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University of Central Florida 1985 self study Southern Association of Colleges and Schools : Florida Solar Energy Center self study report

Florida Solar Energy Center

UNIVERSITY OF CENTRAL FLORIDA

1985
Self Study

SOUTHERN ASSOCIATION OF COLLEGES AND SCHOOLS

FLORIDA SOLAR ENERGY CENTER

SELF STUDY REPORT

Institute Report of the Florida Solar Energy Center

University of Central Florida
1985 Self Study

August 1984

Florida Solar Energy Center
300 State Road 401
Cape Canaveral, Florida 32920

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Institute Report for
Florida Solar Energy Center
Cape Canaveral, Florida

1. PHILOSOPHY

1.1 Role in the University and the Community

The Florida Solar Energy Center (FSEC) was created by the State Legislature in 1974 to be the focal point of Florida's solar energy activities. It is preeminent among the nation's solar research and development organizations. FSEC is located on a 16.1-acre site adjacent to North Port Canaveral, just south of the Kennedy Space Center. It is a Type I Institute of the State University System and is administratively under the University of Central Florida. Its mission and goals, broadly stated, are to:

- Encourage the use of solar energy and conservation techniques
- Conduct research and development activities
- Provide testing and certification of solar equipment
- Engage in demonstration projects
- Provide educational programs for general and technical audiences
- Disseminate information based on current research
- Seek external funding for a variety of research programs.

FSEC performs the legislatively-mandated functions of setting standards for and certifying all solar energy equipment manufactured or sold in the state (1979), educating the public about energy options (1974), researching solar energy applications appropriate for Florida (1974), and developing solar energy applications for new schools (1982).

Since 1975, FSEC has conducted approximately $18 million worth of research, development, planning and analysis for state and federal governments and private institutions. FSEC has achieved a position of national leadership in development of the following:

- o Solar standards
- o Solar collector testing and certification
- o Low-energy building designs for hot, humid climates
- o Photovoltaic applications
- o Education and training programs for solar practitioners and consumers.

The growth of FSEC's program activities is mirrored by representative statistical increases during the preceding five years:

- o Number of educational programs developed -- from 30 to 145
- o Number of solar collectors certified -- from 63 to 771
- o Number of solar systems certified -- from 0 to 730
- o Number of major and experimental facilities constructed -- from 1 to 13.

In nine years, FSEC has grown from 10 employees and an initial state budget of $1 million to more than 100 employees (one-third of whom are professionals with specialization in solar energy). It has a state budget of approximately $2.4 million, supplemented by approximately $1.8 million annually in external contracts.

One of UCF's major goals is to conduct research for the academic development of students and faculty in both basic and project-oriented areas, with an emphasis on state and national programs. FSEC's goals in energy research parallel the goals of UCF in applying university research in both basic and project-oriented areas to state and national programs.

1.2 Evaluation and Projections

The Florida solar industry has developed very rapidly over the past five years into an industry estimated to have gross revenues of over $250 million in 1983. Industry experts estimate that the solar industry will triple in the next five years and that Florida will experience the greatest growth. Currently, it ranks second only to California in use of the solar technologies. Through the Florida Solar Energy Center the state must continue to develop its most important and abundant resource -- the sun.

The Solar Center's technology programs are designed to evaluate and develop solar applications that have the most potential for Florida's energy

marketplace. The research program is concentrated in four technological areas -- photovoltaics, low-energy building design, solar water heating and advanced technologies. Closely related to the technology program areas are programs in testing and certification, solar in schools, and education and information, all of which are mandated by legislation.

More than 1,200 solar collectors and solar water heating systems have gone through the Center's testing and certification department. Testing for minimum standards has helped the industry improve efficiency of collectors (39 percent since 1977) and has also protected consumers. Further refinement of solar water heater designs will help to stabilize the solar industry.

Building design research is important in a state where buildings consume 41.6 percent of the energy used each year. Ever-dwindling energy resources also call for the analysis of future alternative technologies such as ocean thermal energy conversion and hydrogen production.

