

1.0 PROGRAM DESCRIPTION

The Solar Weatherization Assistance Program (SWAP) program is a pilot program that provides grants to local agencies that participate in the Weatherization Assistance Program (WAP) to install low-cost, low maintenance solar water heater systems in low-income residences. It is a collaborative effort between the U.S. Department of Energy, the Department of Community Affairs, the Florida Energy Office (FEO), the Florida Solar Energy Center (FSEC), participating statewide local WAP agencies, utility companies, and the Florida solar industry.

The program's objectives included the following:

1. Reduce energy bills for low-income residents.
2. Reduce consumption of non-renewable energy resources statewide.
3. Stimulate and encourage manufacturers and installers of solar water heating systems to produce, market and install low-cost, energy-efficient solar water heating systems for low and moderate income consumers.
4. Quantify electrical energy savings that will encourage the increased usage of solar water heating systems in low-income housing.
5. Evaluate the feasibility of incorporating solar water heating as a WAP option.
6. Reduce pollution/CO₂ emissions.
7. Reduce Low Income Home Energy Assistance Program (LIHEAP) expenditures.
8. Increase energy efficiency and economic security for low-income individuals.



Figure1.0-1. Central Florida family with their solar system.

Secondary benefits that can be derived from the SWAP program are:

1. Provide the framework for enhanced recognition by government, the solar industry, and consumers that affordable solar water heating installations are a viable tool that creates jobs, enhances the quality of life for low-income consumers, and provides a marketable product.
2. Provide a program model that utilizes partnerships between government, the private sector, non-profit community based organizations and local volunteer groups that can be replicated in other states.
3. Increase the value of low-income houses through the addition of solar systems.

The SWAP program was targeted to benefit low-income clients with household incomes meeting federal Office of Management and Budget poverty guidelines. Three or more low-income persons were required to reside in each household before a solar water unit could be installed. In a few exceptional cases a solar installation was permitted where less than three low-income residents occupied a home if one or more of the residents were elderly, handicapped or infirm. Installations were geographically distributed in the north, central and southern climate zones of the state. The program was widely administered in rural and urban communities throughout Florida by nonprofit organizations and governmental agencies.

FSEC has established an extensive database to store and compile data obtained from the local agencies on installed systems and by FSEC from onsite inspections, surveys, utility bill analysis and computerized data acquisition at selected sites that monitor water temperatures, water flow and power consumption.

Why was Florida chosen to conduct the pilot SWAP program for DOE? Florida has always been at the forefront of developing a stable state solar infrastructure. It is primarily for this reason that Florida was chosen. This infrastructure includes:

1. Adequate solar resource
2. Substantial low-income housing
3. Large amounts of electrical water heating
4. Solar contractors licensing program administered by the Florida Board of Professional Regulations
5. The Florida Solar Energy Center's capabilities and experience
6. A history of solar development in the Sunshine State
7. An industry base of national collector manufacturers and local solar system installers

The SWAP program merges Florida's unique solar energy potential with the needs of its low-income clients. By providing solar systems that heat water with solar energy instead of conventional energy sources, the savings accrued from these systems provide low-income population with additional income that, as Mr. Oscar Harris of Gainesville's Central Florida Community Action Agency states, ". . . allows the money [for electric bills] to go to other needs such as health care, transportation, and shelter."

1.1 PROGRAM IMPLEMENTATION

The program was initiated by the development of program criteria and guidelines established by FSEC and DCA. These criteria included site selection, system types, sizing and performance requirements, and solar contractor qualification requirements. Solar site and system inspection tools and training were also provided to the local participating WAP agencies. Of course, the ability of local agencies to identify clients and sites that would benefit from the solar systems was, in the end, an important element in the success of this program.

Following is a detailed description of the SWAP program implementation activities.

1.2 SYSTEM TYPE REQUIREMENTS

The introduction of solar water heating systems in low-income residences provided many challenges and special requirements. These challenges were compounded by the necessity of keeping installed costs at a minimum in order to achieve overall system cost effectiveness. It was important that the system design be kept simple. Basic operation principles had to be understood by both the local participating agency staff and the low-income residents.

The reliability of the installed systems was also important. Once installed and out of warranty, it was unlikely that the majority of low-income clients could or would want to spend limited income on system maintenance or repairs. Since all SWAP systems were installed with a back-up electric water heater, electric heated water was always available. Therefore, in the event of system failure, many clients would undoubtedly delay or ignore required repairs to the solar system.

