessions from the WAP energy auditors and contractors was very positive and constructive regarding the value of the technical training sessions. It was a unique opportunity for energy auditors and contractors to share information, experiences, techniques and applications related to the process of comprehensive weatherization. All energy auditors were receptive to Rick's concepts and theories and were reassured when their knowledge and opinions were reinforced by Rick's positive feedback. The vast majority of the weatherization contractors who attended the training sessions were very positive regarding the techniques and procedures presented at the trainings. The value of adding the training

tools (insulation density core sampling kit, density cases and insulation machine pressure test kit) to the project was of extreme importance. Rick's ability to convince skeptical contractors to accept new and different procedures and techniques and to upgrade and properly maintain their equipment was a critical achievement.

Suggestions for training session improvements (comments, format and etc.)
The content, format and structure for each day of training were very effective and efficient in training a large group of contractors and energy auditors in an on-site setting. The only change that we would recommend for our next round of technical trainings would be to allocate more time to blower door guided air sealing procedures and materials. Some weatherization contractors and energy auditors are still having great difficulty in understanding and implementing proper air sealing concepts of attic first, then basement and then living space. Rick addressed these concepts, but actually performing the work with incremental blower door testing would have a greater impact upon the contractors and energy auditors.

Changes the state will make as a result of the training
Since the completion of the O^4S Training Project, the Department of Housing & Community Development (DHCD) has reviewed and amended its WAP Technical Manual to more clearly mandate the utilization of dense packing when insulating sidewalls. We have also completed our two year weatherization contractor procurement process which requires contractors to repair or replace their insulation and blower door equipment if they fail to meet applicable standards. DHCD Technical Field Monitors are also stressing in-process job inspections while performing their field monitoring duties at WAP subgrantees. By performing in-process job inspections we are able to more confidently identify weatherization contractor training needs and can more definitively recommend equipment repair, upgrading or replacement. Rick's Sidewall Insulation Handout will also be given to all 75 Massachusetts Weatherization Contractors along with the opportunity to request state sponsored training. Lastly, Bonded Insulation, a New York based cellulose insulation manufacturer, has initiated a financing program to assist new and existing contractors to purchase cellulose insulation equipment.

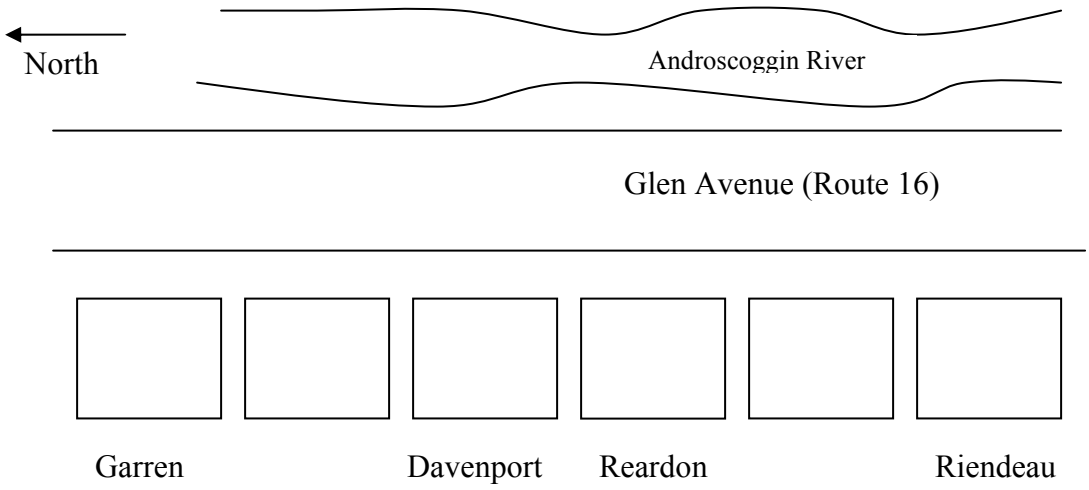


Demonstration in Massachusetts

New Hampshire

Training in Berlin, New Hampshire, Monday, September 27, 2004

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Office of Energy and Planning
    c. Coos County crew
        i. Peter Bilodeau, energy auditor
        ii. Steve Dumesnil
        iii. Mark Tabak
        iv. Jack Hoffman
    d. Carol County crew
        i. Rob Pettis, energy auditor
        ii. Keith Babb
        iii. Mark Garland
    e. Grafton County crew
        i. Dennis Downs, energy auditor
        ii. Dana Maynard
        iii. Bill Parenteau
2. This training took place in Berlin, NH at the Gateway Project. This project includes eight or nine houses in a row on left side of the main street as one enters Berlin from the south. Monday through Wednesday of the training week were spent in various Gateway Project houses. The houses worked on during the three-day training are named in the illustration below.



3. Karg started the day with a group meeting to discuss the format of the training, the funding for the training, and the topics he thought would be addressed. He invited all to ask questions, make use of him as a resource, and to question authority, if appropriate.
4. In the Reardon house we had a lengthy discussion of the thermal envelope possibilities for the attic area. The attic was finished, but only accessible by a pull-down stair. Active knob-and-tube wiring was in at least one of the attic floor

cavities. An electrician had rewired the house (he hadn't noticed this knob-and-tube wiring) and upgraded the service panel. Normally the crew responsible for this house would NOT have insulated this floor because of the old wiring, they would have, instead, insulated the attic walls and ceiling. Karg informed the auditor and crew of the protocol used in Maine for knob-and-tube wiring (voltage drop of 10 percent or less and S-type fuses in a fuse box). We measured the voltage drop and found it was 4.4 percent. Knowing this and knowing that there was a new service panel, we decided to insulate the attic floor. Since the electrician was on site, we asked his opinion. He felt that it would be safe to insulate around the knob-and-tube wiring in the attic floor.

5. Karg distributed catalogs from J & R Products and Applied Energy Products to the three energy auditors/crew leaders present.
6. Karg took static pressure readings at the takeoffs on the Coos County and the Carol County insulation blowing machines. The Coos County Force 2 machine produced 100 IWC with the agitator off and 85 IWC with the agitator on. The Carol County Force 2 machine produced 120 IWC with the agitator off and 80 IWC with the agitator on.
7. We used the insulation density cases to demonstrate the effectiveness of various wall blowing techniques. This demonstration showed that tubing is the best method for insulating walls and that an adequate density can be achieved in much less time with the proper machine settings. The results are listed below:

Insulation Density Case Demonstration Results		
Blowing Method	Coos County Results	Carol County Results
Straight nozzle, 100% air, 4 holes exposed on material feed plate	2.5 lbs/ft^3	2.9 lbs/ft^3
Directional nozzle, 100% air, 4 holes exposed	3.6 lbs/ft^3	4.25 lbs/ft^3
1 ¼ inch ID tube, 100% air, 4 holes exposed	4.25 lbs/ft^3, 14 minutes	
1 ¼ inch ID tube, 100% air, 7 holes exposed	4.0 lbs/ft^3, 3:22 minutes to fill	3.5 lbs/ft^3, 2:26 minutes to fill

8. We discussed basement and crawl space treatment. At least one of the energy auditors has been sealing many basement and crawl space ceilings for health and safety reasons. Karg thought that in most cases this was probably an unnecessary treatment and should be stopped.
9. Talked with two auditors about the thermal boundaries of basements and crawl spaces. Karg said that making a crawl space part of a thermal boundary is usually the best practice. One auditor mentioned a crawl space wall insulation technique of blowing cellulose into a long polyethylene "pillow" hung from the rim joist area down to about six inches above the crawl space floor. The plastic is hung and then it is blown. The plastic encases the cellulose, except at the ends of the long pillow.

Training in Berlin, New Hampshire, Tuesday, September 28, 2004

1. Attending session:
    a. Rick Karg
    b. Coos County crew
        i. Peter Bilodeau, energy auditor
        ii. Steve Dumesnil
        iii. Mark Tabak
        iv. Jack Hoffman
    c. Carol County crew
        i. Rob Pettis, energy auditor
        ii. Keith Babb
        iii. Mark Garland
    d. Grafton County crew
        i. Dennis Downs, energy auditor
        ii. Dana Maynard
        iii. Bill Parenteau
2. Tested the Grafton County Force 2 insulation machine for takeoff pressure. The machine produced 94 IWC with the agitator off and 90 IWC with the agitator on.
3. Performed a blower door test in the upper floor of the Riendeau house (an up-down duplex). Karg explained the use of the DG-700 digital manometer to the auditors and crews.
4. In the same apartment unit, Karg, at the request of the energy auditors, explained zone pressure diagnostics (ZPD) using the attic as the zone. The whole-apartment unit leakage rate was 3750 CFM_{50} (this included air leakage to the downstairs apartment).
    a. The airflow between the house and the attic – without the whole-house fan sealed – was 1819 CFM_{50}. From the attic to the outdoors, the flow was 3360 CFM_{50} and the total path flow was 1469 CFM_{50}.
    b. The airflow between the house and the attic with the whole-house fan sealed was 1384 CFM_{50}. From the attic to the outdoors, the flow was 2927 CFM_{50} and the total path flow was 1158 CFM_{50}. This test indicated approximately 44 square inches of leakage through the untreated whole-house fan.
    c. The airflow between the house and the attic with the whole-house fan sealed and the attic bypass sealing completed was 1286 CFM_{50}. From the attic to the outdoors, the flow was 2929 CFM_{50} and the total path flow was 1095 CFM_{50}. This test indicated that the attic bypass sealing accounted for only about 10 square inches of leakage between the house and the attic.
    d. The airflow between the house and the attic with the whole-house fan sealed, the attic bypass sealing completed, and the attic insulation completed was 812 CFM_{50}. From the attic to the outdoors, the flow was 3387 CFM^{50} and the total path flow was 758 CFM_{50}. This test showed that the attic insulation sealed about 48 square inches of area after the attic bypass sealing was completed.
    e. Karg discussed how measuring pressure difference only can be misleading, so care must be used with pressure-only values. Determining flow values by creating a temporary hole between the house and zone or zone and outdoors is very important to do when possible.

5. Did a few core sample tests. Tried to do many, but found that most drilled areas had insulation in sample hole in addition to the cellulose just installed. One valid sample on the Reardon house in the second floor wall found 1.6 pounds per cubic foot. Another in the Davenport house found 3.23 pounds per cubic foot.
6. Karg presented his PowerPoint ASHRAE 62.2 presentation to Peter Bilodeau and Dennis Downs. This presentation was developed for the Affordable Comfort Conference in Westford, Massachusetts being held the next week.
7. The attic floor blow in the Reardon house was completed and checked for density. The digit test (Karg's finger) indicated approximately 5 pounds per cubic foot density. Loose fiberglass around the chimney so that the two-inch chimney rule would not be violated by cellulose insulation.

