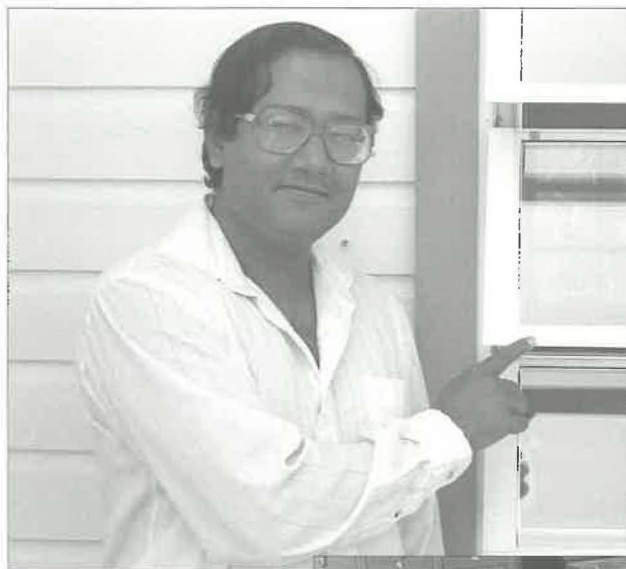


People of the Buildings Program

The buildings program achieved a very high level of success in the '80s, in large part because of the staff members who were hired to support its research agenda. The following section recognizes these talented individuals, who are some of FSEC's outstanding researchers. Apologies are offered to any who might be missed.

- *Dr. Subrato Chandra – Subrato was originally hired to support the solar program on July 19, 1976. In 1980, he began developing the buildings research program. In 1983, he became Acting Director of the R&D Division, which then included buildings, photovoltaics, solar water heating systems and advanced technologies. By 1986, the buildings program had grown to a size that warranted a separate division. Photovoltaics, solar water heating systems and advanced technologies research programs were separated from R&D, and Subrato was made R&D Division Director. He served in that position until August 2001. On the research side, Subrato is best known for his longtime leadership of the EEIH program. He also received FSEC's first, large buildings research contract – the DOE-funded ventilation study.*



Subrato Chandra (April 1987)



Philip Fairey (March 1988)

- *Philip Fairey– Philip was the key individual in the development of the building's research program and has maintained that leadership role. Hired on February 15, 1980, Philip was named Deputy Director on August 9, 1990. From November 2002 through the winter of 2004, he served as Interim Center Director. Philip has played a dominant role in*

most FSEC activities. He designed the PCL and was principal investigator in many of the Center's original DOE - and State-funded projects. He also set policy and planning for all of the Center's activities, often working way beyond the call of duty. Throughout his FSEC career, Philip has always placed the Center and its programs first.

- *Dr. Ross McCluney – Ross was one of the Center's first employees, hired on April 16, 1976. He began the daylighting program in the early '80s, and daylighting has continued to be the focus of his research.*



Ross McCluney at Daylighting Laboratory (April 1987)



Charlie Cromer (May 1985)

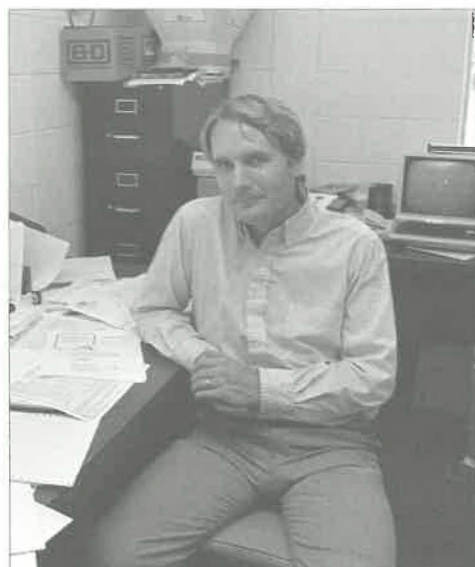
- *Dr. Charlie Cromer – When he was hired on February 1, 1980 Charlie began his tenure as the Center's expert in solar water and pool heating systems. His work is still the industry standard today. In the building's area, Charlie developed the ALT center and its programs by gaining the interest and support of Bill Davis of FPLr– work that continues today. Charlie received his Ph.D. from FIT while working at FSEC in May 2000, and he was appointed Interim PV&AT Division Director after Jerry Ventre's retirement in October 2003.*



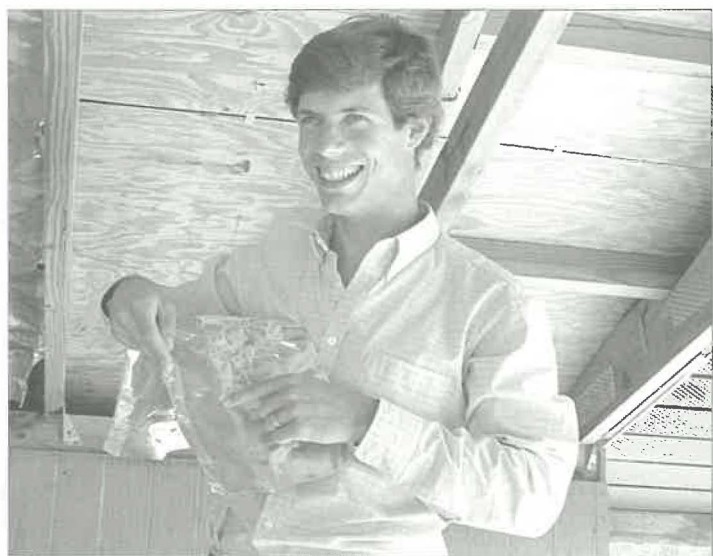
David Beal at Passive Cooling Lab (March 1985)

- *David Beal – A longtime buildings research specialist, David was hired on September 27, 1981. David has been involved in field and laboratory experiments and has worked extensively on the EEIH project.*

- *Jim Cummings – Jim came to FSEC on May 17, 1985, bringing with him expertise in solar thermal technologies. At FSEC, his work shifted to the buildings area. Jim initiated FSEC research on duct leakage and has led this program effort over the years.*



Jim Cummings (July 1986)



Rob Vieira in Passive Cooling Lab (May 1985)

- *Robin Vieira – Rob is a critical buildings researcher who has conducted countless programs. He was hired on September 19, 1983, and was named Buildings Division Director on August 24, 2001.*

- *Dr. Carol Emrich – Carol, who was hired on February 21, 1986, began her work at FSEC in daylighting research. She has also worked in solar water heating, the ACTS satellite project and photovoltaics. She received her Ph.D. from FIT while working at FSEC in May 1999 and retired from FSEC in April 2004.*



Carol Emrich (March 1986)



Muthusamy Swami (March 1989)

- *Dr. Muthusamy Swami – Swami leads the building's area computational efforts. He was hired on January 23, 1987, and received his Ph.D. from FIT while at FSEC in March 1991.*



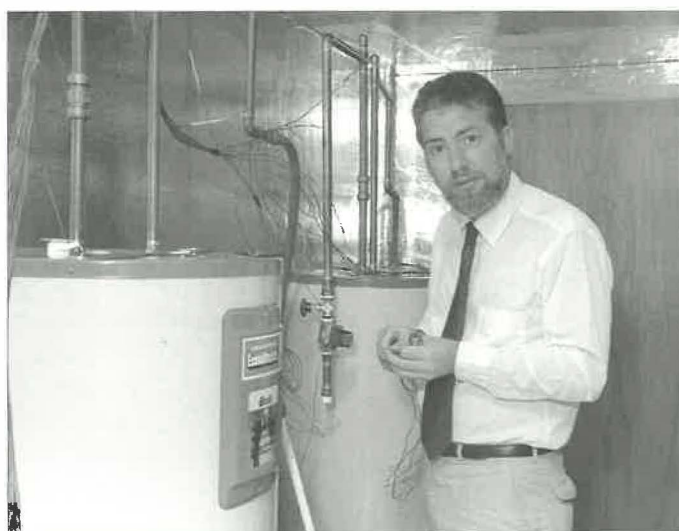
Lixing Gu (February 1998)

- *Dr. Lixing Gu – Gu has also been key in the buildings-related computational efforts. He was hired on April 3, 1988, and also received his Ph.D. from FIT while working at FSEC in December 1991.*

- *Don Shirey – Don came to FSEC on February 1, 1988, after graduating from the University of Illinois. One of FSEC's most productive researchers, he has led the research in heat pipes and air-conditioning systems*