Installations were limited to the following system types according to the climate areas defined in the "Florida Energy Efficiency Code for Building Construction" (State of Florida, 1993). The primary purpose of these criteria was to ensure that systems installed in North and Central Florida areas that encountered periodic freezes during winter months would be protected by the particular system's freeze prevention design strategy. Detailed investigation was conducted by FSEC to determine areas most susceptible to annual freeze conditions. This included the review of weather maps providing long term temperatures for the Florida peninsula (USDA, 1475). The use of a variety of systems that were available in the Florida marketplace was also considered during the selection of applicable systems.

Listed below is the breakdown of systems specified for use in the various Florida geographical regions.

<u>Central & South Florida</u>	<u>North Florida (& Certain Areas of North Central Florida)</u>
Direct Active	Indirect Active
Integral Collector Storage	Integral Collector Storage
Thermosiphon (Direct and Indirect)	Thermosiphon (Indirect)
Indirect Active	Direct Active Photovoltaic Automatic Draindown

Following is a detailed description of the types of systems that are mentioned in the table listed above and installed throughout Florida as part of this program.

Specific systems were selected for each Florida climatic zone. This ensured that systems were compatible with the various climatic conditions, such as frequency and duration of freeze conditions. As previously stated, systems were also selected for their simplicity and convenience to low-income clients.

The primary systems used in North and Central Florida were the Integral Collector Storage (ICS) systems.

The systems installed in South Florida were pumped solar systems using a conventional flat-plate collector and a variety of control methods. These systems have been the workhorse of solar systems throughout Florida during the past decades. Some ICS systems were installed by several agencies in South Florida, but were not used in the large Metro-Dade area due to excessively costly Dade County Product Approval requirements for the manufacturer.

All installed solar systems were retrofitted to existing electric water heaters. This included 40- or 50-gallon water heaters for ICS and pumped systems. Initial site inspections determined whether the water heaters had to be replaced. If so, the new water heaters were sized for the particular system. Flat-plate collector systems were retrofitted with new or existing 40- or 50-gallon water heaters, while ICS systems could be installed with any size or existing water heater due to the storage design and total volumetric capacity of this system. Storage capacities followed the guidelines outlined in Table 1.5-2 of this report.

Standard solar systems, sold primarily to middle-income clients, usually require 80-to 120-gallon water heaters, but for SWAP, it was determined that the use of conventional smaller sized water heaters would be more beneficial. Smaller heaters reduced the cost of the overall systems, plus allowed future tank replacement by the client to be more affordable.

The installed solar collector area was also downsized by approximately 20%. This downsizing of the collectors and the water heaters provided a lower initial system cost and compatibility between the collector area and the tank volume.

1.3 SYSTEM DESCRIPTIONS

PASSIVE SYSTEMS

Integral Collector Storage (ICS) systems

This is an ideal system for low-income clients. It combines both simplicity and reliability. The system provides pre-heated solar water to the existing auxiliary tank. The ICS system has been installed in close to 50% of all the residences in the SWAP program. It is unique in that the hot water storage system is the collector. On demand, cold water flows through the collector where it is heated by the sun. Hot water is drawn from the top, which is the hottest part of the collector. During draws, the hot water from the collector flows to a standard hot water auxiliary tank within the house, eliminating much of the electricity required to heat water. During inclement weather when there is little solar radiation, hot water is still available through the use of the conventional water heater.

Thermal mass of the large tubes within the ICS unit serve as positive freeze resistance in Florida. In addition, and as a secondary back-up, a flush type freeze protection valve is often installed. Both 30- and 40-gallon versions of the ICS system were used in the SWAP program.



Figure 1.3-1. ICS System in North Florida.



Figure 1.3-2. Water heater and plumbing from ICS system.

Thermosiphon systems

Thermosiphon systems, like ICS systems, are considered passive systems since no pump is used to circulate water to the collector. Thermosiphon systems use flat-plate collectors to solar heat water. As the sun shines on the collector, the water inside the collector flow-tubes is heated. As it is heated, this

water expands slightly and becomes lighter than the cold water in the solar storage tank mounted above the collector. Gravity then pulls heavier, cold water down from the tank and into the collector inlet. The cold water pushes the heated water through the collector outlet and into the top of the tank, thus heating the water in the tank.

A thermosiphon system requires neither a pump nor a controller. Cold water from the city water line flows directly to the tank on the roof. Solar heated water flows from the rooftop tank to the auxiliary tank installed at ground level whenever water is used within the residence.

