

Subject: Baseload Audit Procedures

Purpose: A step – by – step process for auditors to understand the baseload audit requirements

Utility Bill Analysis == Focusing Conservation Efforts

- One aim of utility bill analysis (for any fuel type) is to find out where savings are most likely to be cost-effective. Every home uses gas and electric energy differently. Two houses that look alike on the outside can have dramatically different energy use depending on the number of people in the household and their HVAC equipment, appliances, lifestyle and habits. It takes a certain amount of energy just to maintain a residence – though this clearly differs with the severity of the climate. If a household is running at a lean and efficient level, there is little opportunity to reduce use or cut costs. Similarly, if a household is using more than the average amounts of energy, there are likely to be terrific savings opportunities. The cost-effectiveness of energy conservation measures varies directly with pre-usage (or pre-retrofit) consumption.
- A second purpose is to use the foundation of the pre-usage consumption to discuss issues with the customer. It becomes a matching game involving the occupants, the bills, structure, HVAC equipment, appliances, lifestyle and habits, just to answer a simple question of why a customer's bill is as large as it is. For example, if you were aware that the home visited this morning had a high pre-usage consumption of electricity in the winter time, you may look for additional plug-in space heaters. But during the visit, no plug-in space heaters were located. With this information you can discuss your findings with the customer, who may tell you that they have an electric blanket for their bed, and they don't turn it off during the day. In essence, a plug-in space heater that was hidden from sight.

Making connections between Utility Bills and Meters

Two primary factors determine the amount of utility bills:

1. the price of energy being charged by the utility company, and
2. how much electrical energy is being used.

Electrical energy is metered by a central supplier and billed for accordingly. For each customer, this information is gathered and stored by the utility and will be provided to auditors in electronic format as a billing/use history (consumption) covering a 12 month period. Several assumptions are built into bills and usually, but not always, they are good assumptions.

1. the bills are based on readings from the meters (some may be estimated);

2. the meters are calibrated to a national standard and are accurate; and
3. only the customer being billed is using the energy on the downstream side of the meter.

Like most mechanical devices, when they get old or malfunction, they tend to slow down. Consequently, when meters are substantially inaccurate, it's usually because they *under-report* consumption. On occasion a meter that has been running slow for a period of time gets replaced. This causes the bill to increase, as the accurate consumption is now being reflected, even though their behavior or rate has changed.

THINGS TO CHECK ABOUT THE BILL

* Estimated/actual reading	* Incorrect meter reading or data entry	* Current rate per unit
* Number of days in billing period	* Compare use to same period last year	* Cost adjustments to rate
* Customer rate is appropriate	* Special billing status: pro-rated, budget plan	* Additional services on bill: maintenance plan, security light

ESTIMATED METER READINGS

Ideally, utility companies would read residential meters every month. However, actual readings may be required less often. This allows the utility to estimate energy use based on past consumption at the residence. For the most part this is reasonable and discrepancies between estimated and actual use are corrected the next time the meter is read. In the meantime, it is difficult for an educator, auditor, or occupant to extract useful feedback from a single bill based on an estimated consumption. Review of the 12 or 13 month consumption history, however, provides the necessary context for fitting over- or under-estimated months into the total picture.

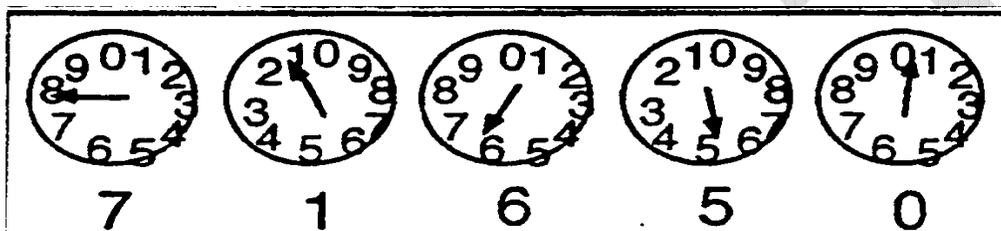
READING ELECTRIC METERS

The first step in reading an electric meter is to find it and be sure it is the right one. In duplexes and multifamily units, this can be tricky since meters may not be clearly labeled as connected to a particular unit. Electric meters may be either digital or analog (dial). In both cases, typically the edge of a thin wheel is visible

through a glass case enclosing the meter. This wheel turns as electricity is used. The bigger the load, the more electricity is being used, the faster it turns.