Training in Berlin, New Hampshire, Wednesday, September 29, 2004

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Office of Energy and Planning
    c. Phil Guiser, Weatherization Director, Tri-County
    d. Coos County crew
        i. Peter Bilodeau, energy auditor
        ii. Steve Dumesnil
        iii. Mark Tabak
        iv. Jack Hoffman
    e. Carol County crew
        i. Rob Pettis, energy auditor
        ii. Keith Babb
        iii. Mark Garland
    f. Grafton County crew
        i. Dennis Downs, energy auditor
        ii. Dana Maynard
        iii. Bill Parenteau
2. Karg did blower door test in second floor of Riendeau building. Found 3600 CFM_{50}. This was with the attic bypasses sealed and the attic insulation installed. We concluded that the house had been set up differently the day before when we got a 3750 CFM_{50} BEFORE the attic bypass sealing and attic insulation installation (chances are, something was different in the apartment unit below that we could not control).
3. With the blower door operating, Andy Gray demonstrated the Monroe infrared camera in the Riendeau apartment. He was able to get many of the crew members involved with the scanning.
4. The two energy auditors present requested that we do a multi-blower door test of the Riendeau house, one blower door in the upper apartment and one in the lower apartment. The blower door operators communicated with walkie-talkies.
    a. With the upper blower door operating at 50 Pascals of depressurization and the lower blower door off, the CFM_{50} was 3600 in upper. The negative pressure recorded in the lower during this test in the upper was -17 Pascals.
    b. With the lower blower door operating at 50 Pascals of depressurization and the upper blower door off, the CFM_{50} was 3500 in lower. The

negative pressure recorded in the upper during this test in the lower was -18 Pascals.

c. With the upper AND lower blower doors operating at the same time at -50 Pascals of pressure, the upper CFM_{50} was 2800 and the lower CFM_{50} was 2250. Adding these to flow rates together gives the true whole-building CFM_{50} of 5050. Conducting blower door tests on each of the apartment units individually always exaggerates the true building CFM_{50}. In this case, the two separate CFM_{50} values for the individual blower door tests added up to 7100, or 2050 more than the true whole-building CFM_{50} of 5050.

d. All were very intrigued by this multi-blower door test.

5. Did a blower door test in the Davenport house with the infrared camera operating at the same time. We found a few areas that had been missed when the house was blown with cellulose. Some air leakage from the basement area up through an interior was also discovered.
6. Conducted blower door test on the Garren house and found 4500 CFM_{50}.
    a. Had a lengthy discussion of the thermal envelope boundaries in the upper part of this house. The attic was finished, but will probably never be used. Decided to make the attic floor and the walk-up stairway the thermal boundary. Started this installing the cellulose in the afternoon.
7. Karg attempted to do some wall core sampling, but could not find any wall cavities with only newly installed cellulose.
8. Discussed the treatment of the crawl space in the Reardon house.
9. Karg suggested that the damming around attic hatches, specifically in the Riendeau house, should be ¾ inch plywood extending at least two inches above the installed attic insulation. The crews had not been doing this, but said they would start.

Training in Rochester, New Hampshire, Thursday, September 30, 2004

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Office of Energy and Planning
    c. Eric Beaton, Wx Program Manager, Boston Department of Energy
    d. Charlie Wolfe, Wx Director, Strafford County
    e. Jerry Spaulding, Jr., energy auditor, Strafford County, job auditor
    f. Margie Izzo, Northern Utilities
    g. Affordable Energy Solutions (AES), job contractor for King Street
        i. Rick Schwartz
        ii. Paul Button
    d. Terminix
        i. Ryan McKelvey
        ii. Rusty Patnode
    e. R. D. Hoitt, job contractor for Academy Street
        i. Bob Hoitt
2. Met at Stratford County agency parking lot and drove to sites on King and Academy Streets in Rochester.
    a. The King Street site included two up-down duplexes. These two buildings were superficially attached.

   b. The Academy Street site included a Victorian era house with an attached barn or carriage house. The house included three apartment units and the barn included one unit on the first floor.
3. At the King Street site, Karg started with a group meeting about the format of the training, the funding for the training, and the topics he thought would be addressed. He invited all to ask questions, make use of him as a resource, and to question authority, if appropriate.
4. After the group meeting, the group inspected the King Street house closest to the street. The second-floor apartment was directly connected to the attic in a number of places. This connection made the apartment very leaking. The living-area-attic connection was rather complex, so much discussion of possible solutions ensued (when the blower door test of this house was done, it was clear that there was significant leakage to the outdoors). The first-floor apartment was much tighter, however, the basement was open to the outdoors through a bulkhead that was being built (there was no bulkhead door to the outside, it was wide open).
5. Early in the day at the King Street site, Karg showed how to conduct a multi-blower door test in the building closest to the street.
   a. Karg explained the use of the DG-700 to the group.
   b. Karg and Spaulding communicated with walkie-talkies while conducting the test.
   c. With the upper blower door operating at 50 Pascals of depressurization and the lower blower door off, the CFM_{50} was 5300 in upper. The negative pressure recorded in the lower during this test in the upper was -11 Pascals.
   d. With the lower blower door operating at 50 Pascals of depressurization and the upper blower door off, the CFM_{50} was 2000 in lower. The negative pressure recorded in the upper during this test in the lower was -1.5 Pascals.
   e. With the upper AND lower blower doors operating at the same time at -50 Pascals of pressure, the upper CFM_{50} was 4900 and the lower CFM_{50} was 1450. Adding these to flow rates together gives the true whole-building CFM_{50} of 6350. Conducting blower door tests on each of the apartment units individually always exaggerates the true building CFM_{50}. In this case, the two separate CFM_{50} values for the individual blower door tests added up to 7300, or 950 more than the true whole-building CFM_{50} of 5050.
   f. At the end of this multi-blower door test, the tenant living in the second-floor unit came home. He claimed he was not informed that we would be there, was very upset that Karg was using his kitchen for a training session, and angrily insisted that we get out of his house. He later apologized for overreacting.
6. At the Academy Street site, we did a walk through inspection of the four units. The group found some difficult problems and had some good discussions.
   a. The crawl space under the barn contained a high-efficiency horizontal furnace. The auditor had called for insulating the crawl space ceiling, sealing and insulating the ductwork, and insulating the plumbing pipes (there is a history of these water pipes freezing). Karg suggested that the

crawl space walls be insulated instead and explained reasons. The auditor agreed and altered the work order.

b. An unused stairwell area above one of the stairways to the basement was open and connected to bathtub areas and interiors walls. We discussed this area and options for fixing the associated air leakage problems.

7. The AES power takeoff insulation machine was tested for takeoff pressure. No reliable reading was made because the machine peaked the 150 IWC pressure gauge immediately.
8. J & R Products and Applied Energy Products catalogs were given to contractors and workers.
9. In reference to insulation blowing machines, the important air-to-material ratio was discussed.
10. The group had an interesting discussion about the cost effectiveness of adding insulation to walls that already have insulation in them.
11. Karg discussed the delivery system transitions with the AES crew. Some of their transitions were likely to cause clogging of the cellulose. The altered many of their transitions to reduce the likelihood of clogging.
12. Back at King Street, Karg attempted to do wall core sampling. Many of the walls were already insulated. Two samples were taken near the top of the first-floor windows at the left corner of the rear house when facing it from the street. These samples were 4.2 and 3.8 pounds per cubic foot. Karg and the contractor were very happy with these results.
13. Jerry Spaulding and Karg discussed the viability of using Tyvek or Typar to hold up crawl space ceiling or basement ceiling insulation. Karg said this material should not be used for this purpose because it might lead to moisture problems on the warm side of the Tyvek. He suggested other materials for this purpose, such as "Insulweb" or nylon or plastic insulation netting. On the other hand, Tyvek and Typar are probably fine to use on the cold side of knee wall areas when these walls are blown with cellulose.

Training in Rochester, New Hampshire, Friday, October 1, 2004

1. Attending session:
    a. Rick Karg
    b. Andy Gray, NH Office of Energy and Planning
    c. Charlie Wolfe, Wx Director, Strafford County
    d. Ray Sorosy, Wx Director, Rockingham County
    e. Jerry Spaulding, Jr., energy auditor, Strafford County
    f. Affordable Energy Solutions (AES)
        ii. Rick Schwartz
        iii. Paul Button
    f. Terminix
        i. Rusty Patnode
    g. R. D. Hoitt
        i. Bob Hoitt
2. Met at King Street house in Rochester. Also spent some time at the Academy Street house.
    a. The King Street site included two up-down duplexes. These two buildings were superficially attached.

   b. The Academy Street site included a Victorian era house with an attached barn or carriage house. The house included three apartment units and the barn included one unit on the first floor.
3. Tested the Terminix Krendl 450A insulation machine for takeoff pressure. It produced 122 IWC with the agitator off and 95 IWC with the agitator on.
4. Tested Bob Hoitt's Krendl 550 for takeoff pressure. It produced 85 IWC with the agitator off and 75 IWC with the agitator on.
5. We used the insulation density cases with all three insulation machines on the site.
   a. With the Terminix Krendl 450A with the air on 100 percent and the material feed at 2 ¾:
      i. A straight nozzle yielded a density of 2.5 pounds per cubic foot.
      ii. A directional nozzle yielded a density of 2.75 pounds per cubic foot.
      iii. A 1 ¼ inch ID tube yielded a density of 3.3 pounds per cubic foot.
      iv. For some reason that we could not determine, the cellulose packed in the very end of the tube sooner than we expected it would. We started with Applegate cellulose, which was relatively lumpy, and then switched to National Fiber cellulose. We thought this would improve the performance, but it did not.
   b. With the AES power takeoff machine, with a 1 inch ID tube, the density case showed a 4.5 pound per cubic foot density.
   c. With Bob Hoitt's Krendl 550 machine and his 1 inch ID tube, the density case showed a 3.0 pound per cubic foot density.
6. Karg discussed insulation machine upgrades with Rusty Patnode of Terminix and with Bob Hoitt.
   a. Terminix is exploring the possibility of starting an insulation blowing business in order to level out the seasonal cycle of their pest control business. Karg suggested a better insulation blowing machine with a much greater output capacity, similar to that of the machine used on the site by AES.
   b. Karg also suggested that Bob Hoitt consider a larger machine with a greater output. However, Bob convinced Karg that the Krendl 550 was just right for him because he works alone. While the machine is filling a wall cavity with the use of a tube, Bob pulls siding, drills, replaces siding, fills the machine, etc. He understands that the only time he is loosing with this machine is his walking time. If he decides to hire a helper, he understands that this Krendl 550 will slow the work down significantly and that he should, then, purchase a higher output machine.
7. Karg took two wall core samples on the back side of the rear King Street house. AES workers used a twelve-foot tube for their work. In the balloon framed wall they drilled the lower fill hole near the bottom of the first-floor windows. The tube was pushed up all the way to its end before the blow begins. Then they drill a fill hole at the lower level of the second-floor window to complete the two-floor cavity fill. At the request of the installers, Karg took this core sample before they did the second-floor fill. The core sample density was 2.7 pounds per cubic foot at this top hole.