These systems are quite popular throughout the world and, due to their simplicity, would also be quite feasible for the SWAP program. They do take a bit more installation time since both the solar storage tank and collector must be mounted on the roof with a proper sloping of the pipes.

Because of the great weight of the thermosiphon and ICS units, the structural integrity of the roof must be verified before both thermosiphon and ICS systems are mounted on the roof. In many cases, the weight of a 40-gallon ICS or thermosiphon unit can easily exceed 500 pounds. Therefore the truss and roof sheathing must be strong enough to take this load. Of course, the units are usually mounted so that the weight of the unit is placed in four locations. As was the case in several SWAP installations of the ICS units, if the roof is not suitable for the mounting of these units, they are ground mounted.



Figure 1.3-3. Thermosiphon system in Central Florida.

Indirect thermosiphon systems work in the same manner except a freeze-proof glycol solution is used in the collector loop. A heat exchanger transfers heat gained by the heat transfer solution to the potable water in the solar storage tank.

ACTIVE SYSTEMS

Pumped system using a flat-plate collector and differential controller

The direct pumped system has a flat-plate solar collector installed on the roof and plumbed to a standard electrical storage tank. A pump circulates the water from the tank up to the solar collector and back to the tank. The sun's heat is transferred directly to the potable water circulating through the collector tubing and storage tank. This system uses a differential controller that senses temperature differences between water leaving the collector and the coldest water in the storage tank. When the water in the collector is

about 12-20⁰ F warmer than the water in the tank, the controller turns on the pump. When the temperature difference drops to about 3-5⁰ F, the pump is turned off. Simply put, the sensors and controller determine when there is enough solar heat available to turn the pump on.



Figure 1.3-4. Flat-plate collector mounted flush to roof.

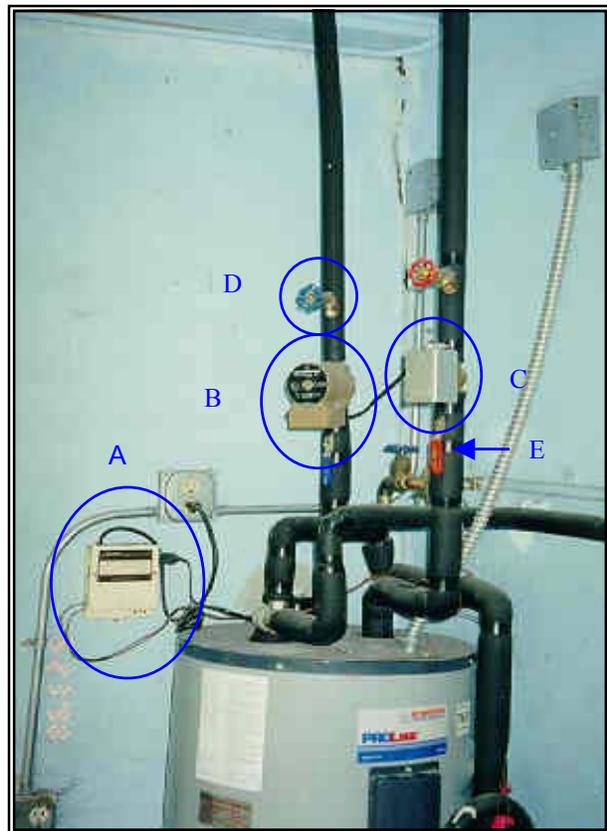


Figure 1.3-5. Flat-plate collector mounted at an angle.



Figure 1.3-6. Sensor being attached to collector.

Figure 1.3-7. Differential control system. Note controller (A) at left of tank, pump (B) on collector feed piping, motorized check valve (C) on collector return piping, and ancillary drain (D) and isolation valves (E).



These systems also incorporate a freeze protection valve. Whenever temperatures approach freezing, the valve opens to let warm water through the collector - much like allowing water to flow through house piping to prevent the piping from freezing. Once the valve senses the warm water it shuts off. This process is repeated numerous times during freezing conditions. A minimal amount of water is used – a total of approximately 1 gallon or less per day, depending on the severity of the freeze.



Figure 1.3-8. Freeze valve jutting from collector return line.

Another method of freeze protection is achieved by water recirculation in those systems that use a differential controller. When the temperature drops below 40⁰ F, the collector sensor activates the pump to circulate warm water through the collector.

The majority of pumped systems installed under the SWAP program incorporated differential controller methods. Differential control systems are also the most commonly installed control in conventional Florida solar water heating systems.