As with digital clocks, reading digital electric meters is pretty obvious. Some have a stationary zero in the last place – a circumstance that masks consumption in the one to ten kilowatt hour ranges, and limits its usefulness for short term diagnostics.

To read analog (dial) utility meters, read the dials from right to left. Record the number each dial has just passed. Notice that the dials alternate from moving in a clockwise to a counter-clockwise direction. If the dial falls between two numbers, record the smaller number. If the dial points directly to a number on one dial, be sure the dial to the right has passed zero. If not, record the next lowest number.



In this example, the meter reading is 71650.

To determine how much energy has been used in a given period, subtract the previous reading from the current reading. This is the basis for the monthly electric bill. The meter can be used for shorter-term diagnostics and evaluation as well.

Sometimes, it may be helpful to know how much energy is being used during a specific time period. For example, a consumer may wish to compare the amount of energy used in a 24 hour period with and without air conditioning. Or, a family may want to see what it consumes between the hours of 6 a.m. and 9 a.m. when everyone is getting up and preparing for the day. Periodic readings can provide interesting insights into the relationship between a household's energy-use habits, appliance efficiency, the weather, and energy costs.

SWITCHED METERS, UNKNOWN LOADS AND THEFT OF SERVICE

Sometimes utility bills reflect consumption that simply can't be explained. Once in a while, someone besides the customer is using the electricity. Particularly in multifamily units, meters may be switched and consumers charged for each other's use. More commonly, something in the dwelling is using energy unbeknownst to the occupant. Often, it is seasonal equipment that is inadvertently left on. Examples of this include baseboard heaters or heat lamps in well pits. Occasionally, it is a matter of intentional theft-of-service.

In all three cases, a quick diagnostic trick is to disconnect all loads in the dwelling and see if the meter is still turning. If so, you can reasonably imagine that one of the three situations exists. Remember, it isn't enough to turn appliances off since many continue to draw power even when not being used. This technique requires

unplugging and turning things off in the circuit breaker box. Two key features of this technique: remember to reconnect all equipment, and never disconnect any life-support systems.

OPPORTUNITIES FOR ELECTRIC SAVINGS

A careful review of utility bills offers a way to “see” how much energy a household used in a given period. Unfortunately, there is incredible variation in the appearance and information presented on customer bills. Utilities and customers alike tend to concentrate on the “bottom line” of dollars owed. Important as this is, it is often not particularly helpful in understanding how much energy was really used. Since the first step toward empowering a household to manage its energy use differently is understanding the bill, indicators beyond dollars must be examined and can simplify the process:

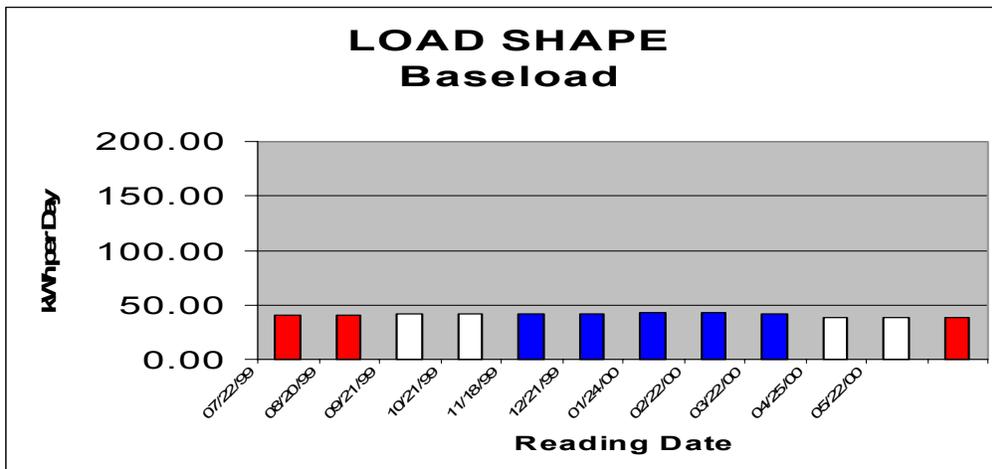
- Monthly electric use (in kWh)
- Number of days in the billing period
- Estimated or actual meter reading
- Cost per kWh
- Energy use summaries and comparisons: daily, monthly or annual
- Weather and energy use comparisons

Above average consumption usually indicates good opportunities for electric conservation, via both retrofits and consumer education.

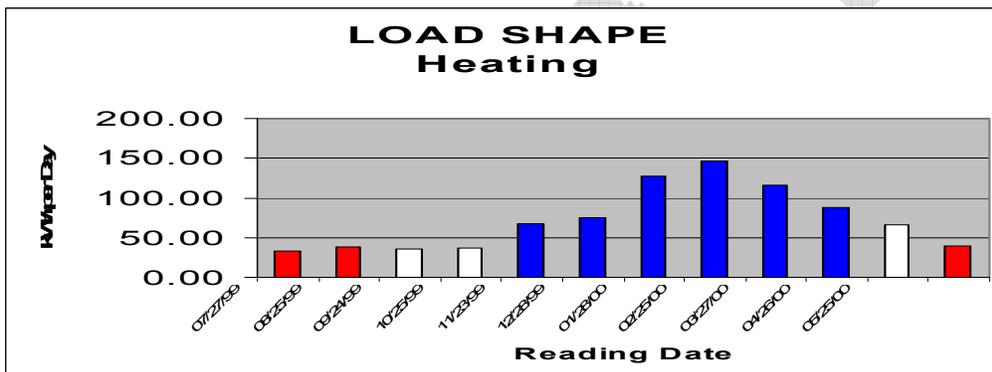
What do we mean by baseload?

- That portion of a household’s non-space conditioning electric use that is relatively constant throughout the year.
- Baseload does show some seasonal variation – lights and water heaters use less in the summer, while well pumps and refrigerators tend to use more.

Typically determined by analyzing previous (12 month) consumption, taking the lowest (two or three) months (one from the Spring and one from the Fall), calculating an average monthly consumption for that period and multiplying it to estimate annual baseload use. As you can see from the examples below, the baseload only home has pre-consumption that is pretty flat throughout the year.



- Whereas the heating home, has significant fluctuation. In this case, calculating the two or three lowest months will allow you to determine the baseload usage for this home throughout the entire 12 month period. Taking the baseload for the entire 12 months and subtracting this from the annual consumption, will provide the auditor with the amount of electricity being used for heating.



❖ **Protocol for disaggregating electric heat usage from baseload usage:**

Auditors will need to build the baseload usage of the client through the audit interview process and thereby construct a reasonable approximation of the actual usage provided through utility records as noted above. **However, in the case of an electric heat client it is a somewhat more involved process to arrive at reasonable estimations of usage, both baseload and heating/cooling.** The following steps will define the protocol for estimating the heating, cooling, and baseload components of a client's electrical usage.

- Auditors will disaggregate the heating & cooling consumption kWh from the baseload kWh by adding the kWh consumption for May and October, or the two lowest Spring (March-May) and Fall (September-November) months and dividing by two. Annualize this usage by multiplying by 12. Then subtract this baseload total from the total annual usage on the customer utility bill. This will give a

good estimate of monthly and annual baseload usage by minimizing heating and cooling usage.