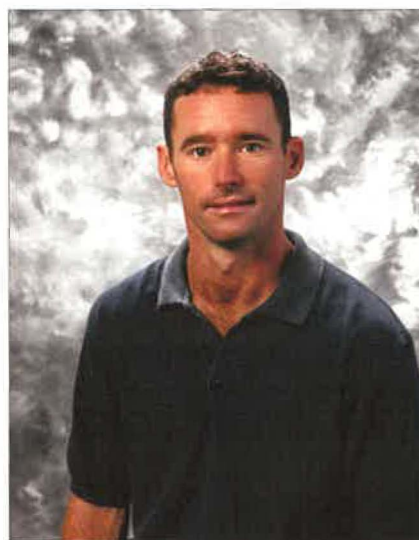
Don Shirey on SunDay (April 1988)



Danny Parker (March 1989)

- *Danny Parker – Danny has proved to be one of the Center's most productive individuals in all areas of buildings research. Hired on March 18, 1988, he originally worked at the ALT facility. His Gossamer Wind ceiling fan, sold by Home Depot, is the most successful of FSEC and UCF patents.*

- *John Sherwin – John is a long-time building researcher who has been key to field experiments. He was hired on December 22, 1989.*



John Sherwin (August 1999)



Carlos Colon (August 1999)

- *Carlos Colon – Carlos began work at FSEC on December 22, 1989. He has worked on a variety of projects and is recognized for his work on monitoring of solar water heating systems in New York.*



Richard Raustad (August 1999)

- *Richard Raustad – Rich began work at FSEC as a student assistant in March 1987. Hired as a research engineer on February 16, 1990, Rich is known for his experimental capabilities and his work in the air-conditioning systems area.*



Mable Flumm (February 1988)

- *Mable Flumm – Mabel is the longtime office manager for the Buildings Research Division. She was hired on March 6, 1984.*



Wanda Dutton (October 1986)

- *Wanda Dutton – Wanda is also a longtime office manager in the Buildings Research Division and was hired on April 19, 1985.*



Andy Pesce working on PV pump for solar water heating (February 1988)

- *Andy Pesce – Andy is a long-term FSEC employee who was hired on June 26, 1987. He has worked with Charlie Cromer at the ALT center and in the PV program.*

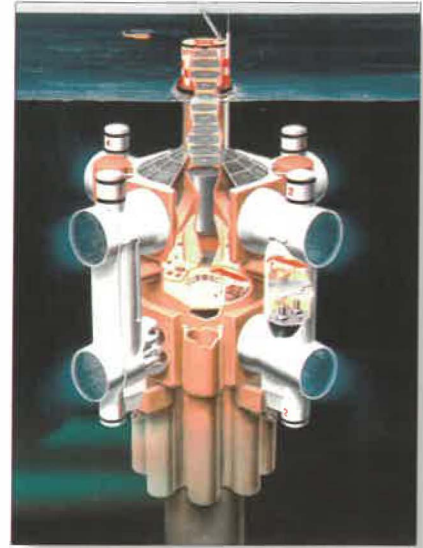
In closing, the buildings program has been one of FSEC's most successful efforts. It is one of the prime reasons FSEC has attained its outstanding level of national recognition.

Ocean Thermal Energy Conversion

While FSEC's first annual report mentioned Ocean Thermal Energy Conversion (OTEC) in 1976, FSEC's OTEC program didn't begin until the early '80s, when the technology gained DOE support. Because Florida and Hawaii were the only two states where OTEC could be deployed, the states formed a natural research partnership. Through FSEC's Louis Rotundo, the Center gained a partner and staunch supporter in Dr. Patrick Takahashi of the University of

perature difference between the warm ocean surface water and the colder deep water at approximately 1,000 meters.

The OTEC concept was first demonstrated in Cuba in the 1920s; however, it was 1980 before federal legislation called for the creation of an OTEC industry. Public Law 96-310 – sponsored by Congressman Don Fuqua (Florida, retired) and Senator Spark Matsunaga (Hawaii, deceased) and Public Law 96-320 called for OTEC plants capable of delivering 10,000 megawatts of electric power by 1999 – a goal that was not achieved.



OTEC Concept – Lockheed



Louis Rotundo (November 1982)

Hawaii. Rotundo's later federal outreach efforts also created partnerships in the areas of hydrogen and energy-efficient industrialized housing.

The OTEC technology process offers a renewable base load and environmentally benign power source. The principle is simple, it employs a heat engine to produce power by using the tem-

When DOE issued a Program Opportunity Notice to design, construct and operate a pilot OTEC plant, Florida responded in 1981 with the Florida Ocean Thermal Energy Consortium, Inc. (FOTEC). FOTEC was a not-for-profit corporation created to pursue the state's interest. Its members included state agencies, educational institutions, electric

power coordinating groups, City Electric System of Key West and TRW, Inc. Rotundo was FSEC's representative. TRW developed and wrote the pilot plant proposal, which described a 40-megawatt electric generating power plant to be moored in the Florida Straits approximately 30 nautical miles south of Key West.

During the initial phases, FSEC was to act on behalf of FOTEC as the project's program manager and fiscal agent. The proposal was planned in six phases; however, the concept was never funded, and FOTEC ceased to exist.

FSEC's next OTEC activity was in the area of open-cycle ocean thermal energy conversion (OC-OTEC). An OC-OTEC plant produces electricity with conventional steam-powered turbines and generators. However, it produces the steam through a method that exposes the ocean's sun-warmed tropical surface waters in a vacuum, which then turns the water into steam to power the turbine. In an open-cycle plant, the spent steam yields fresh water when exposed to a condenser cooled by cold water from deep ocean levels.

OC-OTEC held great potential, especially for island communities, where generating electricity is difficult and expensive, and where fresh water must be imported at significant cost. OC-OTEC plants could provide both beneficial byproducts, which gave it significant cost advantages. By the mid '80s, DOE had spent considerable effort on closed-cycle OTEC. The open-cycle concept provided DOE a sound reason for supporting more OTEC research – a rationale required by the Reagan administration.

FSEC began its OC-OTEC work when SERI funded the Center and Creare, Inc., of Hanover, New Hampshire, to conduct a year-long analytical investigation. The project's objectives were to assess the economic and technical viability of the concept; to develop a conceptual OTEC plant design; and to identify remaining research issues.

The FSEC team, led by Louis Rotundo, evaluated data on the potential for OTEC power plants on six Caribbean island sites and developed generic site characteristics. The generic site needed a 20°C water temperature differential between the surface and 1,000 meter depth, occurring five km or less from shore. The sites were then evaluated for current and projected utility prices, and requirements for electricity and fresh water. [Reference 50]

The Creare OC-OTEC team focused on shallow-water and land-based plants, analyzing five plant configurations. Capital costs were obtained for each of the five configurations given a range of freshwater and electricity output levels. Analysis showed that plant costs would be most sensitive to turbine and generator efficiencies and to the effectiveness of flash evaporators. Cost of the cold-water pipe was the major parameter influencing overall plant costs. The final output was a conceptual design for a 10 MWe shallow-water, or land-based, single-stage OC-OTEC plant. [Reference 51]

FSEC's next OTEC activity was to evaluate a number of Florida sites as possible locations for a large-scale OTEC research facility. Jim Huggins led this SERI-funded activity. Huggins evaluated numerous Florida sites that were already using deep-well sewerage injection as a possible OTEC research site location. These deep wells in Florida offered a unique opportunity



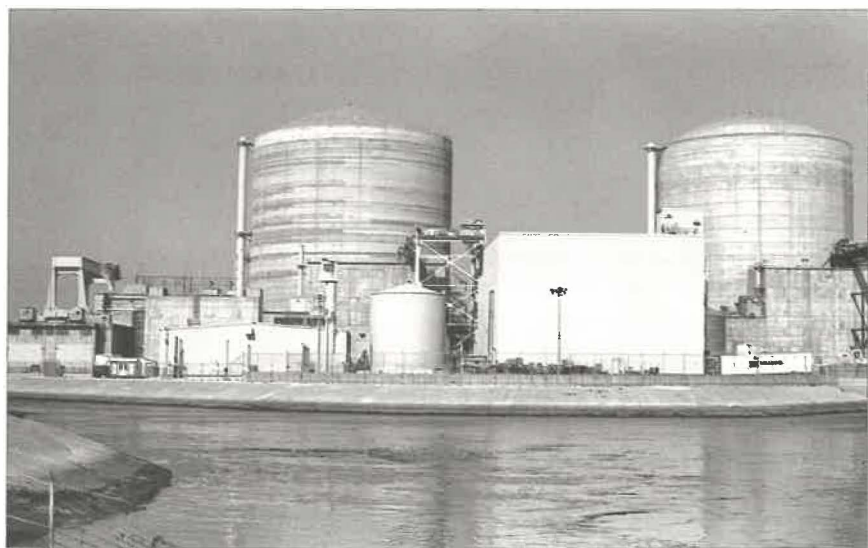
OTEC Concept – Creare R&D Inc.

because temperatures at the surface and bottom of the deep well provided the 20°C differential temperature needed for OTEC. Huggins determined the only inactive Florida site with any potential was an abandoned well located in the Keys at Marathon. The Marathon site was finally determined to be unavailable for use. The project then considered potential sites in the Virgin Islands and Puerto Rico. A report was prepared for DOE, but the project went no further. [Reference 52]

At this point, the OTEC program in DOE began to have funding problems, which led DOE to fund activities only in Hawaii, where the state's Sea Coast Test Facility housed the only OC-OTEC pilot facility. While this pilot facility was built and operated, the OTEC effort never resulted in a unit that could be scaled to a size that would persuade electric utilities to accept the technology. The questions of OTEC plant operation and maintenance costs in the harsh marine environment were never resolved to a point where a utility company could be convinced to make the necessary large capital investment. So, DOE dropped the program, and FSEC's activities ended in about 1989. But the Center's OTEC activities were productive in initiating a long-term partnership with Dr. Patrick Takahashi and Hawaii, which led to FSEC's entry into very productive research in hydrogen energy.