FSEC now has more than 300 publications that include professional papers, contract reports, and consumer publications dealing with design, energy, installation and legal aspects of solar energy. The Public Information Office distributes more than 75,000 publications annually in response to more than 15,000 written and telephone requests for information each year.

The Florida Solar Energy Center's library -- one of the nation's top alternative energy resource centers -- assists more than 6,000 visitors a year, guiding them in consumer, student and professional research. Current holdings include 5,800 books, 10,000 documents, 50,000 microfiche publications and 180 periodical subscriptions.

The Florida Solar Energy Center's education and training program conducts more than 100 workshops and short courses annually. The courses are targeted toward and attended by members of the public, governmental, industrial and trade sectors.

Solar energy research and the transfer of research results to the industry and to the people of Florida are the primary focuses of the Center's mandate. A key to FSEC's future is the construction of a new Library/Laboratory/Learning (Three L) Complex, which is necessary to accommodate the growth of the Center. Not only has the library outgrown its space, the research activities have also increased, necessitating expansion of the laboratory facilities along with the attendant education, training, and public information programs.

The proposed Three L Complex would be a unique consumer-oriented renewable energy demonstration and library center as well as an enlarged research and testing facility.

2. ORGANIZATION

2.1 Duties and Staffing

FSEC's program development has been based on a well-planned procedure that is described in section 2.2. The FSEC technology program emphasizes four technology program areas -- photovoltaics, low energy building design, solar water heating and advanced technologies. The functional program areas are related to testing and certification of solar equipment development and implementation of solar application in new schools, and education and information dissemination. Detailed explanations of these technological and functional programs and their needs follow.

2.1.1 Photovoltaic Program - In the future, photovoltaic systems will probably enjoy the highest degree of commercial success of all the solar technologies. Photovoltaics can become an important new industry in Florida. For these reasons, the FSEC photovoltaic (PV) program will continue to receive the highest priority. The PV program, which focuses on research and development of PV systems applications, has attracted the largest amount of external (nonstate) funding. The U.S. Department-of-Energy-sponsored Photovoltaic Southeast Residential Experiment Station (SERES), a multi-million dollar project, is located at FSEC. Included as a part of this program are evaluations of the most advanced PV modules and inverters, long-term reliability and performance testing of grid-connected systems, and evaluation of the safest and most reliable means of connecting PV systems to existing utility networks. The photovoltaic experimental facilities at FSEC include a full-scale photovoltaic house, a highly flexible PV test facility, three PV prototype facilities, a PV tracking test facility, and a long-term exposure testing facility.

The major application areas for PV are stand-alone, residential and tracking systems. Each has different research needs. In the stand-alone area, there is a need for simple, reliable systems that maximize system efficiency. In the residential PV systems area, it is of utmost importance to find PV module roof-mounting techniques that produce relatively low module operating temperatures at low cost. In the area of tracking PV systems, it is important to identify the optimal sun-tracking mode for

operating flat-plate arrays. Both performance and reliability considerations are important. The residential and tracking areas of research are supported by external contract funds.

For all applications, continued long-term research into performance and durability must be continued to evaluate new PV cell materials. In addition, concentrating PV arrays and PV-powered air conditioners need to be evaluated.

As research continues and PV module costs come down design, installation, and associated technology transfer topics must be addressed. The Center's work in these areas will include:

- o Establishing PV testing and certification requirements (as mandated by Florida law)
- o Developing design, sizing and installation procedures for both stand-alone and utility-interactive systems
- o Developing an information and training center for all PV user sectors, including utilities, industry, government and the public
- o Developing low-cost monitoring systems for stand-alone and utility-interconnected systems.

Five-year photovoltaic program capital equipment requirements are:

- o PV testing and certification equipment and facilities, along with data acquisition instrumentation ($40,000)
- o Evaluation of PV roof-mounting techniques and procedures in a roof integration facility (to be constructed from SE RES funds)
- o A stand-alone PV systems and storage laboratory, which will also serve as a hydrogen laboratory ($110,000 phased over a two-year period)
- o Improved data acquisition control and analysis ($15,000)
- o A materials lab to improve lifetime expectancy and operational efficiency of PV modules ($70,000).