- ✓ **Example: May actual usage + October actual usage / 2 = Average actual monthly baseload usage.**
 - ✓ **Average actual monthly baseload usage x 12 = actual annual baseload usage**
 - ✓ **Total actual annual usage – actual annual baseload usage = actual heating/cooling usage.**
 - ✓ **Similarly, total actual monthly usage – actual average monthly baseload usage = actual heating/cooling usage.**
2. Substantial actual monthly usage variation (actual monthly usage – actual average monthly baseload usage calculated in step one, (4th bullet) will most likely be heating, or central A/C cooling usage depending on the month.
 3. Identify any cooling usage from **May, June, July, August, and September** client usage history. Most of the usage beyond the average monthly baseload usage calculated in step one (4th bullet) will be **cooling kWh history**.
 4. Identify heating usage from **October through April** client usage history. Most of the usage beyond the average monthly baseload usage calculated in step one (4th bullet) will be **heating kWh history**.

Program Descriptions:

Baseload Only Services (High Use – Moderate Use- Low Use)

The purpose of these programs is to install Energy Conservation Measures (ECMs) that reduce baseload energy use only. Screening (either done at the local level or at the state level) will have determined that electricity is not used for space heating or that the amount of electricity used for space heating is too low for cost-effective treatments to be possible.

As previously described, baseload energy is defined as energy not used for space heating or cooling, such as: refrigeration, lighting, domestic hot water, cooking, and miscellaneous plug load (waterbeds, pumps/motors, etc.). Annual baseload usage characteristics are generally divided into high-use (>6,000 kwh), moderate use (4,000 – 6,000 kwh) and low use (<4,000 kwh).

Measures

The list of possible measures includes:

- Hot water tank insulation, reducing temperature setting(s), installing low-flow showerheads & faucet aerators.
- Water line insulation to six feet.
- Replacement of incandescent lighting with Compact Fluorescent Lighting (CFL). Compact Fluorescent lights must be Energy Star™ labeled.
- Replacement of outdoor lighting with CFL or High Intensity Discharge (HID).
- Refrigerator/freezer replacement, removal of secondary refrigerator or unused/under used freezer. Any appliance removed must be recycled in an environmentally sound manner. Refrigeration appliances must be Energy Star™ labeled.
- Switching to alternate rate or off peak program.
- Foam insulation blanket on waterbed (required), or mattress replacement.
- Replacement of Halogen torchiere lamp with a fluorescent torchiere, with a 3-way or fully dimmable CFL.
- Fuel switching of domestic hot water heaters, if alternate fuel is available.
- Repair/upgrade/replacement of pumps or motors.
- Field Measures, as justified by the audit.

High Use – Using SMOC~ERS software, these households will receive an in-depth audit that involves matching the assessment of the household's electric use made during the visit to within ten percent of the usage on the customer's bill. Included in the audit will be a two-hour metering of all refrigeration appliances. Integral to the audit is the development of a partnership with the customer along with development of a plan of actions the customer agrees to take to reduce the household's electric use. The auditor should install all measures at the time the

audit is completed, except for those materials that must be special ordered (for example, appliances and pumps).

➤ **High Use Auditing Procedures**

Auditors will conduct a baseload audit to identify causes of high electrical use related to appliances and plugload and identify solutions to high use problems. They will directly install some measures and coordinate installation of others such as replacing high use refrigerators and freezers. Auditors will provide customer education and motivation on recommended measures and practices during and after the baseload audit.

Data analysis will include an inventory of kWh usage by each appliance. Auditors will then calculate total estimated use and compare it to billing data. This data can then be used to identify sources of high use and also to provide a break out or profile of end uses. The inventory should be fairly precise including metering the wattage of some major appliances, including all refrigerators and freezers. The profile can help auditors to prioritize an appliance management strategy for customers.