OTEC site at Punta Tuna, Puerto Rico (February 1988)



Visit to Martin Co. FPL plant for OTEC deep well injection project (July 1985)

Hydrogen

Hydrogen energy has proven to be an area of great importance to FSEC. In fact, Howard Harrenstien first envisioned FSEC work on hydrogen from the Center's very beginnings in 1975. However, hydrogen activities did not begin in earnest at FSEC until 1983.

FSEC and Florida leadership see many compelling reasons for hydrogen research and development. Hydrogen

- Allows solar energy to be used as a transportation fuel
- Provides a storage medium for solar energy
- Offers a non-fossil-based fuel for the future
- Can be produced locally.

Hydrogen research began at FSEC in 1983, when NASA/Kennedy Space Center (KSC) funded the Center to assess hydrogen production using a photovoltaic-powered electrolyzer – an R&D effort still of interest to the hydrogen community today. Omar Hancock, who had been the Center's solar air-conditioning expert, led the project.

Writing at the start of the project, Hancock stated, "Hydrogen is a near-perfect fuel – it burns cleanly in the air, producing only heat, water and small amounts of nitrogen oxides as by-products; it has about three times the energy content of gasoline per unit weight/mass; it's light weight and

condensable to a small volume; and it can be stored and used when needed."

"It takes energy to produce hydrogen," Hancock noted. "Most methods of breaking down compounds to free hydrogen use massive amounts of scarce fossil fuels. Our continuing research on photovoltaics justified investigating its use for hydrogen production. Although abundant, hydrogen is always found in chemical combination with other elements, the most common being water. Passing an electric current through water splits it into its two component elements, a process called electrolysis."

Based on FSEC's experience with photovoltaics, NASA/KSC provided funding for the experimental evaluation of hydrogen production through electrolysis powered by photovoltaics. The electrolyzer was a first-generation model manufactured by Teledyne Energy Systems and supplied to FSEC with the help of Mr. Bill Kincaide. The electrolyzer operated at internal gas pressures from 0 to 40 psig and was powered by a 1-kWp PV array. Experimental results showed that the energy efficiency of the electrolyzer varied from 63 to 73 percent. It closely followed the peak power points of the PV array. During 15 days of operation, the array and electrolyzer configuration produced hydrogen with a total energy content of 101,600 Btu. Researchers found that the near-term economic outlook for

such a system was not favorable, but calculations showed that the long-term outlook was encouraging. [Reference 53] Hancock also helped install a similar photovoltaic-powered electrolyzer at Brookhaven National Laboratory in New York.

With its established activities in hydrogen research, FSEC was chosen in 1985 to host the Second International Symposium on Hydrogen Produced from Renewable Energy in Cocoa Beach. Organized by Hancock, this symposium brought visitors from around the world to meet and share research findings.

In 1985, DOE funded FSEC and the Hawaii Natural Energy Institute (HNEI) jointly to assess the state of hydrogen technology and determine research priorities. This initiated a stream of cooperative hydrogen activities between FSEC and HNEI. FSEC took the lead in investigating power applications and, in the following year, completed an assessment of four major aspects of hydrogen energy systems: production, storage, utilization and transition. Omar Hancock and HNEI's Sid Browne were principal investigators.

Following the completion of the techno-economic assessment in 1986, FSEC made a significant push for further hydrogen work by hiring hydrogen researchers Subhash Dutta and Ali Raissi. In 1987, Dutta and Raissi led a major hydrogen effort funded by DOE through SERI. The study's

objectives were to develop base-case economics for hydrogen production; to identify improvements in liquefaction technologies; and to investigate advanced utilization systems. The results presented a detailed technical and economic assessment for various hydrogen production technologies, identified potential liquefaction technology improvements and reviewed metal hydride storage. The study also investigated advanced concepts of hydrogen power systems. Many of the findings of this very thorough technology assessment are still valid today.

As a side note, the metal hydride storage work for SERI was done by Dr. Ron Barile of FIT and Dr. Clyde Parrish, who worked for FSEC at the time. Barile is now employed by Arctic Slope Corporation at KSC and Parrish is now employed by NASA/KSC. Clyde oversees FSEC's NASA-funded hydrogen activities. [Reference 55]



1985 Hydrogen Conference – attendees visit KSC



Hydrogen Conference visit to KSC. Wally Boggs (center) explaining shuttle to David Block (October 1985)



Subhash Dutta and Ali Raissi (December 1988)

After the completion of SERI-funded study, Dutta left FSEC in November 1989. In 1988, Kirk Collier was hired to head the PV and hydrogen groups at FSEC.

In early 1989, Center administration and staff recognized the need for laboratory work to advance FSEC's hydrogen research abilities. The Center's hydrogen lab was completed that year, located in one of the trailers at the ALT site. Ali Raissi was the key individual in establishing the lab, which led to continuing hydrogen research. Initial Hydrogen Lab experiments involved photo-electrochemical (PEC) hydrogen production and the investigation of innovative hydrogen storage techniques.

At the close of the '80s and in the early '90s, FSEC's hydrogen production research activities included PEC processes using semiconductors, photovoltaic-powered electrolysis and hybrid electrolysis/thermo-chemical

systems. Some of the earlier experiments employed a solar simulator and a combination of hydrogen sulfide (a model compound for water) and cadmium sulfide as a band gap photocatalyst to produce hydrogen.

Hydrogen storage, another important area of work, presents significant research challenges. Methods exist to store hydrogen in various forms – as a liquid or gas, in activated carbon, and

in chemical combination – but each method requires special materials and handling. FSEC's earlier investigations centered on catalytically prepared magnesium hydrides. The goal was to cost-effectively produce a compound that can contain a significant amount of hydrogen with a high energy density and that then can release the hydrogen as a fuel at moderate temperatures. In 2005, hydrogen storage is still the key to a hydrogen economy and is rated the number one technical challenge by DOE.

Because of the significance of hydrogen research and the DOE-funded activities, FSEC built a very capable research staff during the late '80s and early '90s. This staff – all of whom are still involved in the hydrogen program at FSEC – includes the following individuals.



Darlene Slattery at Hydrogen Lab dedication (August 1989)

- *Dr. Ali Raissi – Ali joined FSEC's hydrogen program in November 1987. He had previously worked on hydrogen during his post-doctoral research and as a member of the Hawaii Natural Energy Institute. Ali's outstanding work at FSEC helped initiate the DOE-funded program, and he was instrumental in developing the research topics for the NASA hydrogen program. He has worked on every aspect of hydrogen technologies and also initiated the detoxification program funded by the U.S. Navy. Ali has more than 10 patents and was named the Hydrogen R&D Division Director when it was created in July 2002.*



Ali Raissi (April 1988)

- *Dr. Darlene Slattery – Darlene is a long-time hydrogen researcher with expertise in hydrogen storage compounds. She began work at FSEC in December 1989 after graduating with a degree in chemistry from UCF. She continued her education while employed and received her Ph.D. from FIT in December 1999.*