Although quite popular and efficient, and generally quite reliable, these systems include many more components than the ICS systems, which could increase the likelihood of future maintenance and service requirements.

Pumped system using a flat-plate collector and timer controller

This system differs from the differential controlled system in two ways. First, a timer is used to control the operation of the pump. A conventional timer with battery back-up (in the event of power failure) is used in conjunction with a standard solar pump. The timer is set to operate the pump during hours of the day when solar radiation is available to heat the potable water. In order to avoid loss of energy from the tank during overcast days, the collector feed and return lines are both connected at the bottom of the storage tank with a special valve. During normal operation, natural convection allows the warmer water to rise to the top of the tank. During cloudy weather, the pump only circulates water that is in the very bottom of the tank, thereby preventing most heat loss of the energy being dumped from the collector. This type of system requires that the homeowner replace the timer battery (common AA type) annually.

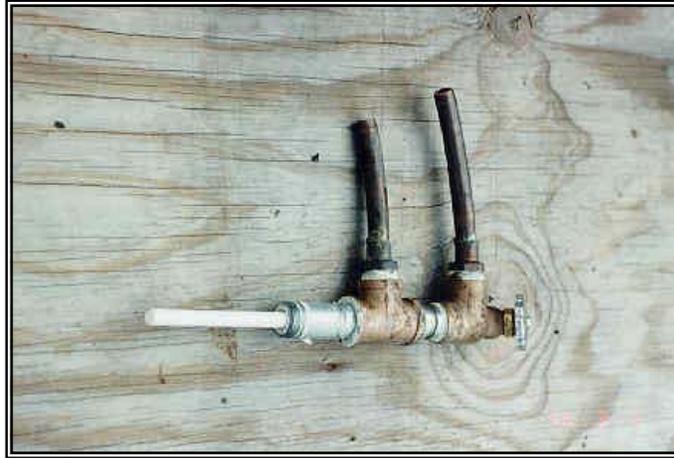


Figure 1.3-9. Tank bottom feed/return valve used in timer controlled systems.



Figure 1.3-10. Tank bottom feed, bottom return valve installed at drain of water heater. Note timer attached to wall at right.

Pumped system using a flat-plate collector and photovoltaic controller

This type of system differs from the differential controlled and timer controlled systems in that the energy to power the pump is provided by a photovoltaic (PV) panel. Unlike the AC-powered systems, there is no separate controller in this system. This PV panel converts sunlight into electricity, which in turn drives a direct-current (DC) pump. In this way, water flows through the collector only when the sun is shining. The DC pump and PV module must be suitably matched to ensure proper performance. The pump starts when there is sufficient solar radiation available to heat the solar collector. It shuts off later in the day when the available solar energy diminishes. The pump flow varies throughout the day in proportion to the sun falling on the PV panel. The compatibility of the PV panel and the DC pump are determined during the FSEC system approval process.



Figure 1.3-11. PV modules installed in plane of flat-plate collector.

The PV controlled system is ideal for use in residences where there is no readily accessible electric receptacle for AC powered pumps and controllers. As with the differential and timer controlled systems, a freeze valve is also incorporated into the system design as a freeze protection mechanism. One maintenance item on some DC pumps is the periodic replacement of the pump motor brushes.



Figure 1.3-12. Freeze valve attached to collector return line. The long non-insulated pipe stub to the freeze valve allows the valve to obtain better ambient temperature readings. It also provides heat release in the summer. Note the foil tape used as protective covering for the pipe insulation.

Pumped system using DC pump, photovoltaic panel and automatic draindown valve

This system is also ideal for areas in which freezes can occur. It uses no house electricity to power the pump since a PV panel wired to a DC pump provides electricity whenever there is sufficient solar energy. An automatic draindown valve is also incorporated in the system design to provide fail-safe freeze protection by draining the water from the collector every day. After sufficient solar energy has been received from the PV panel, the draindown valve is actuated. At this point, the pressurized city water is allowed to flow into the collector and the pump takes over and circulates water from the storage tank to the collector. When there is insufficient solar radiation, the draindown valve is no longer energized and at this time, the collector will drain water out of a drain port located at the tank. The drain line is run to a suitable drain location, usually outdoors.

Active systems electric water heater on/off switch.

A water heater on/off switch, with which the client could regulate the power to the electric water heater, was installed on the majority of active pumped systems. The logic behind the addition of this component was to turn the electricity to the water heater off during days when there was sufficient solar radiation to heat the water. The use of this switch increases system efficiency and reduces electrical consumption.