➤ **High Use Data Entry and Analysis**

The appliance inventory will be entered into SMOC~ERS to conduct the calculations and identify which measures are to be installed. The process will begin with a carefully conducted client interview in which active listening skills will be employed to gain good information and to draw the customer into the process. Collecting and entering updated electrical usage from the customer's utility bill is a very important aspect of the client interview. Auditors will walk throughout the home with the customer while asking questions and entering the information into the SMOC~ERS. This has two primary purposes: (1) to identify and quantify sources of use and (2) to identify customer education and custom measure possibilities. The software will also track the installations performed and provide the on-site data entry, which will later be uploaded into the program database.

The estimated electric baseload usage from the audit process described above must be comparable to the actual usage numbers provided by the utility within 10 percent (seasonally and annually).

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➤ **High Use Customer Education**

A cooperative co-learning approach will be employed wherein the auditor will work with customers for mutually beneficial outcomes rather than merely

instruct or do things to or for them. One method for identifying the sources of high use will be to question customers and listen actively about how they use their appliances. This same knowledge will be used to prioritize savings opportunities and create a workable plan with the customer for them to operate their appliances more efficiently. An ACTION PLAN, detailing these commitments, will be presented to the customer at the conclusion of the baseload audit. The Action Plan should have no more than 3 to 5 commitments for the customer to act upon, which should target the top 10 highest electrical users in the home.

➤ **High Use Customer Follow-Up**

Follow-up contact to reinforce customer education, identify appropriate changes in the Action Plan if necessary and to learn what does and does not work must be made on 100% (if possible) of all completed jobs. A follow-up phone call, mailing, or on-site visits are allowed. Dependent upon activities completed for the customer, at least 3 months (preferably 4 to 6 months) should pass before contact is made. This will allow the usage of a replacement refrigeration appliance, actual reads of the meter, and other impacts of electricity to be included on the bill.

Moderate Use – Since moderate use customers will have less opportunity for savings, the focus of the audit for them will be on common measures such as lighting and appliances. As in high use households, partnership and action plan development are integral parts of the audit. There is no requirement to match predicted to actual usage to within 10 percent of the bill. Metering of refrigerators will not be required when their usage is available in the database loaded into the tablet or notebook computer. If the model is not available in the database, a one-hour metering is required.

➤ **Moderate Use Auditing Procedures**

Auditors will conduct a baseload audit to identify causes of electrical use related to appliances and plugload. They will directly install some measures and coordinate installation of others such as replacing high use refrigerators and freezers. Auditors will provide customer education and motivation on recommended measures and practices during and after the baseload audit.

Data analysis will include an inventory of kWh usage by appliances. Only enter appliances that will get a measure applied or an action written about. There is no requirement for auditors to calculate total estimated use and compare it to billing data.

➤ **Moderate Use Data Entry and Analysis**

The appliance inventory will be entered into SMOC~ERS to conduct the calculations and identify which measures are to be installed. Only enter appliances that will receive a measure applied or an action written about. The process will begin with a carefully conducted client interview in which active listening skills will be employed to gain good information and to draw the customer into the process. Collecting and entering updated electrical usage from the customer's utility bill is a very important aspect of the client interview. Auditors will walk throughout the home with the customer while asking questions and entering the information into the SMOC~ERS. This has two primary purposes: (1) to identify and quantify sources of use and (2) to identify customer education and custom measure possibilities. The same software will also track the installations performed and provide the on-site data entry, which will later be uploaded into the program database.

➤ **Moderate Use Customer Education**

A cooperative co-learning approach will be employed wherein the auditor will work with customers for mutually beneficial outcomes rather than merely instruct or do things to or for them. One method for identifying the possible high usage sources will be to question customers and listen actively about how they use their appliances. This same knowledge will be used to prioritize savings opportunities and create a workable plan with the customer for them to operate their appliances more efficiently. An ACTION PLAN, detailing these commitments, will be presented to the customer at the conclusion of the baseload audit. The Action Plan should have no more than 3 to 4 commitments for the customer to act upon.