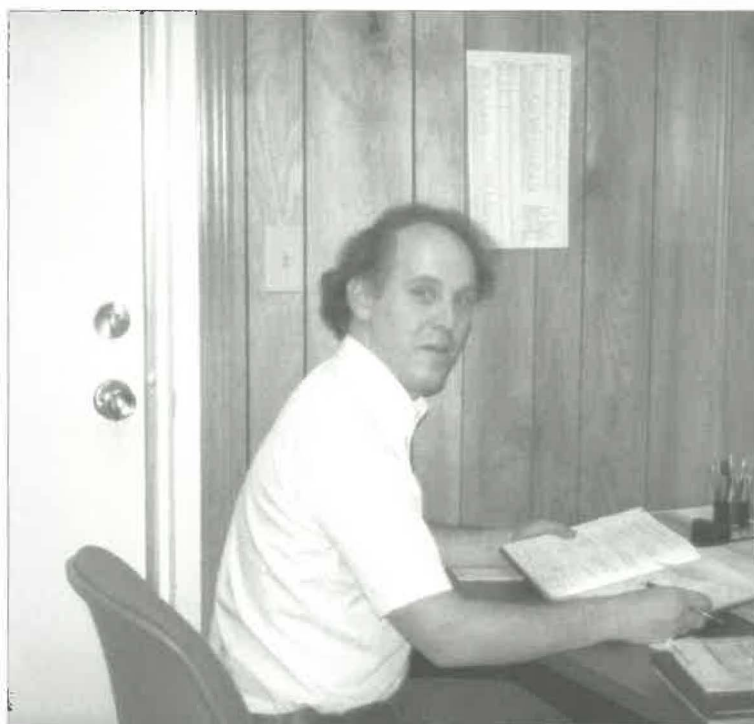


Darlene Slattery in lab (October 1997)



Nazim Muradov (April 1996)

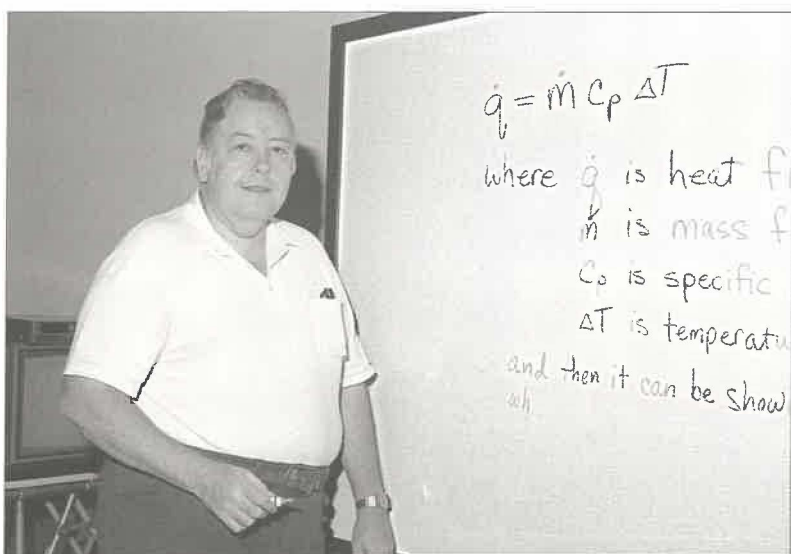
- *Dr. Nazim Muradov – Nazim came to FSEC from Azerbaijan (then a part of the USSR) in November of 1991. Nazim was the first at FSEC to receive a patent, and his patent for applying semiconductors to any surface has been used in many of FSEC's research programs in both the hydrogen and detoxification areas. His present work involves producing hydrogen without CO₂ emissions. This work is highly regarded by DOE and NASA.*



Clovis Linkous (August 1991)

- *Dr. Clovis Linkous – Clovis came to FSEC in June 1990 from Brookhaven National Laboratory where he had worked on hydrogen. His work has covered all aspects of hydrogen technology. Clovis also has many patents, and his main activity has been on the production of hydrogen from photoelectrochemical processes.*

- *Omar Hancock*— Last, but certainly not least, when discussing hydrogen research at FSEC, one must name Omar Hancock. One of the original five FSEC employees in 1975, Omar was the key individual in the design and engineering of many original solar projects. He led in the area of solar water heating and air conditioning, and his versatility drew him to work on PV. That resulted in his design and testing of the first solar hydrogen production unit combining photovoltaics with an electrolyzer in 1983. This outstanding engineer retired from FSEC in December 1989.



Omar Hancock (April 1986)

Solar Thermal Programs - Testing and Operations Division

During the '80s, the state of Florida firmly supported the solar hot water (SHW) industry and FSEC programs. In fact, the '80s marked the most significant advances and changes in SHW technology development. Nevertheless, the solar hot water industry suffered a huge setback in the mid-'80s when Congress failed to re-enact the federal solar tax credits. The tax credits lapsed in December 1985, causing a monumental drop in sales and installations throughout the U.S., from which the solar thermal industry has never fully recovered. However, solar water heating development at FSEC maintained its momentum and, during the '80s, the program produced significant

results that remain national standards today. In this decade, FSEC led the way in collector testing, systems development, solar in schools, training and education, contractor licensing, interstate coordination and solar desalination.



Outdoor solar thermal display (January 1983)



Jim Huggins explains solar collector testing to SunDay audience (May 1982)



Allan Garnett calibrates solar testing instrument (February 1987)

Solar Collector Testing

Through collector testing programs, solar collector design and resulting performance had significantly improved by the early '80s. The FSEC testing and certification program showed proof of these improvements through performance ratings that were calculated for each certified collector. Ratings for 500 collectors tested between 1977 and 1982 showed that the average domestic hot water collector rating increased by 39 percent – from 609 Btu per square foot of collector area in 1977 to 848 Btu per square foot in 1982.

"Solar equipment available to the consumer today is better designed and of higher quality than it was a few years ago," said Jim Roland, Director of Testing and Operations, in 1982. "Our rigorous collector efficiency program continues to improve collector performance, and collector performance gives manufacturers a valid way of comparing the performance of their collectors with others on the market."

Solar Hot Water Systems

In early 1982, FSEC's Tim Merrigan, Charlie Cromer and Tom Tiedemann began fundamental research on solar hot water systems. The results of these fundamental research activities are still valid and used by industry today.

Tim Merrigan's work involved a year-long study that monitored time-of-day performance of 80 different types of water heaters in homes in four cities throughout the state – 20 systems each in Miami, Tampa, Orlando and Jacksonville. The study included four types of systems – conventional electric, dedicated heat pump, waste heat recovery from air conditioning and solar. With funding from the Florida Public Service Commission, the study resulted in a full year of monitored data for all 80 systems operating in conventional, occupied, single-family homes.

Using on-site monitoring equipment and telephone hook-ups between the equipment and the FSEC computer, Merrigan gathered data on how much electrical energy was used, what time of day the energy was used, and how much energy was delivered by each of the four types of systems.

Merrigan's measured data showed a coefficient of performance (COP) of 2.5 for solar, 1.5 for heat pump systems, 1.1 for waste heat recovery units, and 0.8 for conventional electric systems. His time-of-day data

showed that solar water heating systems could substantially reduce electrical demand during summer and winter peak periods, with the winter peak for solar occurring at approximately 10 a.m. "With these potential benefits," Merrigan concluded, "it's in the utility's interest to promote solar." [Reference 56] Merrigan later conducted a similar project for the state of New York.

Charlie Cromer also undertook solar hot water systems research in 1983 in FSEC's solar hot water systems test laboratory. In the lab, Cromer installed six solar water heating systems, each with the same collector and piping length, but each with a different circulation strategy.

By operating the systems as they would be operated in the home, but under controlled

conditions, Cromer's experiments determined which pumps and pump controllers provided the best energy output in active systems. The tests also provided a clear understanding of temperature stratification in solar hot water storage tanks. Cromer's experiments also studied both thermosiphon and pumped systems and compared their system performance.

Cromer's results showed that the best control strategy combines the use of a PV-powered circulating pump and that maintaining storage tank stratification is critical for maximum SHW performance. In other experiments, Cromer helped the industry improve freeze protection of solar water heating installations by demonstrating the best locations for freeze sensors. [Reference 57]

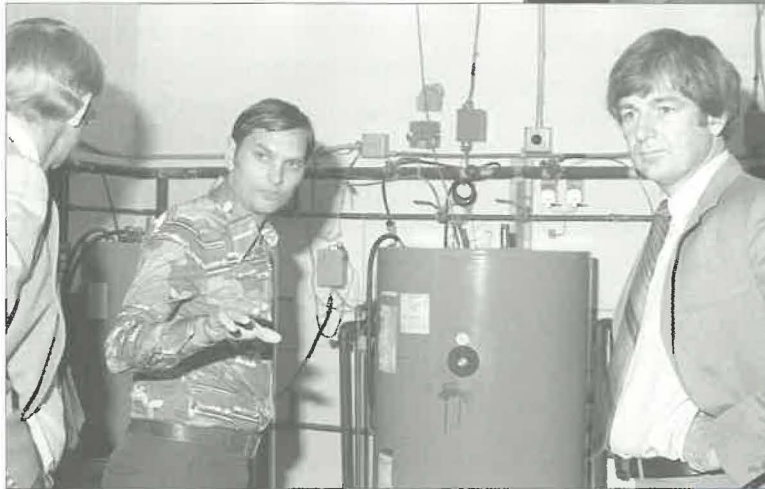


Tim Merrigan (January 1980)

In work somewhat similar to Cromer's, Tom Tiedemann studied four solar water heating systems, each with the same collector, but each with different storage tank configurations. His study compared a variety of double tanks and associated plumbing configurations with a single-tank configuration. [Reference 58]



Tim Merrigan in Solar Hot Water Lab



Dave Block, Charlie Cromer and Dr. Jay Hakes, Governor's Energy Office Director, at FSEC Solar Hot Water Heating Lab (November 1981)



Charlie Cromer at Solar Hot Water System Lab



Solar Hot Water System Lab



Outside Solar Hot Water test facilities



Inside Solar Hot Water test facilities



Charlie Cromer inside Solar Hot Water test facilities



Tom Tiedemann's Solar Hot Water tests for storage tank configurations



Solar Hot Water test facilities

Solar in Schools

FSEC's Solar in Schools Project began in 1983 with funding from the Florida Department of Education and the Governor's Energy Office. The project was initiated as a result of a 1982

the Department of Education. In addition, the Florida Governor's Energy Office supported a series of FSEC-conducted workshops in 1983 and 1984 to teach large solar water heating system design principles to architects and engineers who design schools.

school districts by 1986, with no accurate accounting of exactly how many systems existed or how these systems operated.