General Observations and Recommendations for New Hampshire Weatherization Program

[Because this document is intended for general distribution, these observations have been deleted]

Andy Gray Report on New Hampshire Training

General evaluation of the training experience
Although, initially skeptical of having more than one contractor on site, New Hampshire opted to follow the experiences in the other five states, by inviting multiple contractors to the trainings. The first three days were spent with the three crews serving NH's most northern agency, Tri-County Community Action. The last two days were with three contractors serving Strafford County Community Action and Rockingham Community Action in the southeastern portion of the state. The first group was slightly more experienced than the second, however Rick was able to address the strengths and weaknesses of all very effectively. The introduction by Rick at the start of both training locations set a positive tone early and clearly described the training process. The discussion and exchange of ideas and information between the different crews and contractors was very valuable in identifying future training efforts and points to specify and clarify in the upcoming revision to the technical portion of NH's policy and procedures manual.

Appraisal of the value of the training to the auditors and contractors
Perhaps the most ringing endorsement of the training came from the most experienced auditor/crew chief from Tri-County Community Action. The crews for this agency are very experienced and many of them felt they did not "need" any training. However, by the end of the third day the auditor admitted that initially he was "very skeptical when you scheduled this but it has far exceeded my expectations." The training was able to confirm and quantify that the methods the crews are using are effective. It also was effective at advancing auditing techniques and equipment maintenance.

The training for the newer, less experienced contractors was equally valuable as they were able to ask questions and discuss issues openly with an experienced trainer and their peers. One contractor in particular was just entering the world of Weatherization and learned a good deal about the program, proper insulating equipment and techniques.

Suggestions for training session improvements (comments, format and etc.)
The insulation boxes are a great training tool, however using them to test more than one machine with all three hose attachments (straight nozzle, directional nozzle, and tube) takes a lot of time and contractors seem to get anxious standing for too long not working. Perhaps testing one machine a day rather than all at once would limit some of the down time. Some workers also expressed a desire to have more hands-on air sealing work, that is, what materials should be used in what situation and how those materials should be installed.

Changes the state will make as a result of the training

NH is in the process of completely revising and improving the technical procedures manual for the program. The new manual will address many of the issues found and include lessons learned from these trainings. For example, the manual will explicitly state the required method for dense packing walls (tube method) and the acceptable range of installed dense pack. The manual will also seek to clarify treatment of knob-and-tube wiring. Pressure diagnostics as well as blower door guided air sealing to define the thermal envelope will also be more specifically addressed. The state also intends to conduct more core sampling in the future.

Rhode Island

Classroom training at W. Alton Jones campus, Monday, September 13, 2004

1. Attending session:
    a. Rick Karg
    b. Mike Snitzer, Program Manager, RISEO
    c. Bill Gill, Technical Monitor, RISEO
    d. John Costello, Technical Monitor, RISEO
    e. Dennis Lopes, state heating system specialist, RISEO
    f. Chris Johnson, auditor, RISEO
    g. Jon Cass, director, auditor, SCCA
    h. Bob Swift, auditor, Eastbay
    i. Viola Miller, auditor, Eastbay
    j. Darlene Lemoi, auditor, Westbay
    k. Saul Lemoi, auditor, CCAP
    l. Sol Mochtader, auditor, Tri-Town
    m. Sovan Chhouk, auditor, PROCAP
    n. Ron Fortier, auditor, BVCAP
    o. Bill Laracque, auditor, WestBay
    p. Pat Manjo, auditor, PROCAP
    q. Courtland McPherson, auditor, SCCA
    r. George Voit, auditor, CCAP
    s. Paul Warrener, BVCAP
    t. Mike Lapee, auditor, BVCAP
    u. Robert Lyle, auditor, BVCAP
    v. Attending contractor, Cross Insulation
        i. George Cross, owner
        ii. Ross Mitchell
        iii. Dan Brown
    w. Attending contractor, LeMay Framing & Remodeling
        i. Thomas LeMay
        ii. Jason LeMay
    x. Attending contractor, Arthur Lettieri
        i. Arthur Lettieri
    y. Attending contractor, K.J. Enterprises
        i. Michael Miguire
        ii. Kevin Wong
    z. Attending contractor, L & B Remodeling
        i. Phil Barber
        ii. William Natale
    aa. Attending contractor, R.I. Insulation
        i. Michael Macari
    bb. Attending contractor, Greenwich Insulation
        i. Lee Spencer
        ii. Brett Gralinski
        iii. Randell Bates
        iv. Bob Gru. . . ??

cc. Attending contractor, Insulation Unlimited
    i. Richard O'Connell
    ii. Ed Horn
dd. Attending contractor, Beneficial Energy
    i. Richard Battista
    ii. Sal Cartagena

2. This training day progressed very well. There were many good discussions and questions throughout the day.
3. This training was very well attended. More attended than were expected.
4. Handed out J & R Products and Applied Energy Products catalogs to contractors who wanted them.
5. Agenda for training follows:

* * * * * * * * * * * *

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

9:30 **Overview of day**
Topics, goals, and objectives.
Recording of question and concerns

9:35 **Dense Pack Cellulose Insulation**
Wall insulation priorities
Attic/Slope insulation priorities
Advantages and disadvantages of dense pack
Siding removal and replacement
Drilling the wall
Determining the insulation density
Insulation blowing machines
Wall insulation blowing methods
How can we improve?

12:15 **Lunch**

1:00 **Air Sealing and Tightening Limits**
Blower door testing
Effective air sealing
Weatherization cost-effective guidelines
Building tightness limits (BTL)
Depressurization tightness limits (DTL)
Worst-case draft testing

4:00 **End of training day**

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Training in Warwich, Rhode Island, Tuesday, September 14, 2004

1. Attending session:
    a. Rick Karg
    b. Mike Snitzer, Program Manager, RISEO
    c. Bill Gill, Technical Monitor, RISEO
    d. Dennis Lopes, state heating system specialist, RISEO
    e. Charlie Edwards, auditor, Tri-Town
    f. Sovan Chhouk, auditor, PROCAP
    g. Sol Mochtader, auditor, Tri-Town
    h. Bill Laracque, auditor, WestBay
    i. Jon Cass, director, auditor, SCCA
    j. Courtland McPherson, auditor, SCCA
    k. Darlene Lemoi, auditor, Westbay
    l. Job contractor, Greenwich Insulation
        i. Lee Spencer
        ii. Brett Gralinski
        iii. Randell Bates
    m. Attending contractor, L & B Remodeling (attended for just a few hours)
        i. Phil Barber
        ii. Jay Shamsi
2. House on Belt Street was a story and one-half converted cottage with a full basement. The siding was painted wood shingles. The pre-weatherization CFM_{50} was 3600 before the attic and four second floor knee wall areas were opened for access. The house weatherization was not finished in time to perform a post-weatherization blower door test.
3. After all had arrived at the site, Karg introduced the training, mentioned the funding, and what he expected to do during the day.
4. Karg conducted blower door test.
    a. Demonstrated analog gauges for Minneapolis Blower Door.
    b. Demonstrated DG-700 gauge.
    c. Talked about use of blower door to find leaks and using blower door to keep attic cool and dust-free during attic weatherization.
    d. The job contractor normally uses an Infiltec blower door (this works the same way a Minneapolis blower door does).
5. Karg lead a lengthy discussion in the basement of the house about the definition of the thermal envelope.
    a. The weatherization program is seldom insulating basement walls, although they are often insulating rim joists. Karg suggested they run this through the NEAT audit to determine the SIR for basement wall insulation.
    b. They are sometimes air sealing the basement ceiling when it is not a thermal boundary. Karg strongly disagreed with this practice.
    c. All had an interesting discussion about the cost-effective replacement of basement windows.
    d. Discussed the treatment of ductwork in basements and crawl spaces, depending on whether the area was considered conditioned or not.
    e. One of the auditors mentioned the "55 degree rule". This rule states that if you think the basement will not be above 55 degrees, the basement should be treated as unconditioned. This rule is problematic. For example, how

will the auditor know the basement temperature at a given time? Karg discounted this rule and stated that most basements and crawl spaces in Rhode Island should be treated as conditioned spaces, that is, within the thermal boundaries of the house.

6. Talked with auditors about the questionable measure of putting foil-faced fiberboard behind steam and hot water radiators. Karg said that this practice probably only is cost effective when a radiator is on an outside wall that cannot be insulated. Treating radiators in this manner is a common practice in Rhode Island.
7. Spent time in second floor knee wall areas with contractor.
    a. Talked about the importance of sealing bypasses before insulating.
        i. Plumbing stacks.
        ii. Chimney chases (there was a large one in attic).
        iii. Open-partition walls.
        iv. One knee wall area in the front of the house on the driveway side was very interesting for its nooks and crannies. The contractor did some very effective sealing in this area.
8. Job contractor used directional nozzle on walls.
    a. Contractor also tried Karg's 1 ¼ inch inside diameter tube.
9. Karg measured the takeoff pressure of the job contractor's insulation machine on the site (pressure should be at least 80 inches of water with agitator operating). The Krendl 1000 yielded 75 inches of water column at the machine takeoff. When the agitator was operated, it was found the manometer needle moved excessively, indicating the need to replace the seals on the insulation machine.
10. During the day, Karg and an auditor weighed six bags of National Fiber cellulose. Each bag states "Minimum of 26.5 pounds". We found the following weights: 24.4, 24.6, 24.9, 27.6, 30.5, and 29.85. This is an average of 26.97 pounds.
11. Karg and weatherization auditors (Karg did one sample to demonstrate to others) took some core samples to check wall insulation density. The settings on the Krendl machine were the same for all these tests.
    a. For the two-hole method using a directional nozzle, samples taken one-half way between the two fill holes, the samples resulted in 1.4, 1.1, 0.9, and 1.1 pounds per cubic foot density.
    b. A section of the house was tubed with one of Karg's tubes and with the same settings on the Krendl machine. The density from this core sample resulted in 3.6 pounds per cubic foot. All were extremely impressed at the significant difference the tubing method made.
12. Karg demonstrated the insulation density cases at end of day. These were very helpful in convincing all that tubing was the way to insulate walls.
    a. With the Krendl 1000 settings on 6.5 air and 3.0 material, the directional nozzle resulted in a 2.7 pound per cubic foot density and the tube resulted in a 4.0 pound per cubic foot density.
13. After the insulation density case demonstration, Karg held a wrap-up meeting.