➤ **Moderate Use Customer Follow-Up**

Follow-up contact to reinforce customer education, identify appropriate changes in the Action Plan if necessary and to learn what does and does not work must be made on 100% (if possible) of all completed jobs. A follow-up phone call, mailing, or on-site visits are allowed. Dependent upon activities completed for the customer, at least 3 months (preferably 4 to 6 months) should pass before contact is made. This will allow the usage of a replacement refrigeration appliance, actual reads of the meter, and other impacts of electricity to be included on the bill.

Low Use - Low use customers are not eligible under the current EPP. Low use customers should be referred to the local Home Weatherization Assistance Program (HWAP) provider.

Funds from the Electric Partnership Program (EPP) will be allocated to all HWAP providers using the same allocation formula as the regular HWAP funding. The OCS

believes that the EPP Low-Use program will begin the process of evaluating and taking steps to lower the electric base load usage in the homes of HWAP clients.

The use of EPP Low Use program funding is limited to performing electric base load measures on homes of clients meeting the following criteria:

- ✓ The electric utility supplier must be one of the four Investor Owned Utilities (American Electric Power, First Energy, Duke Power, Dayton Power & Light).
- ✓ The client must be on PIPP or must be PIPP eligible, which is 150% or less of the Poverty Income Guideline.
- ✓ The annual electric consumption for base load must be less than 4,000 kWh.

The OCS will supply a list of PIPP-eligible clients from Investor Owned Utilities, and who have an annual baseload consumption of less than 4,000 kWh to all HWAP providers. Information regarding referring clients not on the list, but identified by the local HWAP provider, will be available in the Customer Referral Section of the manual.

Only cost-effective measures meeting or exceeding a Savings to Investment Ratio (SIR) of 1.0 may be charged to the EPP Low-Use program. Cost-effectiveness will be determined by the charts in section 1506-6 of the Weatherization Program Standards. Refrigeration appliances must be operable to be determined as inefficient. Installation of refrigeration appliances where there currently is not one, or where an existing unit is not operational, is not an allowable expense to the program. No Health and Safety activities (i.e. electrical panel upgrades, re-wiring portions of the home) are allowable with these funds.

The fee structure for the EPP Low-Use program will be different than the Regular HWAP program. For each unit where EPP Low-Use program funding is applied, the fees will be as follows:

- ✓ A \$50.00 Administrative / Audit Fee for each home where program funds are applied.
- ✓ An additional \$25.00 Fee, if a refrigeration appliance is replaced. Replacement must still be cost-effective (SIR equal to or greater than 1.0)
- ✓ An additional \$25.00 Fee, if two (2) refrigeration appliances can be removed for the installation of one (1) appliance. (A "2 for 1" swap.) Replacement must still be cost-effective (SIR equal to or greater than 1.0).
- ✓ Compact fluorescent lights (CFL) must be Energy Star™ labeled and replacement pricing will be set through a price list.
- ✓ Refrigeration appliances must be Energy Star™ labeled and the replacement pricing will be determined through appropriate purchasing procedures at the local provider level.

Baseload Plus Weatherization Services (TEE)

The purpose of the weatherization component of EPP is to install ECMs that can cost-effectively reduce heating and cooling energy in addition to baseload measures. All participants with greater than 4,000 kWh of baseload usage and with over 6,000 kWh of their electric usage being used to heat or cool their residence (seasonal usage), will most likely be placed in this category. The provider should try to install as many weatherization and baseload measures at the time of service as possible. For a description of baseload measures and procedures, see page 6. Weatherization retrofits to save heating and cooling energy may include:

- insulation
- air sealing
- heating and cooling equipment repair
- heating and cooling equipment upgrades
- heating and cooling equipment replacements
- distribution system repairs

All work must be performed in accordance with the Weatherization Program Standards and all other local, State, and Federal codes.