In early 1987, the Governor's Energy Office again funded FSEC to locate as many of these systems as possible and evaluate the installations. Engineers then visited and inspected systems throughout the state and documented many common design, installation and operation problems. They found that even some well-designed systems had fallen into disrepair for lack of maintenance. To help correct existing problems and to keep the new systems in good working order, FSEC developed a generic operations and maintenance manual for school personnel. Finally, the Governor's Energy Office provided funding that allowed FSEC to subcontract for the repair of existing school systems. Jim Huggins and Tom Tiedemann led this project, with critical input from Marvin Yarosh. [Reference 59]



Tom Tiedemann and Jim Huggins collect school data (March 1984)

state law requiring that schools using more than 1,000 gallons of hot water per day consider the use of solar energy to heat the water. The project's main goals were to ensure that solar systems were considered for use on schools and that the systems were properly designed, installed, operated and maintained.

To start the program, FSEC engineers inspected more than 50 existing solar systems at schools throughout the state and evaluated more than 25 solar system designs for new public schools.

By 1983, FSEC engineers recognized that the larger systems on schools have very different design requirements. Subsequently, they offered to review all the solar designs for the Office of Educational Facilities of

By late 1985, FSEC engineers formally began to review new school drawings and specifications prior to final design and construction. Despite these efforts, numerous systems had been installed across Florida's 67



Marvin Yarosh and Martin Rauber, Visiting Researcher from Switzerland (April 1983)

Solar Training and Education Project

In the mid '80s, FSEC undertook a project to increase solar water heating knowledge by the public, as well as industry members. With materials funding from Florida Power & Light Company, FSEC staff designed and constructed the Solar Training and Education Project (STEP). The STEP facility consisted of six roof structures, each equipped with a complete but different solar water heating system. Each system included collector, tank, controls and all other necessary components. The STEP facility was used for solar water installation courses and was a showcase for all Center visitors to learn about solar water heating installations.



STEP Project



Dedication of STEP Project – David Block, Marvin Yarosh and Senator John Vogt (1985)



John Harrison, Bruce Holbaugh and Colleen Kettles at STEP Facility (January 1988)

Solar Contractor Licensing

By the '80s, it became obvious that, for the solar industry to achieve credibility and offer good service, it was critical that solar water heating installers be licensed contractors. After 10 months of deliberation and



John Fix at Policy Advisory Board meeting with David Block (October 1986)

numerous public hearings, the Florida Construction Industry Licensing Board in 1981 adopted a rule establishing the Residential Solar Water Heating Specialty Contractor License. The license required successful completion of an examination and fulfillment of established experience and training requirements. Florida Construction Industry Licensing Board member John Fix spearheaded this first crucial step toward a comprehensive regulatory framework for solar installations. John joined the FSEC Policy Advisory Board in October 1981 and is still an active member of the Board. [Reference 60]

Interstate Solar Coordination Council

FSEC administration played a lead role in creation of the Interstate Solar Coordination Council (ISCC) in 1980. At the time, Florida had a solar collector certification and solar system

approval program, and California had a collector rating and certification program, as did the Solar Energy Industries Association (SEIA) and the Air Conditioning and Refrigeration Institute (ARI). However, none of the programs were equal to, or accepted by, the others. This lack of reciprocity meant that solar equipment manufacturers had a maze of requirements to satisfy if they wanted to carry on an interstate or national marketing program. One centralized certification was desperately needed.



ISCC meeting at FSEC (January 1980)

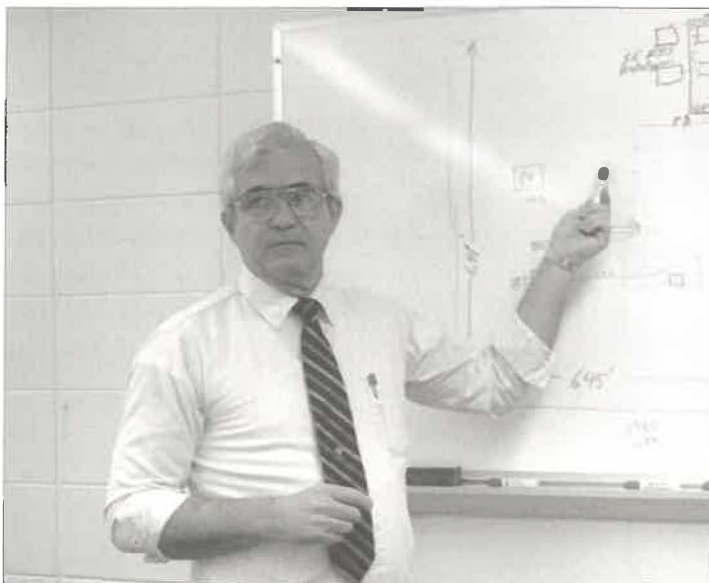


ISCC Conference: Jim Roland, David Block, Ron Doctor and Greg Shuckman (September 1982)

With the support of a 1979 DOE grant, five state government representatives formed the ISCC in January 1980. Their goal was to develop national mechanisms that would lead to uniformity among the many emerging private and state-level solar collector testing and certification programs.

Organized under DOE contract with FSEC direction, ISCC grew to involve the cooperation of 37 states. David Block was the project principal investigator with Ron Doctor of the California Energy Commission as co-principal investigator.

To initiate centralized certification, Jim Roland of Florida and Dale Trenchel of California devised a process that combined the Florida and California programs into one program acceptable to both states. All ISCC state parties then reviewed and agreed on the program that blended the Florida and California programs. Finally, in April of 1980, ISCC and SEIA agreed to the uniform standards and developed a method for administering the program. The process resulted in creation of the Solar Rating and Certification Corporation (SRCC), which became the program manager. Under FSEC management, SRCC still operates today as the national organization for solar collector certification. The ISCC also exists today under the name of Interstate Renewable Energy Council (IREC). [Reference 61]



Jim Roland, ISCC Conference (January 1983)



Bob San Martin, Deputy Assistant Secretary, U.S. DOE, at first ISCC Conference, Salt Lake City (January 1983)

Solar Energy Industry

All of the activities described within the solar thermal program – testing, certification, licensing and research – were directly related to the goal of creating a strong solar energy industry for Florida. As mentioned previously, FSEC helped to organize the Florida Solar Energy Industry



Scott Sklar (2004)

Association (FlaSEIA) in 1976 and has had a representative on the FlaSEIA Board of Directors since its inception.

The other major industry activity has been the long-time association of FSEC with the national Solar Energy Industries Association (SEIA) in Washington, D.C. This strong collaboration began in the early '80's with the ISCC collector certification program and with SEIA's request for assistance when the industry recognized the solar tax credits were going to expire. Since that time, FSEC has worked with SEIA on a great variety of industry pro-

grams and has supplied support to industry initiatives. Recognition is given to Scott Sklar, the long time executive director of SEIA, for his help in initiating these cooperative activities and for his support of FSEC to Congress and to DOE over the years and continuing today.