Training in Pawtucket, Rhode Island, Wednesday, September 15, 2004

1. Attending session:
    a. Rick Karg
    b. Bill Gill, Technical Monitor, RISEO
    c. John Costello, Technical Monitor, RISEO
    d. Dennis Lopes, state heating system specialist, RISEO
    e. Bob Swift, auditor, Eastbay
    f. Viola Miller, auditor, Eastbay
    g. Ron Fortier, auditor, BVCAP
    h. Paul Warrener, BVCAP
    i. Mike Lapee, auditor, BVCAP
    j. Robert Lyle, auditor, BVCAP
    k. Job contractor, Cross Insulation
        i. George Cross
        ii. Adam Comire
        iii. Dan Brown
        iv. Jim Carroll
        v. Steve Girouard
    l. Attending contractor, Insulation Unlimited
        i. Ed Horn
2. House on Desmarais Avenue was a Cape Cod style home with a full basement. The siding was vinyl with painted wood shingles underneath. The work order called for the walls of the house to be insulated, the floors behind the knee walls and the knee walls insulated, and insulation and air sealing work in the basement. The pre-weatherization CFM_{50} of the house, as measured by the job energy auditor, was 2550.
3. We did not perform a blower door test at the site because the attic knee wall areas were open and there were at least two open holes in the sloped ceiling upstairs that needed repair.
4. The job auditor had called for the washer/dryer room in the basement to be treated as outside of the conditioned space of the house. The other areas of the basement were finished. We discussed that this was the wrong approach; although the washer/dryer room was unfinished, it was still within the thermal boundaries of the dwelling.
5. Talked with the auditors about the importance of performing a worst-case draft test. It seems that this important test is seldom done in the Rhode Island weatherization program.
6. Karg spent a long time with the crew foreman in the knee wall area discussing proper air sealing.
7. Tested a number of insulation blowing machines for pressure at the takeoff. The Giesken 610 and the Intec Force 2 owned by Cross Insulation were measured with 52 and 90 inches of water column, respectively. For the Giesken 610 machine with two external blowers, the takeoff pressure was not affected by shutting down one of the two parallel-mounted blowers. An early Intec machine, "The Force", owned by Insulation Unlimited, had 70 inches of water column. Although the Giesken 610 had a measured takeoff pressure significantly less than the frequently quoted required minimum of 80 inches of water, the core sampling

demonstrated that it was able to dense pack walls, although it was very slow at doing so.

8. Cross Insulation normally uses the tubing method for walls. They insert a tube and blow the cavity. While this cavity is filling, they insert another disconnected tube in the next cavity so that it is ready to go. They then disconnect the hose from the tube in the cavity that has just filled to the tube inserted in the cavity not yet blown. This saves them time.
9. Karg demonstrated the insulation density cases with Cross Insulation's Giesken 610 machine (one blower running). They normally use a 1 ¼ - inch inside diameter tube about six feet long for walls.
    a. A straight nozzle blow yielded a density of 2.25 pounds per cubic foot.
    b. A directional nozzle blow yielded a density of 2.3 pounds per cubic foot.
    c. A blow with a tube yielded a density of 3.25 pounds per cubic foot.
10. Karg and the attending energy auditors did core sampling on three sides of the house to determine the effectiveness of methods and different machines.
    a. The Giesken 610 machine with one blower operating yielded core samples about one-half way up the windows on the back of the house of 3.4 and 3.2 pounds per cubic foot. Another sample showed that a bay had been missed entirely.
    b. On the driveway side of the house, the Force 2 machine run by a different installer yielded a core sample density of 1.7 and 0.6 pounds per cubic foot.
    c. On the front of the house, the Force 2 machine yielded a core sample density of 1.4 pounds per cubic foot.
    d. These results are curious. Although the Force 2 machine was more powerful than the Giesken 610, its performance was substandard. This was probably due to the settings on the Force 2 and the methods used by the two installers.
11. Karg and an auditor weighed five bags of Bonded cellulose and found the bags to be 30.5, 31.0, 31.2, 29.5, and 31.0 pounds, for an average of 30.64 pounds per bag. The weight range of the Bonded cellulose is much narrower than that of the National Fiber insulation weighed the previous day.

Training in Cranston, Rhode Island, Thursday, September 16, 2004

1. Attending session:
    a. Rick Karg
    b. Bill Gill, Technical Monitor, RISEO
    c. Ralph Groves, RISEO
    d. George Voit, auditor, CCAP
    e. Charlie Edwards, auditor, CCAP
    f. Saul Lemoi, auditor, CCAP
    g. Bill Laracque, auditor, WestBay
    h. Job contractor, Cross Insulation
        i. Russ Threlfall
        ii. Adam Comire
        iii. Jay Szpila
        iv. Norm Gilbert
    i. Attending contractor, Beneficial Energy

   i. Sal Cartagena
   ii. Ed Diaz
j. Attending Contractor, Insulation Unlimited
   i. Ed Horn
k. Attending Contractor, L & B Remodeling
   i. Bill Natale

2. House on Eagle Road was a ranch style home with a basement and an attic with an access from the attached garage. The siding was vinyl with ¾ inch of rigid insulation underneath. The pre-weatherization test by the job auditor with a Minneapolis blower door yielded a CFM_{50} of 3100. Light rain fell most of the day at the site.
3. Day began with a meeting where Karg informed attendees about funding for training and the topics we would cover.
4. After we inspected the house, did a blower door test at the front door.
   a. Used analog gauge and found a CFM_{50} of 2600.
   b. Demonstrated the DG-700 and found a CFM_{50} of 2200.
   c. Karg discussed the use of the blower door to find leaks.
   d. He also discussed the use of the blower door to cool attic while working on air sealing or blowing insulation.
5. Karg tested one insulation machine for pressure at the takeoff (need at least 80 inches of water for capacity to dense pack cellulose in walls). The Giesken 510 owned by Insulation Unlimited yielded a takeoff pressure of 42 inches of water.
6. Cross Insulation used the tubing method. This operator drilled the fill hole under the windows, used the tube to fill upward, that then used a directional nozzle to fill downward. Core samples were taken to determine the installed insulation density.
   a. With the tube-up/directional-nozzle-down method, four samples in two cavities yielded at the high holes (half way up the windows) 3.2 and 3.2 pounds per cubic foot. One low sample was damaged. The other low sample (about one foot up from the top of the rim joist) yielded 1.5 pounds per cubic foot.
   b. As a result of the bad densities with the use of the directional nozzle for the down blow, Karg recommended the installer not only tube upward, but also downward. These samples found 3.0 pounds per cubic foot high and 3.1 pounds per cubic foot low. This was a good improvement in consistency.
7. Had a good discussion of tube method of insulating walls.
   a. Labor saving (takes longer to blow in insulation, but open-up and close-up time is reduced because of one fill hole per cavity per floor).
   b. Safer because less time on ladders or staging.
   c. No settling of cellulose.
   d. More even density throughout the height of the wall cavity.
   e. Significant reduction of air leakage through wall.
   f. Slight reduction in R-value with a denser pack, but not significant.
   g. Must be careful not to damage interior wall surfaces.
   h. For dense packing walls properly, need

i. An insulation machine with the proper capacity (at least 80 inches of water pressure at takeoff or 2.9 pounds per square inch of pressure).
ii. The proper machine settings. For dense packing, the air-to-material ratio must be high enough for a cellulose density of at least 3.2 pounds per cubic foot. On the other hand, if this ratio is too high, the job of insulating will take much longer. A balance must be found for each machine, delivery system, and wall.
iii. A good delivery system from insulation machine to the end of the wall tube.
    1. No leaks in hose or at joints.
    2. Delivery system should be as short as possible for the job.
    3. All reductions/transitions in delivery system should be gradual to minimize clogging.
    4. Open end of tube should be cut at an angle to facilitate inserting the tube into the wall cavity.
iv. A tube operator that used an effective technique.
    1. The tube should be inserted all the way up to the top plate and then pulled down just less than one foot before the machine is turned on. [Core sampling has demonstrated that the end of the tube must be within one foot of the area to be insulated to achieve an acceptable density.]
    2. As the flow in the hose and tube slows and stops from increasing resistance in the cavity, the tube should be pulled out of the fill hole by just less that one foot at a time. If the tube is pulled out too soon, the density will decrease.
    3. After the wall cavity is filled upward from the fill hole, the tube should be inserted downward through the fill hole. Inserting the tube with just the air running will help "drill" through the cellulose that has fallen from the upward fill. This will help achieve a higher density in the downward fill.
    4. Plug the fill hole with a wood or rigid insulation plug or spray foam or piece of fiberglass batt.

8. We did not use the insulation density cases because of lack of time. The job contractor had seen the density cases the day before, so nothing was lost.
9. Karg had a lengthy discussion with the Beneficial Energy workers and Saul Lemoi in the attic regarding attic air sealing. The discussion included:
    a. Proper air sealing around the chimney. This was done with aluminum flashing and furnace cement rather than high temperature caulking.
    b. Air sealing as partition walls in the attic.
    c. Air sealing at the plumbing stack.
    d. Pulling existing fiberglass away from perimeter of ceiling before cellulose is installed. This attic had 2 ½ inches of fiberglass installed. This was pulled back from the eaves and removed from the gable end bays because the ceiling was strapped.
    e. Dirty (blackened) fiberglass is a sign of air leakage.

10. We had a long discussion of how to treat a suspended ceiling in the back entry hall that connected the attached garage, the basement, and the kitchen door. This suspended ceiling above the basement stairway partially collapsed during the blower door test, indicating that we had a problem there. Above the ceiling was open to the garage. This leaky suspended ceiling would have been very difficult and costly to air seal. The choices for treatment were:
    a. Treat entry hall as outside of the thermal boundaries of the house. This would have required the installation of a basement door at the bottom of the basement stairway. This would have been very difficult because of the shape of the opening.
    b. Bring this entry hall within the thermal boundaries of the house. This area was already nicely finished in a manner consistent with the other finished parts of the house and the basement. This would require air sealing this suspended ceiling. This was the final solution.
11. Karg closed day with a summary of what we had discovered.
    a. To get a uniform and complete blow in a wall, the tube method must be used.
    b. Uniform R-value and no damage to walls are most important. The next level of best practice is dense packing walls to at least 3.2 pounds per cubic foot to stop air flow and settling.

Training in Provincetown, Rhode Island, Friday, September 17, 2004

1. Attending session:
    a. Rick Karg
    b. Lois Pasquerella, Weatherization Program Manager for Northeast Regional Office
    c. Bill Gill, Technical Monitor, RISEO
    d. John Costello, Technical Monitor, RISEO
    e. Dennis Lopes, state heating system specialist, RISEO
    f. Charlie Edwards, auditor, Tri-Town
    g. Sovan Chhouk, auditor, PROCAP
    h. Pat Manjo, auditor, PROCAP
    i. Job contractor, Beneficial Energy
        i. Richard Battista, owner
        ii. Sal Cartagena
        iii. Ed Diaz
        iv. Ted Charron
    j. Attending contractor, Insulation Unlimited
        i. Ed Horn
2. House on Freese Street was a one story house with a full basement. The siding was wood shingles. The house had no insulation in the walls and attic. The walls and attic were finished on the interior with metal lath and plaster. The pre-weatherization test with a Minneapolis blower door yielded a CFM_{50} of 3700 with the basement door open and 2000 CFM_{50} with the basement door closed. A few post-weatherization blower door tests were done during the training at the end of the day. After the basement and attic had been air sealed, but the walls and attic had not yet been insulated, the CFM_{50} with the basement door open was 2700. After the attic was insulated and the attic hatch was sealed, the CFM_{50} with

the basement door open was 2000! This was a very significant reduction in the CFM_{50} value (only eight of the wall cavities had been dense packed and no windows or doors had been treated).