Follow-Up Education Services

As mentioned in each of the baseload services only descriptions, some method of follow-up will be required for each customer. Follow-up may be in the form of a letter, a telephone call, or a home visit. The purpose of the follow-up is to assess satisfaction with the program's services, answer any new questions from the customers, and especially to reinforce the action plans. Where personal contact is made, the follow-up should include a review of the action plan and a report from the customer on their progress. If it seems the customer is receptive to additional action items, those should be suggested, based on the results of the original audit. The determination as to which type of follow-up is appropriate for which customers should be based on the judgment of the auditor as to which will be most effective and cost-effective. Any follow-up to customers beyond the one contact required, can only be provided with prior approval from OCS.

Auditor Skill Requirements

- The success of the program depends largely on the skill of the auditor and active customer participation. Training will be provided on the program requirements, electric baseload auditing, and computer use. Auditor candidates should already have significant auditing and communication skills as well as an aptitude for computers. Baseload / Consumer Education Follow- Up Training will be required of all auditors to expand and improve their skills. A set of broad based skills are recommended for Auditors:

- Technical skills including:
 - An ability to audit electric baseload consumption, to diagnose causes and to suggest solutions to lower high electric usage;
 - Ability to assess and implement cost-effective measures;
 - Understanding the insulation needs for the building envelope; and
 - Ability to operate and understand results of a blower door test.

- Communication, customer education, creativity and interview skills:
 - Schedule and perform Baseload Assessments with eligible customers;
 - Coordinate follow-up installations of refrigerators and other measures;
 - Educate customers on appropriate practices to lower electricity usage. Follow-up with customers to ensure progress and satisfaction; and
 - Effectively coordinate and communicate work activities between the auditor, the customers, and sub-contractors (such as refrigeration appliance vendors).

- Basic computer skills:
 - Ability to assess and implement cost-effective field measures using the SMOC~ERS software; and
 - Ability to process and print off SMOC~ERS reports specific to the household.

- Patience, compassion and commitment to low-income customers:
 - Actively participate in training and skill development activities to improve auditor's skills; and
 - Ability to emphasize the concept of a partnership between the customer, the utility and the auditor, which will include follow-up calls and/or visits.

Suggested Equipment List for Auditors [baseload only services]

Items should be issued by the Provider or provided by the Auditors:

- Flashlight
- Magnifying glass
- 3 prong adapter(s)
- Extension cord(s)
- Philips screw driver
- Standard flathead screw driver
- Strap Wrench, or Channel lock pliers and rubber jar opener to remove showerheads and low flow aerators
- Knife or mini-saw for cutting pipe insulation
- Scissors or shears for cutting tank wrap insulation
- Mechanical fasteners and tape – to secure tank wrap insulation
- Tool box or case
- Tools and materials for replacing CFL's including:
 - Gloves for hot lamps
 - Rag for cleaning lights
- 2x4 with padding to provide leverage to move refrigerators
- Plain paper for printing reports
- 2 each - Thermometers – to measure hot water temp and refrigerator/freezer compartments
- 2 each - Kilowatt Hour Meters (or Electric Consumption Meters)
 - 4 each - 40 Amp probes for use with Kilowatt Hour Meters
 - 4 each - Plug Adapters for use with Kilowatt Hour Meters
 - NOTE: THE AUDITOR SHOULD HAVE ENOUGH METERS TO MEASURE AT LEAST THREE APPLIANCES
- Laptop, TabletPC, or other computer
 - SMOC~ERS software
 - Portable printer - HP or Canon (compatible with Laptop, TabletPC or other computer)
 - Carrying case to hold printer
 - Printer cable
- Black permanent ink marker – to identify appliances that will be replaced
- Tape measure – to measure the openings for appliance replacement (doorways, cabinet height, countertop depth)
- Step ladder – to access ceiling fixtures
- Needle nose pliers
- rag rug to move old appliance
- gliders to move old appliance
- power strip