Solar Desalination

The ever increasing global need for fresh water makes solar desalination processes important technological options. Recognizing the need to explore these options, FSEC's David Block and Jim Huggins began a solar desalination technology assessment in 1989 and continued the work into the '90s. The assessment examined solar power for simple distillation, multi-effect or multi-stage flash distillation, freeze separation, electrodialysis and reverse osmosis. It concentrated on experimental results and included an extensive review of world literature. The assessment revealed that very little research had been conducted on solar to power these technologies during the last decade. It also showed that the lack of good experimental data and high production costs remain barriers to the technology's widespread use. [Reference 62]

To address issues identified in this study, FSEC focused a solar desalination research effort on two technologies – a solar still and photovoltaic-powered reverse osmosis. Under Jim Huggins' direction, staff installed

three simple solar stills at FSEC in August 1989. "Simple" describes the most basic design of a solar still with no enhancements. A simple still consists of an evaporating pan covered by a sheet of clear glass that is tilted so that the fresh water that condenses on its underside will trickle down to a collecting trough. Investigators evaluated the stills' performance by measuring daily freshwater production, ambient insolation and air temperature. Results provided basic performance parameters for a simple still in Florida. They showed that a still would produce about 0.1 gallon of water per square foot of still area per day. [Reference 63]

David Block began the reverse osmosis technology study with construction of a small PV-powered reverse osmosis unit at FSEC. This project led to installation of a PV-powered reverse osmosis project at St. Lucie Inlet Preserve State Park. While that project occurred in the '90s, it is presented here for continuity.

St. Lucie Inlet Preserve State Park is located on an island between the Indian River and the Atlantic Ocean. It provides no water or electricity for the park's rangers or for its 600 weekly visitors. Because the park is an important wildlife preserve, the project needed to have minimal impact on the environment. In 1994, FSEC completed design and installation of the first public project demonstration of a photovoltaic-powered reverse-osmosis water desalination system.

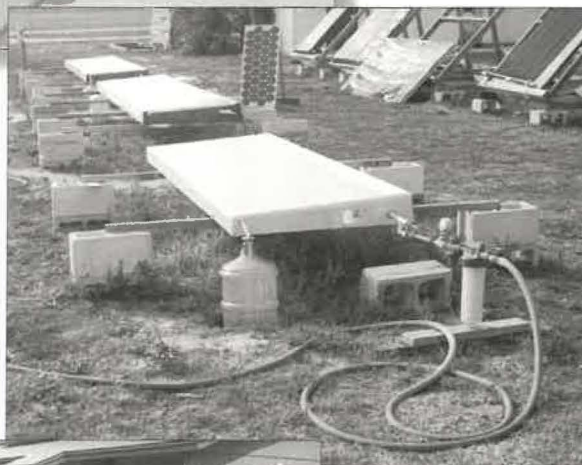
The showcase system employed a 3-kW photovoltaic array and two reverse osmosis units to produce 180 gallons of desalted water per day at the island park. Jim Dunlop designed and developed the PV power system, and Jim Huggins led work on the desalination system and the project installation. [Reference 64]

John Fix of the FSEC Policy Advisory Board accomplished a major effort in the desalination project by obtaining the state permit that allowed water production at the park. The St. Lucie State Park project ended FSEC's desalination efforts, but the technology holds the potential for future work.



Ross McCluney with water distillation system (September 1985)

Testing of three simple stills (May 1990)

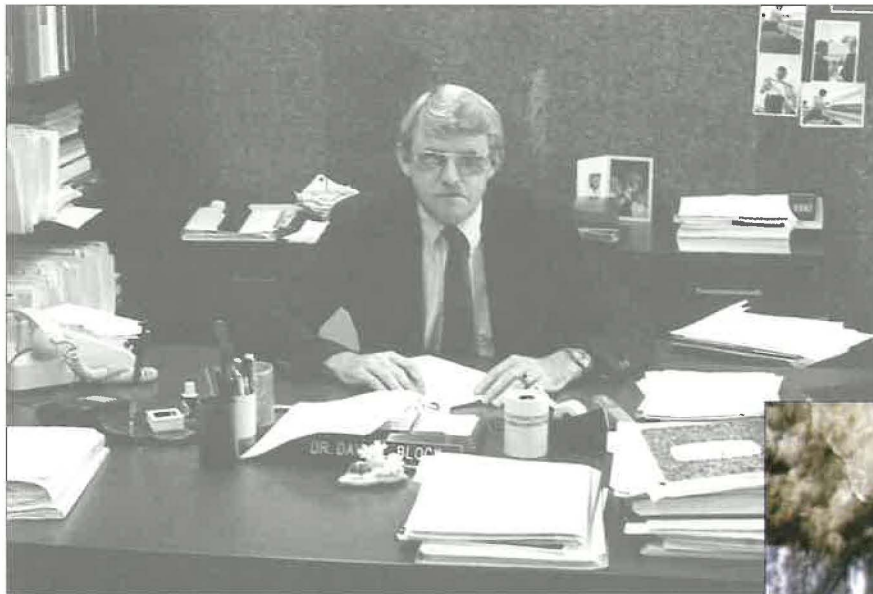


M. Keita, with small-scale PV powered reverse osmosis desalination unit (October 1990)

Solar Technology Assessment Project

The Solar Technology Assessment Project, completed in 1980, was funded in the last year of the Carter presidency. For the project, David Block directed a nationwide assessment of nine solar technologies: passive heating; active space and water heating; passive, hybrid and active

maries of their assessment papers at the Solar Technology Assessment Conference in Orlando, on January 29 and 30, 1981. The final assessments were then published as 12 volumes – one for each assessment area and one overall review by Block as project director. [Reference 65]



David Block (February 1982)

cooling; industrial process heat; photovoltaics; ocean thermal energy conversion; wind energy; heliostat systems, and biomass. He also included an assessment of the then-current status of, and prospects for, the solar industry, and state and community solar commercialization issues.

The project hired 11 experts from the U.S. to assess and then write a paper on their particular area of solar technology expertise. The group presented sum-

Biomass

In the late '70s and early '80s, FSEC undertook a technology evaluation of biomass, which did not result in further Center efforts. FSEC's Calvin Sherman spearheaded this activity by growing a crop of Cassava plants at the Cape site. The activity attracted the interest of IFAS at the University of Florida, whose purview included biomass research. For this reason, and to avoid possible competition for funding support, FSEC dropped the biomass effort and did not develop further expertise in this area. A second reason for dropping the biomass effort was FSEC's lack of technical expertise in biological sciences.



Calvin Sherman with Cassava roots (December 1979)

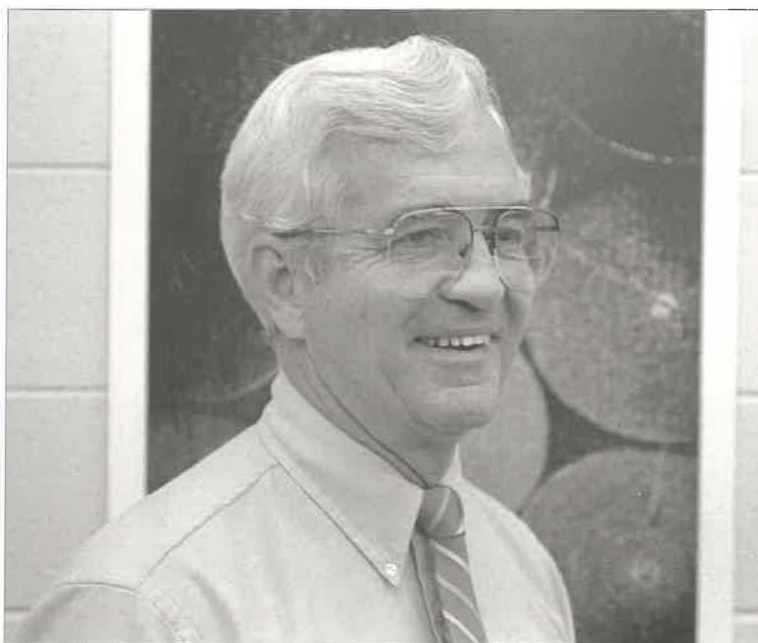
People of the Testing and Operations Division

This discussion of the solar thermal program concludes by recognizing some of the key individuals of the Testing and Operations (T & O) Division. These individuals made the solar thermal program successful in the '80s:

- *Jim Roland – Jim was one of five individuals initially hired by FSEC, beginning in 1975. He became the Testing and Operations Division Director on April 13, 1979, and held that position until his retirement from FSEC 24 years later on June 30, 2003. He provided outstanding leadership in solar thermal testing and in supervision of all physical plant activities, including the construction of and relocation to the new facilities in the mid '90s.*

Jim was also very concerned about the need to recognize the accomplishments of individuals under his supervision. This led him to develop the concept of incentives for professional development and recognition of deserving university support personnel system (USPS) employees. Under his guidance, the USPS Award has been given twice per year to outstanding USPS employees since March 1984. The selected employees' names are added to a prominently displayed per-

manent plaque, and each employee receives an individual plaque and a check for \$250. Chapter 10 presents a list of these deserving employees.