3. After everyone arrived, Karg started with a chat to explain the funding and training and what we would do during the day.
4. Karg checked the job contractor's analog blower door gauges against his DG-700 and found close agreement.
5. Conducted insulation machine pressure tests at takeoff of Beneficial Energy's Giesken 610. One blower yielded 50 inches of water, the other 45 inches of water.
6. Karg did blower door test with contractor's blower door.
    c. Covered zeroing and use of rings.
    d. Covered finding leaks with blower door running.
    e. Discussed using door to cool attic during work and reduce dust.
7. Karg did some core sampling with the help of auditors and the job contractor. The contractor was using a Giesken 610 with one blower with the air setting 50 percent open. The contractor tubes up and then down.
    a. Two core samples in one cavity – one high and one low – yielded 2.0 and 3.7 pounds per cubic foot, respectively.
    b. Two core samples in another cavity – one high and one low – yielded 3.35 and 2.7 pounds per cubic foot, respectively.
    c. Karg discussed these densities with the owner of the company and suggested that the air setting on the machine be opened to 100 percent.
8. We used the insulation density cases at the beginning of the day at the suggestion of Bill Gill. Bill thought it would be better to demonstrate these cases early in the day rather than toward the end of each day. Good idea. For these tests, we used the Beneficial Energy Giesken 610 with one external blower operating.
    a. Using a straight nozzle method and air at 100 percent, we achieved 2.0 pounds per cubic foot.
    b. Using a directional nozzle and air at 100 percent, we achieved 2.25 pounds per cubic foot.
    c. Using a tube and air at 100 percent, we achieved 4.0 pounds per cubic foot.
    d. Using a tube and air at 50 percent, we achieved 3.5 pounds per cubic foot.
9. We had a very useful discussion about whether the front foyer should be within the thermal boundaries of the house. The job auditor said no, Karg disagreed. Eventually, all agreed that the foyer should be within the thermal boundaries.
10. Karg spent much time with the crew discussing air sealing in the basement and the attic. The attic was very clean with no insulation, making it extremely easy to find and seal air leaks. The chimney was sealed with aluminum flashing and high temperature caulk. The blower door testing we did demonstrated that the air sealing was extremely effective.
11. The job auditor had ordered all the windows to be weatherstripped at the meeting rails. This is a measure that the state monitors have been trying to stop in program. This was discussed.
12. Lois Pasquerella, Weatherization Program Manager for Northeast Regional Office visited the site for most of the morning and part of the afternoon and

talked with most of those attending. She also had the opportunity to talk with the client.

General Observations and Recommendations for Rhode Island Weatherization Program

[Because this document is intended for general distribution, these observations have been deleted]

State Report on Rhode Island Training

General evaluation of the training
The training was designed with two components, one day of classroom and four days in the field. The classroom training was very well attended by all auditors and all contractors. We chose a narrow focus for the classroom training was dense pack insulation in walls and slopes, insulation blowing machines, sidewall blowing methods, blower door testing and effective air sealing. The training was well received and Rick did an excellent job of explaining all these subjects in detail. The overall evaluation is that both the classroom and field training was very successful, well received and the presentation was excellent.

Field Training
With the classroom training behind us it was now time to bring our training into the field. Four homes that were good candidates for dense pack and air sealing had been previously selected around the state. Rhode Island requires that all walls be ether tubed or blown with a directional nozzle and two holes. The homes were representative of the type of housing stock we see in WAP in Rhode Island and provide Rick with ample examples to implement the earlier classroom training. Rick took core samples for density and then the auditors took more samples. One thing became very clear, tubing the walls was superior to the directional nozzle method.

The field training over the next four days gave Rick opportunities to demonstrate air sealing, dense pack measurements, interpreting pressure readings and the importance of maintaining Weatherization equipment.

Suggestions for training session improvements
The demonstration of filling the test boxes was excellent. We feel that this portion of the training would be better received at the beginning of the training so the contractors and crews could better visualize what is happening in the wall cavities.

Changes the state will make as a result of the training
Rhode Island will reexamine the option of the use of a directional nozzle as opposed to requiring all contractors to tube all sidewalls.

Vermont

Training for Energy Auditors in Montpelier, Vermont, Tuesday, February 22, 2005

1. Attending session:
    a. Rick Karg
    b. Jules Junker, State Weatherization Program Director
    c. Dwight DeCoster, Technical Monitor
    d. Geoff Wilcox, energy auditor, CVCAC
    e. Mark Diego, energy auditor, CVCAC
    f. Charlie Toohey, energy auditor, CVCAC
    g. Mike Brookman, energy auditor, BROC
    h. Dave Howe, energy auditor, BROC
    i. Earl Niles, energy auditor, SEVCA
    j. Mike Kohler, energy auditor, SEVCA
    k. Tim Page, energy auditor, CVOEO
    l. John Colby, energy auditor, NETO
    m. Jeff Hall, energy auditor, NETO
2. Training took place at a house on Sibley Street in Montpelier. This three-story house with a full basement is split into two apartment units; one is on the first floor and one on the second and third floors. The upper apartment unit is heated by a steam boiler in the basement and the first-floor apartment is heated by a hot water boiler. The boilers are common vented. The third floor includes two finished bedrooms and an unfinished attic. This floor is framed similarly to the second floor of a Cape Cod style house, with knee walls and floored areas behind the knee walls. The house has vinyl siding over one-half inch of extruded polystyrene over wooden clapboards. Geoff Wilcox selected this house for the O^4S training week.
3. Topics addressed during training included:
    a. Use of the blower door.
        i. Zeroing properly.
        ii. Used the analog gauges and the DG-700.
        iii. Karg discussed the importance of temperature adjusting blower door values in the Vermont climate when using an open fan.
        iv. Found 5385 CFM_{50}, temperature adjusted, with the basement door closed.
        v. Found 6494 CFM_{50}, temperature adjusted, with the basement door open.
        vi. CFM_{50} divided by 10 to get approximate square inches of leakage in dwelling.
        vii. Walking around one unit that was unoccupied looking for leaks with blower door running.
        viii. Although the house included two apartment units, the blower door test was done on the entire building.
    b. General discussion of defining the thermal envelope and the importance of doing this correctly.

c. Lengthy discussion of conditioned and unconditioned areas on the third floor. This section has knee walls and an unconditioned attic area. Finally decided to treat the knee wall and floor behind it rather than the slope.
d. They often do a blower door test with the basement door open and closed. This is good.
e. Importance of plugging holes at the top of the house first.
f. One of the auditors mentioned that they use stressed skin panels for attic access panels, six inches thick. This works very well for them. They use a material with extruded polystyrene insulation and drywall on one face.
g. Discussion of using two-part foam in a crawl space for air sealing and R-value.
h. Geoff Wilcox used his infrared camera to determine where wall insulation was needed.
i. Discussed the proper treatment of the chimney sealing work and block for the cellulose. This chimney will be difficult to treat because of the lack of access. Karg mentioned that many states will not allow the use of fiberglass as the block for the cellulose. A few firefighters at the training agreed, but no one had a logical answer for a good reason to not allow unfaced fiberglass.
j. Karg recommended that they specify a rigid block around the attic access that will support the weight of a person. They said they are doing this.
k. Karg mentioned the possibility of accessing the small attic flat through the roof and then closing up the roof again. He said this is not the best method to get into a small attic, but it can be a very useful method, especially if the room shingles are in good condition.
l. Discussed the importance of finding and sealing attic bypasses, even if the attic if floored. The flooring is no excuse for not looking for and sealing bypasses.
m. Some of their crews are using bubble wrap on the back of knee walls before blowing with cellulose. Karg mentioned the possible difficulty of this method (same possible condensation problems as Tyvek or Typar, but with no opportunity to dry out in warm weather).
n. House has an unusual space above the second-floor stairway that is behind two closets. This space was an inaccessible space in the shape of a triangle 12 feet by 4 feet by 6 feet at its highest. We looked into the space with a fiber optic tool, but could not see much. We asked the niece of the first-floor owner (she is also the mother of the second-floor tenant) if we could create an access to this space so that we could examine and weatherize the space. She agreed. The access was created two days later when the crew technicians spent the day at the house.
o. At the end of the day the group had a very good discussion in the basement about "confined" space in the basement. Because the basement has two boilers, it is only about one-half the volume that it should be to comply with the confined space rule in NFPA 31 and NFPA 54.
    i. Karg mentioned the simple "20 rule" to the auditors for determining the volume in the combustion appliance zone (CAZ) that is needed to be classified as "unconfined space". This 20 rule merely means that you add to Btuh input of all the combustion

appliances in the CAZ and then divide this sum by 20. The result is the number of cubic feet of volume needed in the CAZ. This house had a total Btuh in the CAZ of 180,000. Dividing this by 20 yielded 9000 ft3. The CAZ only had about 5000 ft3, so the basement was considered confined space.

ii. The group discussed possible solutions to this code violation.

iii. The group also discussed the relationship between the confined space issue and the worst-case draft test. Karg mentioned that the worst-case draft test, from the perspective of building science, is a better test than the confined space calculation and in this case, if the appliances passed the worst-case draft test, the violation of the confined space rule is not significant. However, a code enforcement officer might think the violation is very significant. In this case, the job auditor must reconcile good building science and combustion appliance venting code.

Classroom training for Crew Technicians in Waterbury, Vermont, Wednesday, February 23, 2005

1. Attending the classroom training session:
   a. Rick Karg
   b. Jules Junker, State Weatherization Program Director
   c. Dwight DeCoster, Technical Monitor
   d. Joel Pennucci, BROC
   e. Terry King, BROC
   f. Rick Brown, BROC
   g. Tom McLean, CVACA
   h. Tyler Sabin, CVACA
   i. Tom Graves, CVACA
   j. Kevin Fleming, CVOEO
   k. Roland Lavoilette, CVOEO
   l. Steve Thornton, CVOEO
   m. Fred Cram, CVOEO
   n. Dan Labarron, NETO
   o. Allen Marsh, NETO
   p. Kevin Kurkul, SEVCA
2. Karg had prepared classroom training units on the topics of:
   a. The house as a system.
   b. Dense-pack installation of cellulose.
      i. Dense-pack wall slide show of house in Maine.
      ii. Slide show of dense-pack wall testing in Maine done during Phase 1 of the O^4S project.
   c. Proper use of the blower door, including the "can't-reach-fifty factors".
   d. The House of Pressure (Anthony Cox model) was in the classroom during the training. Karg and DeCoster used this great model to demonstrate pressures, backdrafting, and appliance venting.
   e. In addition to the prepared slide shows, Karg discussed:
      i. The Maine test for sealing the ceilings of conditioned basements.

ii. The need to consider doing worst-case draft testing at the end of each work day, not just at the end of the job.