Figure 1.3-13. Electric on/off switch being installed on water heater.

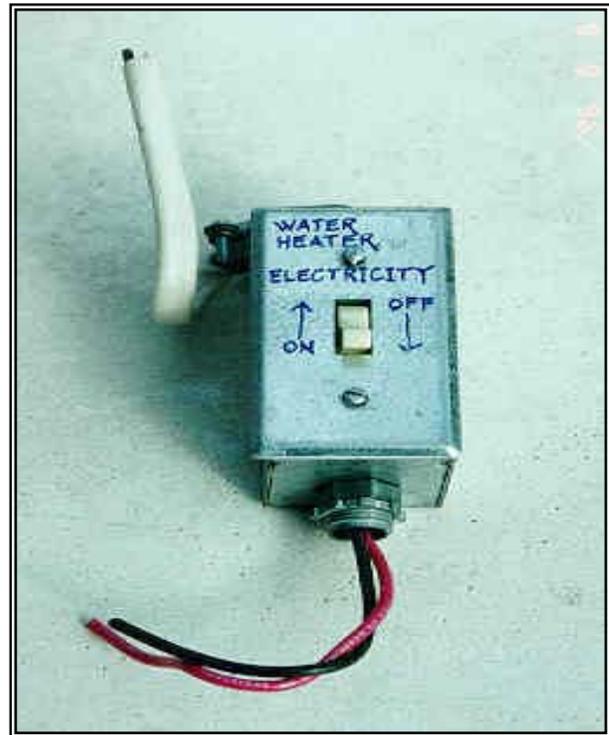


Figure 1.3-14. Close-up of on/off switch.

In the first few installed pumped systems, the top thermostat in the water heater was set at approximately 125 to 140 F⁰ while the bottom thermostat was disconnected to improve performance. Unfortunately this strategy did not provide the clients with enough hot water during inclement periods. After this, the top thermostats were set at 125-130 °F and the bottom thermostats were set at their lowest settings (90 to 110 °F).



Figure 1.3-15. Water heater thermostat.

Since a secondary goal of this program was to help create a niche market for the solar industry in Florida, FSEC and the local agencies initially attempted to equally distribute the installations to several installers in each geographical area. Many agencies had several installers to choose from and each installer was provided with a listing of installations. As the program progressed, some installers became more efficient with an increased number of installations, their installed costs remained stable, and they developed a good working rapport with the local agencies. Because of this, many agencies became accustomed to working with only one or two installers during the remainder of the program. Also, some agencies felt more comfortable procuring specific system types as long as they were approved for their area.

1.4 SYSTEMS NOT USED IN THE SWAP PROGRAM IN FLORIDA

Several common systems were not used in the SWAP program. Florida's warm sub-tropical climate presented opportunities for using systems that could not be used in other climates where freeze protection is a major and routine problem. Therefore, the systems used in Florida are basically those intended (and restricted) for use in warm climate states. Most of the SWAP systems used in the Florida SWAP program could not be used in, for example, Wisconsin, unless the systems were deactivated during the cold winter months.

Several systems could be used in Northern climates, but they each have specific characteristics that make them less than ideal for low-income residents. These include indirect pumped systems and drainback systems. Indirect pumped systems are more common in colder climates, where freezing weather occurs more frequently. These systems use heat exchangers and antifreeze solutions to protect the collector and other components from freeze damage. There were several reasons for not including these systems in the SWAP program. These include:

1. A possible candidate system manufactured in Florida that was designed to use an external heat exchanger (ideal for retrofits to conventional electric water heaters) was not available until the majority of SWAP systems had been installed.
2. A thermosiphon system incorporating a heat exchanger at the tank, which is currently manufactured in Australia, was considered for the SWAP program. Since the contract between DOE and DCA stipulated that systems used in the SWAP program had to meet "Buy U.S.A." requirements, this system was excluded from the program.
3. Most important, indirect systems require periodic maintenance and the checking of the heat transfer fluid chemical (pH, etc.) makeup. This, it was felt by program principals, would be a financial burden to low-income clients. In addition, it was presumed that most clients would not have this service conducted. This service is strictly required on systems using heat transfer fluids.

Other types of systems such as drain back were not used due to the complexity of the systems, as well as the markedly increased initial installation costs.