Jim Roland (July 1985)



Ruth McAllister receives first USPS Award (April 1984)

- *Jim Huggins – The other Jim in T&O started at FSEC on June 1, 1976, after graduating from the University of Texas. This loyal, dedicated employee has accomplished or performed just about every activity involved with solar water testing and systems development. Jim also did work in solar desalination and OTEC. He was appointed Interim T&O Division Director after Jim Roland's retirement on July 1, 2003.*



Jim Huggins (May 1985)



Tom Tiedemann (March 1986)

- *Tom Tiedemann – Tom was one of the original five FSEC employees hired in 1975. This long-term employee and dedicated worker devoted his entire career to the solar hot water program. He retired on March 9, 2001.*

- *John Harrison – Hired on June 16, 1980, John has been a key member of the solar thermal team. He has been involved in a great variety of SWH programs and had significant impact on the SWAP program discussed in the next chapter.*



John Harrison (April 1987)

- *Craig Maytrott – An electrical engineer hired on July 21, 1980, Craig is the individual responsible for instrumentation and measurements for the T&O Division.*



Craig Maytrott at solar simulator (April 1996)



Rodney Champagne (February 1988)

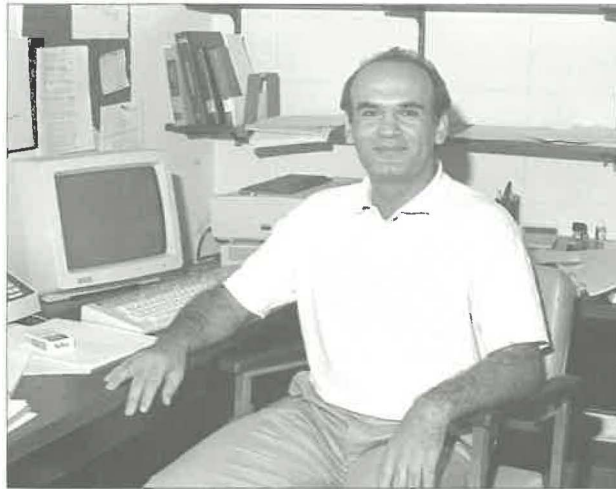
- *Rodney Champagne – Rodney was hired on September 16, 1975, and he operates the shipping and receiving area. He has been a most loyal employee.*

- *Sue Blum – Sue has provided administrative and secretarial support for the T&O Division since being hired on August 31, 1981. Sue has maintained the data files during all the years of FSEC collector testing. She's the individual to see for solar company information.*



Sue Blum (February 1988)

The Testing and Operations Division has always been the home of FSEC's computer services and technical support staff. Without these computer services and technical support staff to provide the necessary research tools, FSEC could not have accomplished its research mission. The computer services area operates under the long-term and very capable leadership of Safvat Kalaghchy.



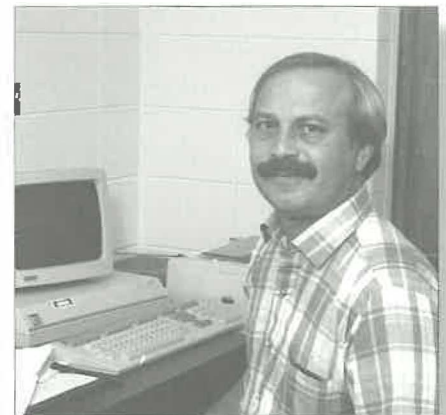
Safvat Kalaghchy (April 1986)

- *Safvat Kalaghchy – Safvat's leadership has kept FSEC at the forefront of the computer revolution. In addition, Safvat is the "father" of FSEC's unique data acquisition system, which is discussed in the next chapter. Safvat was hired as a student assistant for the PV program at FSEC on April 4, 1981. On June 13, 1986, he took the position of FSEC Computer Operations Director; a role he continues to fill in an outstanding fashion.*



Patrick Robinson (July 1988)

- *Patrick Robinson – Patrick has worked on all types of T&O activities, including drafting and collector testing. He was hired in a salary position on January 1, 1990.*



Larry Abdullah (August 1989)

- *Larry Abdullah – Another long-time employee, Larry assists Safvat in the computer center. Larry began work at FSEC on June 7, 1989.*

FSEC's technical support staff of the '80s comprised the following highly trained, very capable individuals:

- *Jay Buckholdt – FSEC's first electronics technician, Jay was hired on June 28, 1976. During Jay's tenure, he worked on almost every major FSEC project before retiring on December 31, 1998.*



Career Service award to Jay Buckholdt by Jim Roland with David Block (March 1987)



Del Whipple (June 1985)

- *Del Whipple – This long-term employee was hired as an electronics technician on June 6, 1980. Del's first retirement occurred in January 1994, and then his second in November 1998. After each retirement, FSEC has rehired Del, who is still an employee. He specializes in maintenance and operation of the telephone system.*

- *Mel Rosencrants – Mel was another long-term electronic technician in T&O. Hired on April 4, 1983. Mel worked on almost every major FSEC project at one time or another. Mel passed away in 1996.*



Mel Rosencrants (July 1983)

- *Allan Garnett – Allan is a long-term support staff member and FSEC's only staff member to serve in both Gulf wars. Allan was hired on April 19, 1981.*



Allan Garnett (March 1989)

- *Doug Matley – Doug is an air-conditioning specialist who was hired on July 22, 1985. He has assumed the role of supporting and maintaining the innovative HVAC system in FSEC's physical facilities, along with many other tasks in T&O.*



Doug Matley at Open House (December 1989)

Education and Information Division

Over the years, the Education and Information (E&I) Division has been involved in every aspect of FSEC programs through its education, training, proposal preparation, public affairs, public information, press relations and governmental liaison activities. FSEC's positive public image is a result of efforts of the E&I Division and the division's able staff. The division's Graphics Department and Library have also added a great deal to FSEC's success.

Education Programs

Education and information outreach has always been an important Center function, which continued to grow during the '80s. For example, in 1982, the education and training office offered more than 100 workshops, short courses, seminars and conferences to solar practitioners, teachers and the general public. These courses each drew an average attendance of 25 to 30 professionals and were conducted in cities and locales throughout Florida.

The Center's educational activities emphasize educating the educator and the practitioner. The division also focuses on the equally important area of disseminating information to the general public through its Library and Public Information Office.



*Ken Sheinkopf at workshop
(November 1983)*



*Paul Maycock, former DOE
PV Program Manager and PV
Newsletter Editor, at PV work-
shop (December 1983)*



*John Harrison at SW/H workshop
(July 1983)*



Jerry Ventre at PV workshop (February 1986)

People of the Education and Information Division

Jerry Ventre, who joined FSEC in December 1977, was the first Director of the Education and Information Division. Within a couple of years, Jerry became director of the R&D Division and moved the education and information activities into that division. In 1983, education and information activities moved back to a separate division that was directed by Colleen Kettles.

During the '80s and '90s, the E&I Division employed four critical staff members: Colleen Kettles, Ingrid (Melody) Norberg, Carolyn Burns and Ken Sheinkopf. These individuals, along with technical staff members, wrote many of the public information documents still in use today.



Colleen Kettles (October 1988)

- *Colleen Kettles – Colleen joined the FSEC staff after graduating from law school at the University of Florida in September 1978. She was hired to work on solar-related legal issues for the Consumer Protection Project conducted by Marvin Yarosh for DOE. When the Consumer Protection Project ended in 1981, Colleen had firmly established herself as FSEC's legal expert, with a vital role in the Center's education and information activities. Colleen was named Education and Information Division director in late 1983. She became Director of the Institutional Affairs Division in 1988, following the creation of an Office of Public Affairs under Ingrid (Melody) Norberg from 1986 to 1988. Colleen also served as FSEC's representative on the Florida Solar Energy Industries Association (FlaSEIA) Board of Directors. After serving as FSEC's FlaSEIA Board member for many years, Colleen became executive director of the organization after her resignation from FSEC in August 1993. She continues her membership on the FlaSEIA Board.*

- *Ingrid (Melody) Norberg*– Ingrid is a very creative individual who was a loyal FSEC staff member. This outstanding writer joined FSEC in August 1981. Through the years, she developed the public information and public affairs programs. Ingrid also worked very closely with the Director's Office and headed the Office of Public Affairs beginning in 1986. In 1993, Ingrid became the Institutional Affairs Division Director, a position she held until she left the Center in August 1996. Now employed by the State of Oregon, Ingrid played the major role in editing this document.



Ingrid (Melody) Norberg (December 1981)



Carolyn Burns (April 1990)

- *Carolyn Burns* – Carolyn Burns began work in the Public Information Office at FSEC on May 1988, where she wrote the FSEC newsletter and news releases. In 1996, Carolyn assumed leadership of the activities of the Institutional Affairs Division and remained in this role until she transferred to work with Dr. Jim Drake at the UCF Brevard Campus in August 2000.