Training for Crew Technicians in Montpelier, Vermont, Thursday, February 24, 2005

1. Attending session:
   a. Rick Karg
   b. Dwight DeCoster, Technical Monitor
   c. Paul Zabriskie, Weatherization Director, CVCAC
   d. Geoff Wilcox, energy auditor, CVCAC
   e. Joel Pennucci, BROC
   f. Terry King, BROC
   g. Rick Brown, BROC
   h. Tom McLean, CVACA
   i. Tyler Sabin, CVACA
   j. Tom Graves, CVACA
   k. Kevin Fleming, CVOEO
   l. Fred Cram, CVOEO
   m. Josh Robinson, NETO
   n. Brian Fenoff, NETO
   o. Kevin Kurkul, SEVCA
   p. Jeff Palapil, SEVCA
2. This on-site training included most of the attendees of the classroom training the day before. This training took place at a house on Sibley Street in Montpelier. This was the same house the auditors used on the Tuesday before. This three-story house with a full basement is split into two apartment units; one is on the first floor and one on the second and third floors. The upper apartment unit is heated by a steam boiler in the basement and the first-floor apartment is heated by a hot water boiler. The boilers are common vented. The third floor includes two finished bedrooms and an unfinished attic. This floor is framed similarly to the second floor of a Cape Cod style house, with knee walls and floored areas behind the knee walls. The house has vinyl siding over one-half inch of extruded polystyrene over wooden clapboards. Geoff Wilcox selected this house for the O^4S training week.
3. Topics addressed during training included:
   a. Attic/third-floor weatherization strategy. There were varying opinions about the treatment of this area of the house. One-half of the group inspected this area, then the other one-half.
   b. Spent much time discussing air sealing, including around chimney and plumbing stacks.
   c. Cut into the stairwell ceiling area to inspect and weatherize. The group was split between making this a conditioned or unconditioned space. Karg asked Dwight DeCoster and Geoff Wilcox to leave the room so that the crew people could speak more freely. The group remaining decided to make the stairwell space unconditioned. The work then proceeded with two-part foam, fiberglass batt, and cellulose dense packed into a few wall cavities that were open to the space.

i. The two-part foam was a big topic of discussion. Many of the crew people had not seen the material. It required almost three hours for the two canisters to warm up enough so that the chemicals flowed properly.
ii. After the space was weatherized, all were asked to inspect the work.

d. Mentioned importance of plugging holes at the top of the house first.
e. Discussed the issue of conditioned and unconditioned basements.
f. Discussed thermal envelope issues using basement and attic/third floor as examples.
g. Knob-and-tube wiring was found and discussed.
h. Started dense-packing walls at the rear of the house. A number of people watched and discussed different methods that they use. These walls were blown with a Force 2 machine with the air at full and the material gate set a five holes exposed.
    i. Karg did some core sampling after some of the cavities were blown. A density of 2 pounds per cubic foot was found about four feet above the fill hole and less than 1 pound per cubic foot was found at the open second-floor joist area (the house was balloon framed, so this area was impossible to dense-pack.
    ii. The group talked about the important air-to-material ratio for proper dense packing.
    iii. Fred Cram demonstrated the bag method used to block the second-floor open joist area of this balloon framed house. He first used a plastic garbage bag (he has used these many times on other jobs), but he found that it broke open during the blow. Karg gave him a woven grain bag to use and Fred found that this worked fine. Many watched Fred perform this bag blow.
i. Karg set up and asked Josh Robinson to blow one of the cellulose insulation density cases as a demonstration in the front yard. The Krendl 2090 machine (only two weeks old) blew the box to a density of 4 pounds per cubic foot, but it took over five minutes to do so. Karg, being suspicious that this new Krendl might be defective, measured the static pressure at the takeoff of the machine. He found 90 inches of water column (he had measured similar machines that were much older at 125). Someone suggested that the respirator over the air intake for the machine might be causing low static pressure. The respirator was removed, but the machine again tested at 90 inches of water column. The agency owning the Krendl machine will have it checked for problems.

Training for Crew Leaders in Montpelier, Vermont, Friday, February 25, 2005

1. Attending session:
    a. Rick Karg
    b. Dwight DeCoster, Technical Monitor
    c. Mark Curler, CVOEO
    d. Kevin Campbell, CVOEO
    e. Kerry Kirkpatrick, CVCAC
    f. Bruce Landry, CVCAC
    g. Mike Brockman, energy auditor, BROC
    h. Mike Hanlon, BROC

i. Russ Champine, BROC
j. Doug Baker, BROC
k. Patrick LaDuc, SEVCA
l. Tony Coyne, SEVCA
m. Jim Ruggles, NETO
n. Gene Tessier, NETO

2. This training took place at a house on Sibley Street in Montpelier. This was the same house the auditors used on the Tuesday and the crews had used on Thursday. This three-story house with a full basement is split into two apartment units; one is on the first floor and one on the second and third floors. The upper apartment unit is heated by a steam boiler in the basement and the first-floor apartment is heated by a hot water boiler. The boilers are common vented. The third floor includes two finished bedrooms and an unfinished attic. This floor is framed similarly to the second floor of a Cape Cod style house, with knee walls and floored areas behind the knee walls. The house has vinyl siding over one-half inch of extruded polystyrene over wooden clapboards. Geoff Wilcox selected this house for the O^4S training week.
3. The day started with a meeting in the front yard. DeCoster and Karg introduced the training, funding, and mentioned the objectives for the day. Karg asked the crew leaders what they would change with the weatherization program if they could change one thing. The responses included:
    a. More consistency among the Vermont agencies regarding the methods of auditing and weatherizing.
    b. More blower door guided air sealing.
    c. The auditors should do a better job of estimating the time it will take to complete a job. It is important that they get this right.
    d. Salaries and wages are too low.
    e. Worker safety should be given a higher priority.
4. Topics addressed during training included:
    a. Blower door testing.
        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, including the basement.
        v. The group found that the work that had been competed so far on the house had little impact on the CFM_{50} value. The weatherization to the house at the time of this blower door test included:
            1. Installing Typar on the back of some of the already insulated knee walls.
            2. The second-floor stairwell ceiling area foamed and insulated and made into an unconditioned area outside of the house thermal boundary.
            3. Five to eight wall cavities were insulated with cellulose.
    b. While outdoors Karg discussed the importance of testing the insulation blowing machines regularly for static pressure at the takeoff. It was

suggested that all the crews obtain a magnehelic pressure gauge for this testing.

c. The group spent at least two hours in the basement discussing the worst-case draft test procedure used by North Dakota (Karg wrote this procedure). Karg gave a copy of the North Dakota worst-case draft form to all the crew leaders so that all could follow along. There was a discussion of each of the steps for the test and then parts of the test were done at the site.
    i. A number of the crew leaders expressed confusion about the Building Tightness Limit and the Depressurization Tightness Limit values. Karg explained the purpose of each and the differences between them.
    ii. Karg mentioned the need to perform a worst-case draft test at the end of the job and, sometimes, at the end of a work day even though the job had not yet been completed.
    iii. The crew leaders are the people who are responsible for performing the worst-case draft test for weatherization jobs in Vermont.
    iv. Karg discussed the three distinct parts of the worst-case draft test and follow-up:
        1. Finding the worst-case condition.
        2. Measuring the appliance draft under worst-case conditions.
        3. Remediation of problem if an appliance fails the worst-case draft test.

General Observations and Recommendations for Vermont Weatherization Program

[Because this document is intended for general distribution, these observations have been deleted]

Dwight DeCoster Report on Vermont Training

General evaluation of the training experience

The training project was rated as good to excellent by the 10 weatherization subgrantee energy auditors, 12 new (experience ranged from two weeks on the job to 3 years) crew installers, 11 crew chiefs and the 1 state technical monitor who attended the 3 days of field based and one day of classroom training sessions. The investment of time by those in attendance was considered well spent and very productive. Vermont utilized on day of field work for the auditors, one day of classroom and one day of field work for the new installers and one day of field work for the senior installers. This style of training allowed differing skill sets from all over the state to gather, compare ideas and methods and learn from not only Rick Karg but also each other. The model worked extremely well for our network and contributed to an extremely positive dynamic atmosphere. Prior to each training session, Rick Karg sought input from those in attendance regarding special training needs. This worked very well as each day was tailored to those in attendance. And finally, the inclusion of additional training tools added to the value of the training experience for all those in attendance.

Appraisal of the value of the training to the auditors and contractors
The feedback received during and after the training sessions from the WAP energy auditors, installers and crew chiefs was very positive and constructive regarding the value of the technical training sessions. It was one of the first times in Vermont that auditors and crew chiefs had gathered together and exchanged ideas with each other as well as learning new things from Rick. To a man, everyone said that this format worked very well and they all expressed interest in doing this sort of gathering on a regular basis. The one day of classroom for the new installers was very well received. The basis of this day, The House As A System, gave many of the new installers the background for what they were asked to do each day. A number of Eureka moment's occurred with installers understanding why they were taught to do things certain ways.

Suggestions for training session improvements (comments, format and etc.)
The content, format and structure for each day of training was very effective and efficient in training a large group of installers and energy auditors in an on-site setting. The only thing that did not work well for us was while the site chosen worked very well for the blower door testing, auditor training and installation techniques due to its number of challenging features and overall energy inefficiencies it did not work well for the final day of training which was focused on Worst Case Draft Scenario and Blower door assisted air sealing due to the still extremely leaky home. Rick addressed these issues and was able to overcome the difficulties presented and get the very important messages across.

Changes the state will make as a result of the training
Many opportunities to advance Vermont's program were brought out by this training. As a result of the success of this style of training Vermont will schedule these skill set focused gathering on a regular basis. This format not only allows cross-leveling of skills across the network but also is very good for the moral of our personnel. They thoroughly enjoyed meeting with other people from other agencies. We will also look at several dense packing techniques that are in current practice such as dense packing the floor wall connection on balloon framed homes. Testing on actual homes and scale models of such connections will occur to determine the best possible practices. Vermont's technical monitor will reenergize the cellulose density testing due to some varying density readings that were discovered when using certain combinations of blowers, generators, techniques and hoses.

Appendix

Training Evaluation Questionnaire Results, Phases 1 and 2

The number of evaluations collected from each state, Phases 1 and 2, is listed in Table 4. The number of evaluations collected increased during Phase 2 because the instructor was more diligent about distributing and collecting them and the number trainees was up by 35 percent over Phase 1.

Table 4
Training Evaluations Collected from
Participants Attending an O^4S Training Event, Phase 1 / Phase 2

State	*Evaluations Collected*
Connecticut	16 / 45
Maine	57* / 83*
Massachusetts	13 / 36
New Hampshire	6 / 14
Rhode Island	5 / 16
Vermont	37 /42

* 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.