The total five-year photovoltaic improved program capital equipment requirement is $235,000.

2.1.2 Low-Energy Building Design Program - Residential, commercial and governmental buildings comprise the largest single end-use energy sector,

accounting for about 41.6% of Florida's energy consumption. Residences alone consume 22.3% of Florida's energy, and the residential peak demand pattern mirrors the demand peaks observed by Florida utilities. In buildings, air conditioning (36%) and heating (12%) account for 48% of the total building use. Heating and cooling loads place demand peaks on utility generation during severe or extreme weather conditions.

The Center has established an aggressive program to study low-energy building technologies. Begun in 1979, this program quickly gained a national reputation through FSEC's research into radiant barriers, natural ventilation and daylighting. To date, the program has attracted more than $1 million in funding from organizations such as the U.S. Department of Energy, Gas Research Institute, Florida Power & Light Company, Brookhaven National Laboratory, NASA/Kennedy Space Center, Solar Energy Research Institute, U.S. Postal Service, Louisiana State University, etc.

As with other FSEC programs, the building design program consists of experiments and analysis. The program includes full-scale and model-scale system and component level experiments, field measurements, computer analysis of experimental results and subsequent generalizations. Research results are disseminated to the building industry and public through workshops, publications and consultation.

Present design programs concentrate on the following:

- Innovative building construction and shading techniques to reduce heat gain
- Ventilation methods to reduce mechanical equipment needs
- Innovative mechanical systems and the integration of daylighting and artificial lighting techniques.

Experimental facilities and equipment include the Passive Cooling Laboratory, a gas chromatograph, air conditioner test equipment, a high-efficiency dehumidifier, a daylighting laboratory and monitoring equipment.

Future programs will emphasize assistance for the building industry to help it make the optimum design and construction choices and assistance for consumers and manufacturers in the evaluation of appliances. The program will continue current activities and will emphasize applied research leading to:

- Development and testing of innovative building construction practices to include desiccant construction materials, radiant bar-

riers, enhanced ventilation, thermal storage to reduce utility summer and winter peaks, and shading and daylighting strategies

- o Development and testing of vapor compression air conditioners with heat pipes to improve dehumidification capability and energy efficiency
- o Development of an appliance testing laboratory, in cooperation with, and partially funded by, Florida Power and Light Company
- o Model energy code updates, which quantitatively reflect the value of innovative building construction and design alternatives
- o Development of building design guidelines
- o Development and dissemination to design professionals of computer software
- o Field monitoring of well-constructed buildings.

To accomplish these goals, the building design program needs to evaluate a wide variety of materials, construction technologies, mechanical systems and control systems.

Capital equipment needs for the program over the next five years are:

- o An HVAC and appliance-efficiency laboratory to test residential and light commercial heat pumps, air conditioners, electronic controls, and appliances. The lab should be able to generate, in a controlled fashion, heating and cooling loads up to five tons (60,000 Btuh) which will provide capabilities that meet Air-Conditioning and Refrigeration Institute specifications and very accurately measure energy loads. This lab will also permit investigation of utility peak demand reductions by thermal storage. ($150,000 phased over a three-year period)

- o A materials lab for evaluation and improvement of building materials. It should contain instruments capable of measuring the shortwave and infrared absorptance and emissivities of paints and selective coatings; a fenestration test facility; and a test bed for measuring heat and mass transfer in desiccants, phase change materials and heat pipes. ($20,000)

- o Improved data acquisition, control and analysis capability for on-site and field monitoring. ($20,000)

The total five-year low-energy building design program capital equipment requirement is $190,000.

2.1.3 Solar Water Heating Program - Solar water heating has been and continues to be the mainstay of the solar industry. Solar equipment available to the consumer today is well designed and of high quality. FSEC's collector testing program, begun in 1977 and mandated by the Legislature in 1979, has shown a 39% increase in the average efficiency of tested solar collectors. FSEC has certified more than 770 solar collectors and approved more than 700 solar water heating and pool heating systems. The program emphasizes solar equipment testing, certification and standards; solar applications for new schools; and solar system performance improvement.