- *Ken Sheinkopf*– This long-term UCF and FSEC employee started at UCF in September 1972 and then transferred to FSEC in October 1983. One of Ken's most notable activities over the years has been authorship of a weekly energy column for 130 newspapers. The column has run for 18 years and counting. Ken also conducted notable work as Deputy Director for the Solar Energy Industries Association (SEIA) in Washington, D.C. after taking a leave of absence from FSEC in the summer of 1988. After seven years in Washington, Ken returned to FSEC in December 1995 and became Education and Information Division Director upon Carolyn Burns's transition.



Ken Sheinkopf (October 1986)



JoAnn Stirling at SunDay (May 1987)

- *JoAnn Stirling – JoAnn began work at FSEC on November 13, 1983, assisting Associate Director Marvin Yarosh. When Marvin retired in June 1992, JoAnn moved to the Education and Information Division, where she has coordinated FSEC's continuing education activities over the years.*

- *Betsy Pesce – Betsy began work in the Public Information Office on May 17, 1988. Over the years, Betsy has responded to all the questions the public has asked about FSEC programs and ensures that they receive the appropriate FSEC publications.*



Betsy Pesce (February 1991)



Ann Fay at Workshop (December 1983)

- *Ann Fay – Ann, who is still a close member of the FSEC family, was the long-time office manager for the Education and Information Division. Ann started at FSEC in October 1975 and retired on June 22, 1993.*

Public Information & Special Events

Over the years, the E&I Division and the Director's Office have worked together in organizing a great variety of special events. The snapshots here are just a small representation of these special events.

One truly special event was FSEC's annual SunDay celebration. FSEC's most successful public information activity, SunDay was first held in 1981 and was consequently held on a Saturday in the spring of each year until the Center moved to its new site in 1995. Almost all the FSEC staff members participated in SunDay events in a variety of ways.



Jo Townsend at SunDay, IFAS (June 1985)



Mable Flumm and Janet Baldwin at SunDay (June 1985)



Wilma Todd and Wanda Dutton at SunDay (May 1986)



Katie Tucker, Florida Energy Office Director, Rick Deakins, FlaSEIA, and David Block on SunDay (April 1988)

The following photos illustrate other special events and occasions:



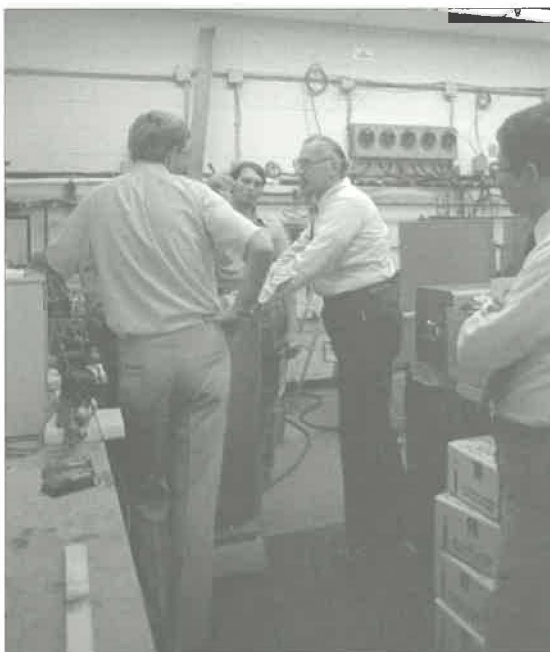
David Block and Louis Centofoni, Director, DOE Atlanta Office, during FSEC visit (April 1980)



College of Engineering Deans Robert Uhrig (UF) and Robert Kersten (UCF) and Jerry Ventre during FSEC visit (July 1978)



TV Interview with John Harrison at STEP facility (September 1985)



Lou Divone, U.S. Department of Energy, tours FSEC (May 1982)



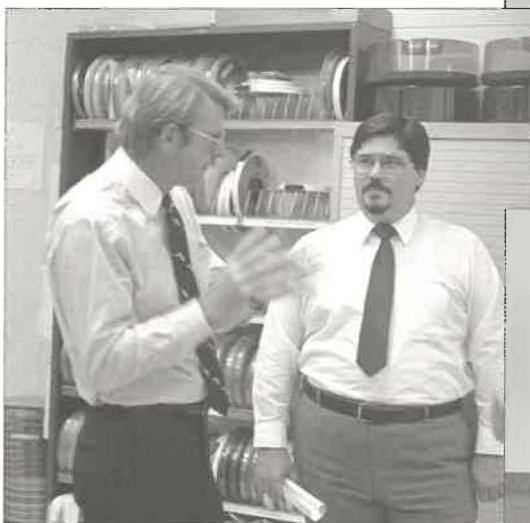
Dedication of Steve Lotz painting with Lou Trefonas (VP Research), Steve Lotz and David Block (June 1984)



David Block and UCF President Trevor Colburn at FSEC (November 1980)



Visit of UCF Vice President of Research Mike Bass at STEP facility (February 1988)



Bob San Martin, Deputy Assistant Secretary, U.S. DOE, and David Block (April 1983)



Award honoring deceased FSEC employees Roy Nash and Lew Patton given to Evelyn Nash and Fern Patton (May 1983)



Iraida (Yayi) Rickling (July 1996)



Susan (Anderson) Merrigan, Yayi Rickling, Wilma Todd and Micky Bagg (September 1986)



Wilma Todd and Micky Bagg (March 1989)

Library

The FSEC library forms the underpinnings of all Center education and public information programs. It contains a collection of solar and energy-efficiency documents among the best in the U.S. This collection is the product of librarian Iraida (Yayi) Rickling. One of the first Center employees, Yayi came to work at FSEC in 1975, when she was hired by Dean Kersten to be the library director. Through her leadership and accomplishments, the library has grown to be truly outstanding. Yayi has not only supported public information and outreach, she has also assisted every area of FSEC research. Yayi retired in 2003 but has since returned to work on a part-time basis.

Two long-time library staff members who assisted Yayi over the years are Wilma Todd and Micky Bagg. Todd began work in the library on November 27, 1977, and retired on September 30, 2003. The other is Bagg, who began work at FSEC in the 1970s and left in the 1980s.

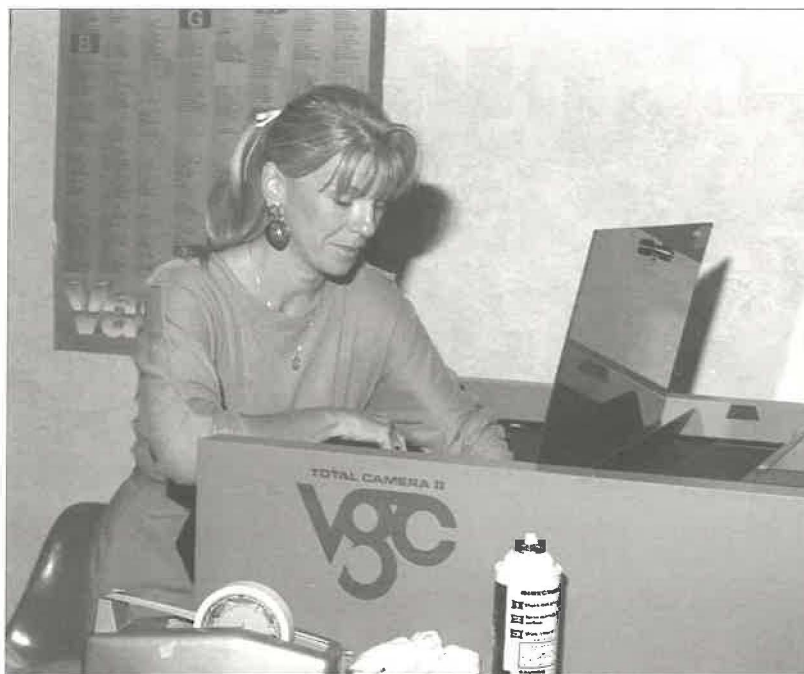
Graphics

To have an impact, the results of research must be disseminated. FSEC's publishing efforts have been supported by an outstanding Graphics Department from its very beginnings. The Center has been lucky to attract and retain extremely talented graphic artists to staff the department. Anne Marie Anderson is an example. This talented, creative employee was hired on April 15, 1988, and continues her exceptionally strong design work at FSEC today.

Former Graphics Director Teri Grossman is another talented designer and artist who had a significant impact on the quality of FSEC publications. Grossman led the Graphics Department from December 6, 1985, to January 1, 1996.

Summary

Through its programs in the '80s, FSEC grew from a solid, state-supported institute to a regional and national research center. The period formed the foundation of the international reputation FSEC enjoys today.



Anne Marie Anderson (July 1988)



Teri Grossman (February 1986)