1.5 SYSTEM SIZING

The primary goal was to provide systems that were inexpensive, reliable, provided reasonable savings, and would provide an FSEC Florida Energy Factor of at least 2.0. (The energy factors represent the ratio of the hot water energy made available by each approved system divided by the electric energy used by the system.) SWAP performance requirements for the solar water heating systems were based on the Florida Energy Factor listed in the document "FSEC Approved Solar Energy Systems: Domestic Hot Water and Pool Heating," (FSEC-GP-15-81, Revised January 1993).

For a four (4) person or larger residence, the Florida Energy Factor listed in FSEC-GP-15-81 was applicable.

For three (3) person residences, an adjusted Florida Energy Factor had to be multiplied by 1.4.

Listed below are examples of the procedures used for calculating the adjusted Energy Factor.

For three (3) person residences:

Table 1.5-1. Solar Energy Factor Adjustment Procedure

System selected for installation on a three (3) person Residence	Florida Energy Factor listed in FSEC-GP-15-81	Multiplier used to Obtain adjusted Florida Energy Factor for three (3) person residence	Calculation to be performed	Adjusted Florida Energy Factor for three (3) person residence
Solar Florida, Inc. Model: Solar Ray	1.7	1.4	$1.7 \times 1.4 = 2.4$	2.4

As per FSEC-15-81, different energy factors applied for Central/South and North Florida climate zones. It was stipulated that the majority of systems installed would be retrofit applications to existing 30-, 40- or 52-gallon tanks. The use of existing water heaters would keep costs down and would also enable the low-income resident to replace the conventionally sized water heater in the future without incurring high replacement costs as would be the case if large solar storage tanks were used.

Table 1.5-2. System Sizing

Number of People	Estimated Gallons Per Day Usage	Energy Factor: 2.0 - 2.9 Minimum Storage Volume (Gallons)*	Energy Factor : 3.0 and up Minimum Storage Volume (Gallons)*
3	55	40	40
4	70	40	66
5	85	52	80
6+	100+	52	80

*For Integral Collector Storage (ICS) and Thermosiphon systems, the tank size includes both the solar and auxiliary storage volumes.
 The initial gallons per day consumption levels were based on those outlined in the "FSEC Simplified Sizing Procedure for Solar Domestic Hot Water Systems." (FSEC-GP-10-83, Revised April 1992)

All solar domestic water heating systems installed under SWAP were approved by the Florida Solar Energy Center (FSEC), per guidelines outlined in the FSEC document "Florida Standard Practice for Design and Installation of Solar Domestic Water and Pool Heating Systems," (FSEC-GP-7-80) and "Operation of the Florida Standards Program for Solar Domestic Water and Pool Heating Systems," (FSEC-GP-8-80, January 1985).



Figure 1.5-1. FSEC collector certification label.

1.6 SYSTEM INSTALLATION REQUIREMENTS

Additional SWAP program system criteria not previously listed in FSEC-GP-7-80, January 1985, were also required for system installations. These included the following:

1. Installed collectors had to be oriented within 45⁰ west or east of due south and mounted at an angle plus or minus 15⁰ from local latitude.
2. Except when required by system design or constrained by safety considerations, water heaters were to have a minimum insulation rating of R-12. An exterior insulation blanket could also be used to satisfy this requirement.

3. Insulation rated at R-2.4 or greater was to be installed on all interconnecting hot and cold water piping installed in attics, unconditioned garages other unconditioned indoor spaces, as well as all conditioned spaces.
4. Contractors submitting integral collector storage (ICS) systems for use in central and North Florida had to submit collector feed and return pipe size information and the type and thickness of the pipe insulation. This information was used to determine the freeze prevention capabilities of the ICS system and its external piping components.
5. Temperature control of the potable water used by the clients was of concern due to the installation of systems in residences where there were unsupervised young children and/or elderly clients that could get scalded if faucet temperatures were not adjusted correctly. Due to this, it was determined that anti-scald valves had to be used in residences where active systems were installed. The scald preventative valve provided a means of limiting the temperature of the hot water at the fixtures to a selectable temperature. It was also stipulated that the Scald preventative valves used must meet A.S.S.E. Standard 1017, *Temperature Actuated Mixing Valves for Primary Domestic Use*. The major intent of this criterion was for active pumped systems. However, some of the ICS installers also used this valve.

Specific installation requirements followed the criteria set forth in Chapter VII of the FSEC document "Florida Standard Practice for Design and Installation of Solar Domestic Water and Pool Heating Systems" (FSEC-GP-7-80). The installation requirements were also detailed in FSEC's solar system inspection checklist forms provided in the SWAP Training Manual. (See Appendix 1.)