Recommended Additions to Evaluation Questionnaire[27]

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 – Phases 1 and 2 – 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 completed participant questionnaires are available for examination at the office of R.J. Karg Associates.

[27] This identical section was included in the Phase 1 final report; unfortunately, R. Karg did not add these questions to the Phase 2 Evaluation Questionnaire. If there is a Phase 3 to the O^4S project, the questionnaire should be expanded to include these questions.

The Phase 1 and 2 evaluations from the Maine training participants were recorded on the Maine State Housing Authority (MSHA) standard evaluation form rather than the form drawn up by Karg for the O^4S training. The Maine evaluation responses are summarized on the MSHA form.

O^4S 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, Phase 1

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 Form, Connecticut Summary, 45 Respondents, Phase 2

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.	4.8	
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.	4.97	
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?	4.8	
9. Will the training help you do your job better?	4.8	
10. Was the training worth your time and attention?	4.9	

11. What did you like BEST about this training?

"The trainer; actual hands on training; DG-3 overall performance on different pressure zone; training will help me on other jobs; use of the DG-700; the hands on training; very knowledgeable; hands on elements, best way to work; everyone was involved; learning the things you don't know; explanation of approach to achieve best results; trainer talked so I understood; trainer was easy to talk to; the amount of information the trainer has; blower door explanation; seeing how cellulose was installed; better blower door training; information about cellulose insulation; information about cellulose; sidewall work; opportunity for hands on experience; wall insulation; actually, everything; topic about the roof/attic insulation; trying to find out the best way to do air sealing in the basement; it showed me how important it is to find other ways to sealing better; how to address the envelope of the house; air sealing methods; blower door and dense pack; the way it was presented, received lots of useful info.; very informative; trainer taught in a way easily understood; how to address the different issues in the attic; hands on, measuring density; good presentation; the two days, you get more out of it; this was really a good training experience."

12. What was the LEAST IMPORTANT topic covered?

"Ventilation; ventilation; none; N/A; coverage of DG-3 and blower door; none, all was important; every topic was important; everything was of essence; nothing; cellulose insulation; every part of training was informative; all was important; all was important; none; cellulose insulation; none are least important; nothing; basement; working in better conditions; none; N/A; all topics covered were beneficial; N/A; N/A; good."

13. What topics should be ADDED?

"Proper ventilation; side wall prep.; none; all basics was covered; you cover all topics; to me, all areas were covered; air sealing methods – what works; we hit all the topics; none; when do you turn work away because of conditions; having home owners get more involved; none; always room for added training methods; N/A; N/A; other types of zone pressure diagnostics; good."

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

"Shows us the standard techniques; able to determine possible stack effects and by passes; more awareness in able to find trouble spots; how to weatherize better; use of latest techniques; pay attention to detail; help me with problem solving with insulation; I think that it me work a lot easier; how to get best results; work faster; things brought to my attention that I didn't experience before; helps develop a standard for our work; more accurate use of blower door; gave me an understanding of what happens in the field; enhances skills we are already practicing; sidewall methods; understand blower door operation; I can look at problems different to help client; enhanced knowledge, skill development, customer service; look carefully at jobs, especially the basement; finding the best ways to air seal; it will give me a chance to show customers more better ways to help insulate their home; helps me be a better auditor; lots of ways, new methods and training improve your overall success; learned many useful tips on the new blower door equipment; I will be better focused on job; how to be a better auditor; I have a better understanding of the technical aspects of blown-in insulation; more aware of problems; make you want to do more to help client."

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

"Provide some type of network for contractors, provide handouts; should be followed by showing of other agency by video; this training was excellent; N/A; I rate a 10; more training to keep us sharp; I can't think about anything to improve; to be conducted more often; have more training; have more trainings; more training aids (material); more on-site training to address different leakage problems, mobile homes; if possible, eliminate any gaps in day; can't think of any; more on air sealing; more on air sealing; more of it; additional air sealing ideas; I have no problem or ideas more than what was already showed or taught; N/A; N/A; N/A; provide a written summary of rules of thumb for pressure diagnostics and weatherization; good enough for me."

Training Evaluation Forms, Maine Summary, 48 Respondents, Phase 1

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 as a result of this discussion	4.2		

6. 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
7. Length of workshop/session	4	42	2
	Yes	Probably	No
8. I would recommend this workshop to a colleague	38	10	0

9. 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."
10. 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."
11. 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."
12. 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, Phase 1

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 Forms, Maine Summary, 83 Respondents, Phase 2

MAINE STATE HOUSING AUTHORITY
EVALUATION FORM
October 25, 26, 27, 28, and 29, 2004

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	4.5		
2.	Effectiveness of presenter	4.5		
3.	Value of session interaction	4.4		
4.	Content	4.5		
5.	Length of session	Too long	Just right	Too short
		6	61	3

6. What is the most important knowledge or skill gained
"How to dense pack; density calculation; uniform density and maintenance of blowers; cellulose density calculation; entire lecture was informative; input from others; real world issues contractors face; how to set machine; make sure we are supplying enough wattage; the use of different tubing; sharpened blower door skills; information on different blowing machines; people only know what they think is correct, not what really is correct; how to sit quietly; heating envelope; step-by-step house evaluation and blowing walls; more knowledge about equipment we will be using; the proper way of doing this and what to look for; cellulose packing; I learned a lot of good information, thanks; adjustments on my Krendl; all of the skills; bagging floors, proper settings for blower; blower door demonstration; the blower door setup; testing machines; hands on operation; how to gauge the infiltration of air through odd spaces; infrared camera work; CAZ testing; worst-case testing; CAZ test; CAZ test; got some questions answered about recessed lights; air sealing."

7.	I would recommend this workshop to a colleague	Yes	Probably	No
		70	11	1

8. How could the training/workshop be improved?
"Add safety; develop a step-by-step program, this program is too random; none; shorten; more hands on, a lot of contractors still don't seem to understand the importance of dense packing (from hearing their comments); more hands on to get everyone involved and on the same page; calculations; less time talking about a certain item; smaller room; more often; full day of walking and talking about what we do and why; models; more on mobiles; have more training on this subject; more demos; more on the job training; more crew interaction; more health and safety factors; little more excitement; better equipment at site; more training such as this, maybe quarterly; 2 days at same house; it was great; more hands on training; just keep doing what you are doing; more planning between crew and estimator; get a new Krendl; new to me so I don't know; good as is; have a single manager of the works, too many chiefs; set up trailer training on the best was to fix trailers; little more organized; to be more structured; more new contractors; I was interested with using the blower door to find air sealing; none; have more crews show up so all crews in state are on same sheet; have more feedback after time; more crews present; I thought the workshop was excellent; more workers from other places that do this work."

9. If another training/workshop was offered in the future, what specific issues/subjects would you like to see covered?
"Metal siding; safety; mold; inspection techniques; hands on for doing proper attic air sealing; more attic air sealing practices and how important that is; same; asbestos; how to treat a difficult envelope and what would save more; mobile home insulation, both tube method and stuffing; blowing mobile home from top; mobile homes; siding removal; health and safety vs. cost effectiveness; trailers; same; more on advances air sealing and diagnostics; more on blowing walls and blowing knee walls; all; trailers; wet insulation; all the new ways and skills of doing it; trailers; more time on the blower; air sealing; trailers; repair directions and techniques for old houses; trailer blowing in roofs as well as wall and belly; mold; air sealing; heating system modification for increasing efficiency; more CAZ testing for different problems; siding removal and installation; air sealing."

10. Additional comments:
"I liked it all; good job, good start; blower door segment was too technical for contractors, a lot of them were lost; already knew much of this information but was good to see what other contractors went about doing the same tasks; nice training, and lots of information; more examples of new building failures brought up at training; on site visits; thank you; a lot of this workshop I already knew; send new contractors to hand on training first, before classroom; if trainings were scheduled quarterly a different topic could be every time; it was a great workshop; I'm looking forward to meeting all the guys in the program, everyone was great, thanks; all good; overall well worth the time spent; excellent time spent on homes as a whole; recommend you have a couple of workshops a year for people in the industry to see new projects and procedures on the market; love the training (team spirit); thanks; great workshop; more contractors show up; where's my hose?"

Training Evaluation Form, Massachusetts Summary, 13 Respondents, Phase 1

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, Massachusetts Summary, 36 Respondents, Phase 2

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.	4.4	
2. It taught me useful methods and skills.	4.3	
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?	4.2	
Trainer		
5. He was knowledgeable about the topics discussed.	4.8	
6. He presented information so that I could understand it.	4.9	
7. He gave me the answers I needed.	4.5	
Overall Training Experience		
8. How do you rate the overall training experience?	4.4	
9. Will the training help you do your job better?	4.4	
10. Was the training worth your time and attention?	4.2	

11. What did you like BEST about this training? "Hands on, aluminum siding, dense blow demonstration; opening metal siding; see how other contractors work; aluminum siding; multiple methods, excellent 'wall box' demos, meeting other contractors, friendly atmosphere; aluminum removal; aluminum removal procedure; the intro of a new method; hands on explanations; hands on; hands on field techniques and ability to try all different techniques; learning about tubing methods; the way Rick showed, instead of jut told, contractors better techniques; working along side other tradesmen and companies; variety of topics covered; technical information regarding the insulation density; well qualified trainers; better explanation about the proper tool for installing wall insulation; involvement of all parties and problem solving; different methods, different contractors; different types of ways to blow cellulose; testing everyone's blowers and machines; lunch; one on one; getting different techniques on others; hands on, more than one contractor ideas; testing Force 2 and Krendl; it showed me how other crews do things (and not for the better); new methods; learning new job skills; overall everything; have attended similar training, nothing new; training; a chance to gain more knowledge; learned the difference between nozzle blow and tube blow; the tubing."

12. What was the LEAST IMPORTANT topic covered? "They were all important; none; dense blow info; N/A; all topics helped; all was good; no such thing as least important; I found all topics important; blower door setup; none; drill bit; it was all important to us; I thought it was all important; drill bits; lunch; it was all good; lunch; blower doors; the machine test; blower doors; none; lunch; lunch; everything was important; the tube."

13. What topics should be ADDED? "Blower door assisted air sealing; none; need more time, air sealing chases and bypasses; different times to use the methods; none; N/A; additional attic sealing; more training programs where fellow tradesmen can gather and pass on knowledge; venting; details on air sealing, basement foundation sealing; more weatherization; none; air sealing; differences of machines and equipment; options on machines you can use; electrical precautions; more air sealing; how contractors can work more cost effectively; ventilation; none; none; air sealing; not sure at this time; none."

14. How will this training HELP YOU in your weatherization work? "Better quality control; more knowledge about the insulation process, densities, etc.; will take off aluminum siding faster and with less damage; open new ways to blow depending on house construction, situation; I myself would not recommend shoving a plastic tube up a plaster and lathe, knob-and-tube wired home; on certain houses it will do a very good job; change the way things are done; better knowledge of dense blow/insulation techniques; getting more insulation in walls; contractors will do better work for clients; improve time, money, quality; showed me exactly how the contractors did their work; information leads to better quality work; conscientiousness about blown in cellulose effectiveness; widening my knowledge of installing sidewall insulation; better communication with contractors and auditors; understand more about blower door; learned new ways to do stuff; different techniques you pick up from other people; fill the cavity more; cut time on installing; it gives me a better understanding of what not to do; using different ways to blow walls; it will make you think; aluminum siding removal; save working time; more knowledgeable; in many ways; learning to use the tube to blow with; to do a better job; I know more."

15. How do you think this training can be IMPROVED? "2 day training; none; needs to be longer, Rick had more info but ran out of time; maybe more hands on; maybe more demonstrations; house should have been screened better for work to be done; 2-day to cover more in depth; make it available to the rest of our contractors, excellent; have more trainings; have it done regularly; make it a two week class in Honolulu; more in depth training on individual weatherization issues; by mandating that contractors use tubing, not nozzles to install insulation; lunch; more topics; it can't be improved, it was great; I did not see anything wrong with it; discuss different products; I think it's perfect; I would need to attend more to see what's different; cover more than just blowing walls and blower door setup; needs to be more one-on-one, less contractors on site; more hand on; less people; not really; it can't; more classes; pretty close to perfect."

Training Evaluation Form, New Hampshire Summary, 6 Respondents, Phase 1

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, New Hampshire Summary, 14 Respondents, Phase 2

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.		4.6	
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?		4.5	
Trainer			
5. He was knowledgeable about the topics discussed.	5.0		
6. He presented information so that I could understand it.	4.9		
7. He gave me the answers I needed.	4.9		
Overall Training Experience			
8. How do you rate the overall training experience?	4.8		
9. Will the training help you do your job better?	4.8		
10. Was the training worth your time and attention?		4.6	

11. What did you like BEST about this training?
"I like core sampling the buildings; the guys to work with; pressure testing houses, new insulation tips; everybody participating; infrared; meeting other crews, seeing how they work; the experience of hands on training; overall methodology; insulation; contractors getting involved in the concept of building design and are able to share ideas and methods; watching Rick pull tarp from insulation machine; people attending; I was the only insulator working, got to show skills to others."

12. What was the LEAST IMPORTANT topic covered?
"Nothing really; some things that we do all the time; stupid questions; there was none; I thought everything was important; none; none; all topics seemed to have importance; tenant relation."

13. What topics should be ADDED?
"More TI-86 , more pressure stuff; air sealing; unknown; safety; venting."

14. How will this training HELP YOU in your weatherization work?
"A lot of stuff I did not know and now I do; air sealing on more than one apartment at a time; better defining of house; better dense packing; knowing common misconception; understanding of what is expected on the job, quality control issues are important to me; by being able to locate and solve problem areas; overall understanding; understand knee wall vs. slope; show me the technical side of insulating."

15. How do you think this training can be IMPROVED?
"More; more often, let people you are training pick some of the topics; more classroom situations; have more time in the field; more organized on the site would accomplish more training, this was not the trainer's fault, but a tenant problem; unknown; single family home with hands on training; allow crews to try out each others equipment in actual walls or attics; more workers to get more input."

Training Evaluation Form, Rhode Island Summary, 5 Respondents, Phase 1

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, Rhode Island Summary, 16 Respondents, Phase 2

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.	4.6	
2. It taught me useful methods and skills.	4.5	
3. It provided me the chance to ask questions.	4.9	
4. Do you think you will have fewer re-works or call-backs as a result of this training?	4.5	
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?	4.7	
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?

"Being able to observe other ways of removing siding; core sampling; it brought all the players to the table, or actually, job site; allowing the contractors to see how we wanted the house to be dense packed; questions were answered; brought workers and auditors together; field work; hands on; direction vs. tube; dense pack procedures; the one hands/on job work experience and seeing how contractors fulfill the job; core sampling; core sampling; the end; learning density of different types of blowing machines."

12. What was the LEAST IMPORTANT topic covered?

"None; N/A; different machines, old, new, tired; no one to take responsibility in following up; all were important; N/A; none; it was all pretty important to me; not the machine, it's the operator; all had to do with weatherization."

13. What topics should be ADDED?

"Testing heating units; heating systems; when you can dense pack, when and why you can't or do you always; where to air seal; N/A; venting and when and when not too; different views on saving client money on heating costs; none, for what we were doing, there was enough time to get everything covered and didn't feel rushed or like we were going too fast; the tubing method correctly; probably about other contractors outcome."

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

"Added information; better prepare for thorough inspection; better observance of installed dense pack standards; it should help contractors understand what we are trying to achieve and to try to maintain parity; the contractors know what is wanted; by paying closer attention to detail; taking core samples; better understanding of dense packing; better monitoring; inspect good work and bad; more knowledgeable and educated when making decision; better improve the quality of work and comfort for our clients in weatherization; be able to check density and take off power or the blowers; patience; to be able to present more information to clients."

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

"All auditors give their own audit and inspections, see how they match up; meters that can read/scope the density of insulation; twice a year for new employees of contractors; do a before and after on what client is saving on heating; by having Rick conduct more training in RI; training was fine."

Training Evaluation Form, Vermont Summary, 37 Respondents, Phase 1

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."

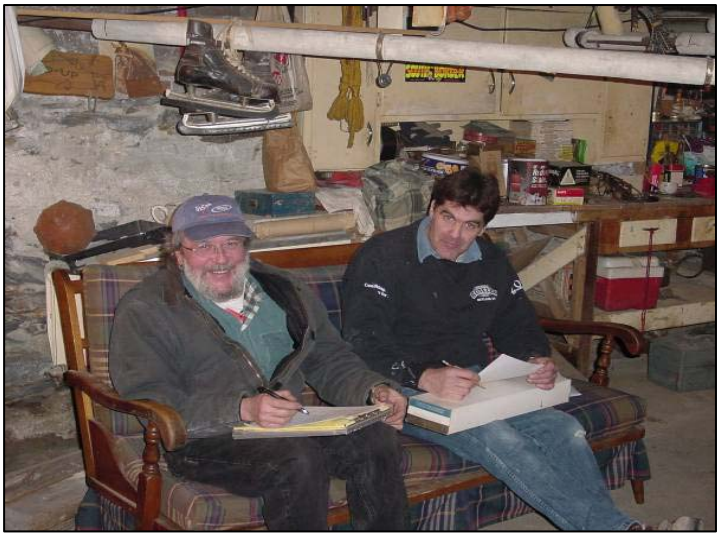
13. What topics should be ADDED? "Blower door assisted air sealing; more on heating; trapping moisture when home is too tight; CAZ testing and heating systems; pressure diagnostics; heating systems, especially duct work; heating systems, how they work; Gary Roundy's test boxes; mold issues; heating systems; 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."



What the Heck is That?! in Vermont



Worst-Case Draft Training in a Vermont Basement

Training Evaluation Form, Vermont Summary, 42 Respondents, Phase 2

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.			4.3		
2. It taught me useful methods and skills.			4.4		
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?				4.0	
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.			4.5		
Overall Training Experience					
8. How do you rate the overall training experience?			4.4		
9. Will the training help you do your job better?			4.5		
10. Was the training worth your time and attention?			4.5		

11. What did you like BEST about this training? "Getting together with counterparts from across the state; group interaction, different organization s present; interaction with other auditors from the state; see what other auditors do; the interaction between auditors, learning the different ways things can be done; opportunity to get multiple ideas to solutions from peers; discussion with other auditors; attic work; learning more about blower door; talking about blower door; went by quick; answered any and all questions with understandable knowledge so that it made sense; Rick was understandable and made it fun; I learned a lot; slides of what we talked about; good explanation of topics covered; demonstration of model home and air exchanges; different ways to do different things; all the little pointers; learning how everybody does different way; discussing work techniques with other technicians; getting the answer I needed; hands on/visual; the info; hands on and advice; everything; dense pack; discussion of how to determine what the envelope should be; lunch; how to test furnaces and boilers; worst-case scenario; detailed walk through on how to do worst-case backdraft; all crews getting to ask different questions; all was need to know info; hands on and talking with other crew chiefs."

12. What was the LEAST IMPORTANT topic covered? "All was good; blower door setup; N/A; blower door; none; blower door; wall insulation; belly blow; things that the auditor knows; techniques; everything was important; about clean and tuning furnaces; gas toilet (ha ha); N/A; dense packing through outside wall that are unpackable; none; lunch; filling the boxes; lunch; too many people; none; N/A; nothing; all of it is important; all of it is important; NASCAR scores; all was equally important; none; N/A; N/A; N/A."

13. What topics should be ADDED? "More time for Q + A; moisture, indoor air quality; duct work; hydronic/steam hat distribution deficiencies; heating systems; worst-case draft testing; auditor exchange; don't know; other option besides the ones you know; none that I can think of; should add more about belly blow, perimeter blow; more on newer buildings where insulation installed was no good and how to fix problem; mobile home insulating; safety equipment; introduction to newest methods; dense packing; all; air sealing more; N/A; belly blow; discussion of combustion air for furnaces so we don't inadvertently limit it by too much air sealing ; none; more viable solutions, testing with analog blower door gauges; this training covered all the bases; N/A; more building science discussion or hand outs about IAQ and backdrafting."

14. How will this training HELP YOU in your weatherization work? "Good ideas to bring with me; more complete coverage on audit, look at things differently; become more aware of the thought process and ideas of others in the state; do more testing; estimating and post impaction; don't be afraid to look closer and try new ideas; other auditor's ideas; learned new practices; it will help me improve my skills; be a little more efficient; better knowledge of how and why things are done; a better understanding of things; helpful tips, air sealing, dense packing, talking with other crews, blower door; see things different; knowing what to look for and address things; how to look for things that I wasn't sure about, but now have proper knowledge to get done; it will help me do the job better and quicker; easy way of doing things; introduction to newest methods; improve; different things I learned from others will help; much more knowledge; to think it through before action; make sure not to seal the basement too much, thus causing back drafting the furnace; do my job better; better understanding of backdrafting; I understand it more clearly; more thoughts on safety issues; may help increase productivity, cut down unnecessary work; complete work scope knowing I didn't create a dangerous condition for our clients; it helped me understand worst case better."

15. How do you think this training can be IMPROVED? "Always good job, Rick; infrared and more pressure diagnostics, more round table talk among auditors; peer to peer auditor exchange; would be best to have an empty house without any clients, maybe training house in Waterbury, more time; maybe a little more time, be able to see job through; smaller group; none; hands on I can learn more; more time to discuss each others techniques; it seemed fine the way it was presented; more hands on; maybe one more day of class and one day of work; N/A; by offering all to do one to two times a year; more and better tools to work with; more time; more hands on; everything; none; N/A; spend more time in class; focus on one topic/method for a day; I'm not sure; summertime for easier demonstrations; I think it was well presented; more of them; N/A; having a tight house to do a complete hands on test [worst-case draft test]; more time on it."