1.7 INSTALLATION CONTRACTOR QUALIFICATIONS

Requirements were also established for SWAP program participating solar installers. The following guidelines had to be met before a solar installer was allowed to install systems under the SWAP program.

1. License: Contractors had to be Florida licensed contractors, in accordance with Chapter 489 Part I, Florida Statutes. Contractors' license was to be in a category that was authorized to install residential solar water heating systems.
2. Experience: Installers had to demonstrate capabilities to install residential solar water heating systems. Past experience was critical in meeting this requirement.
3. Place of Business: Installers were required to provide continuous post-installation service to the areas in which they installed SWAP solar water heating systems. Initial requirements stated that the solar vendor had to be within a 100 mile radius of the installation sites. This was changed to accommodate the installers and installations in North Florida that exceeded the 100-mile radius.
4. State and Local Codes and Ordinances: Contractors had to comply with all applicable state and local codes and ordinances. Appropriate city or county building permits to be obtained for each system installation.

Warranty requirements for the installation and the installed equipment was also established. The requirements were as follows:

1. Collector :
The Contractor was required to provide a full ten (10) year written warranty on the collector. The warranty covered the full costs of field inspection, parts and labor required to remedy the defects, including, if necessary, replacement at the site.

The warranty did not cover defects of any kind resulting from exposure to harmful materials, fire, flood, lightning, hurricane, tornado, hailstorm, windstorm, earthquake or other acts of nature, vandalism, explosions, harmful chemicals, acidic or caustic water, other fluids, fumes or vapors, operation of the collector under excessive flow rates, misuse, abuse, negligence, accident, alteration, falling objects or any other causes beyond the control of the Contractor.

2. Systems:

The Contractor had to provide a full one (1) year warranty on the system. The warranty covered failure of the installed solar system, including any component or assembly where such failure was caused by a defect in materials, manufacture, or installation.

The warranty also covered damage resulting from freeze and over-temperature. This included the full cost of all parts, labor, shipping and handling necessary to remedy the defect, including, and if necessary, replacement at the site.

In those installations in which the SWH systems were retrofitted to the existing conventional electric water heater and the existing water heater failed due to normal circumstances during the one (1) year warranty period, the system warranty excluded the replacement of the water tank.

The system warranty did not cover defects of any kind resulting from exposure to harmful materials, fire, flood, lightning, hurricane, tornado, hailstorm, windstorm, earthquake or other acts of nature, vandalism, explosions, harmful chemicals, acidic or caustic water, other fluids, fumes or vapors, operation of the collector under excessive flow rates, misuse, abuse, negligence, accident, alteration, falling objects or any other causes beyond the control of the Contractor.

The system warranty was effective at the date of installation.

The fulfillment of the warranty was the responsibility of the installation contractor.

3. Contractor Identification:

The Contractor's name, address and phone number had to conspicuously appear on all warranties.

A formal application packet was provided to any solar installer interested in becoming a SWAP authorized installer. The application documentation was completed by the vendor and returned for review and acceptance by DCA/FSEC. The following list outlines the documents in the packet and those required from the applicants.

1. Form 1 - Contractor Profile and License
2. Form 2 - Solar System Application
3. FSEC "Approved Solar Energy System" Form with SWAP system selected components marked
4. Anti-scald valve specification documentation
5. System and collector warranties
6. Copy of the collector and system warranties that will be given to clients
7. Solar system Homeowner's Manual and Freeze Information Label
8. Copy of the System Homeowner's Manual and Freeze Information Label for each system submitted

FSEC and DCA published a listing of SWAP participating solar installers and disseminated that list to all SWAP agencies. During the initial phases of the program, FSEC assisted the local WAP agencies in developing their bid requirements for local installers. Many agencies used the bid forms developed by

FSEC and listed in the SWAP Training Manual in Appendix 1. Other agencies used procedures they had developed as part of the standard WAP program. Nevertheless, FSEC initially assisted all agencies in identifying and selecting both the installers and the system types to be installed in the specific WAP geographical areas.

1.8 PROGRAM IMPLEMENTATION - TRAINING

FSEC provided local WAP agencies an in-depth solar program that emphasized both in-house lecture and hands-on field solar training. FSEC Training included field activities that were repeated during numerous sessions in order to ensure that all parties participating with this program were familiar and confident with site and solar system inspections. (See training presentation in Appendix 2.)



Figure 1.8-1. FSEC staff providing system inspection training for local staff. Lesson learned here - photovoltaic module (on lower right corner of flat-plate collector) is not to be affixed to the face of the flat-plate collector.

A SWAP Solar Manual was developed to provide training guidance and program implementation assistance to all participating agencies. This manual included an overview of solar water heating principles and basic information, as well as detailed site and system inspection instructions and the use of system inspection forms. The manual was intended as a reference guide for local SWAP participating agencies throughout the course of the SWAP program. A copy of the manual is included in Appendix 1.



Figure 1.8-2. Shawn Angell of the Metro-Dade Community Action Agency checking a collector sensor.

1.9 LOCAL PROGRAM IMPLEMENTATION

Implementation of the program was conducted through local Florida Weatherization Agencies. DCA provided grants to local Weatherization Assistance Programs and other non-profit agencies to operate the program while SWAP-certified solar contractors provided installations.

The initial SWAP agencies were selected by DCA based on the selected agency's previous weatherization performance records, their enthusiasm in adopting and working with new technologies, and of course, their willingness to participate in this novel solar energy pilot project.

Selection was also based on geographical location. Since the majority of low-income population in Florida was determined to be in Central and South Florida, with a smaller amount in North Florida, the agencies were selected accordingly. The total number of system installations was also guided by this criterion. The majority of systems were installed in Central and South Florida.

1.10 SITE SELECTION CRITERIA

Income qualification criteria followed that established by the standard Weatherization Assistance Program. Technical criteria were developed by FSEC for the local agencies to select SWAP participating residences:

1. The residence had to be located in one of the selected counties in the three climate zones in Florida as defined by Florida WAP and the Florida Energy Code.

2. At least three people had to be living in the residence. The occupants had to meet WAP program income requirements. Recently completed weatherized housing was acceptable for inclusion in the monitoring program.



Figure 1.10-1. South Florida system installation at the Matos' residence. The solar system serves both Mr. and Mrs. Matos', as well as their two children. In the summer, they have learned to keep the water heater electricity off and allow the solar system to heat all the water.

Solar access had to be suitable to provide uninterrupted winter and summer season solar radiation at the potential collector mounting location between approximately 9 AM and 4 PM. There was to be no shading from trees, bushes, and fences (if the collector was ground mounted), etc., on the collector during this time period.

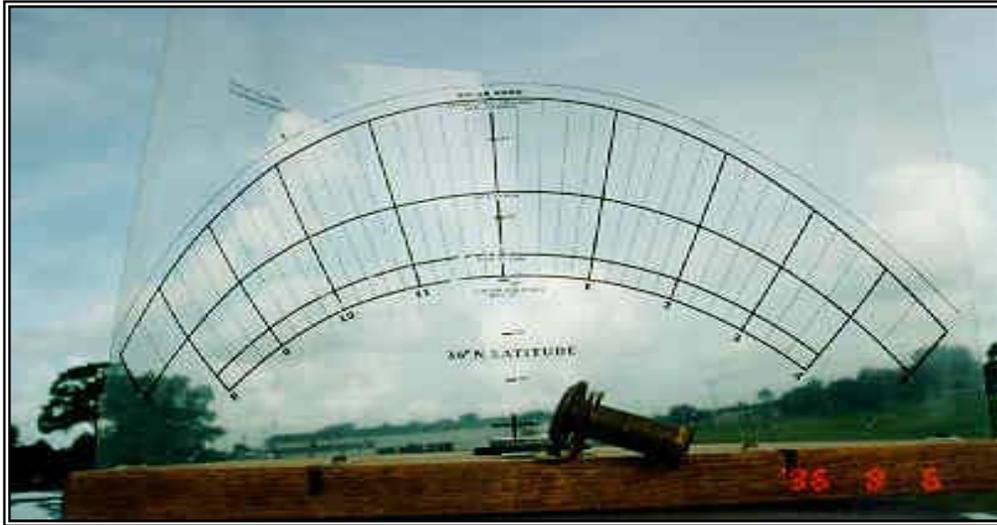


Figure 1.10-2. Solar site locator indicating that shade will not be a problem at this site.

4. In accordance with WAP requirements, the residence had to be a single-family detached structure. Mobile homes were not allowed due to WAP requirements.



Figure 1.10-3. ICS on single-family detached residence.

5. The occupants' potable water had to initially be heated with electricity. This is the most common type of water heating system in Florida, so it is more representative of the majority of the population.
6. The house was to be owner-occupied.
7. The house and collector mounting location had to be such that the probability of vandalism to the solar collector was low