A major activity of FSEC's educational programs has been dissemination of solar water heating program results. Continued research programs are organized to:

- Improve the accuracy of testing methods
- Develop the "best" design practices for industry
- Compare performance of different types of solar water heaters
- Study various system control and plumbing designs
- Develop low cost methods to measure field performance of systems
- Implement the use of large solar water heating systems in schools.

Experimental facilities include six tracking test stands, outdoor exposure test stands, two system laboratory facilities, an experimental solar air-conditioning facility, and instrumentation, data acquisition system and computer analysis equipment.

The legislative mandate requiring the use of solar water heating systems in new schools has placed a heavy burden on FSEC manpower. One piece of equipment needed for more efficient installed system inspection is an infrared scanner. This scanner would be used to detect (in a nonintrusive manner) the temperature and flow rates of solar systems. Also needed is an experimental program to evaluate design and performance of large solar water heating systems. This experimental program is in the initial development phase.

Future program emphasis will be to provide the solar in schools program and the solar industry with design guidelines, equipment certification, improved performance, improved maintenance and freeze protection methods and materials development.

Five-year capital equipment requirements for the solar water heating program are:

- o Infrared scanner ($100,000)
- o Updating and replacement of solar equipment testing instrumentation, including flow meters, recorders, integrators, data acquisition equipment, temperature measurement bridges and automated meteorological system ($45,000)
- o Indoor solar simulator for controlled research testing ($60,000)
- o A materials lab for evaluation and improvement of solar collection materials. This lab would share use with the building design program. ($10,000)

The total solar water heating program capital equipment requirement is $215,000.

2.1.4 Advanced Technologies - The FSEC advanced technology program addresses long-term research that has potential for Florida. Present program emphasis has concentrated on open-cycle ocean thermal energy conversion (OC-OTEC) and hydrogen production from renewable energy sources. To date, the two program activities have relied entirely upon external contract funding -- OC-OTEC from the Solar Energy Research Institute, and hydrogen from NASA/Kennedy Space Center.

These two projects possess great potential. OC-OTEC can extract significant amounts of energy from the ocean surrounding Florida. Hydrogen has the potential to be the universal fuel of the future, and NASA/KSC is the world's largest user of hydrogen.

The OTEC project will identify the optimum OTEC plant size and configuration for near-term applications and develop an action plan for continued research. The hydrogen project has evaluated the effectiveness of photovoltaic cells as a power source for an electrolyzer used to produce hydrogen. At present there are no program experimental facilities for either program.

Future program emphasis will concentrate on further development of OC-OTEC and hydrogen production from renewable energies. These two programs will evolve based on federal contract work and funding. Experimental facilities will be constructed with a majority of funds from federal sources.

The programs will also consolidate the cooperative efforts of FSEC, the Hawaii Natural Energy Institute of the University of Hawaii, and the Hawaii Natural Energy Laboratory.

Five-year capital equipment requirements for the advanced technology program are:

- o OC-OTEC deaeration facility consisting of flash evaporator and surface condenser. The facility will use seawater. Federal support will supply an estimated $130,000 of the projects total cost of $22,000. ($90,000)
- o Hydrogen laboratory to develop efficient photovoltaic-powered electrolyzers, electrode geometry and electrolyte additives. Federal support will supply an estimated $150,000 of the labs total cost of $220,000. ($70,000)

The total advanced technology improved program capital equipment requirement is $160,000.

2.1.5 Education and Information Program - A comprehensive education and information program is an integral part of effective technology transfer. FSEC's education and information program is such a program.

FSEC workshops and training programs address solar thermal systems, photovoltaics, solar installation and inspection procedures, passive building design and marketing of solar products. The programs are designed to reach consumers, educators, building officials, design professionals, and utility and industry representatives. The FSEC professional staff develops general interest publications and technical reports for the workshops and for public dissemination.

The Public Information Office responds to more than 15,000 written and telephone requests annually. Its quarterly newsletter, The Solar Collector, has a mailing list of over 10,000. A new bimonthly newsletter on FSEC activities is distributed to a select readership.

The FSEC research library has one of the largest collections of solar energy publications in existence and is open to the public. The library maintains computer access to several large data bases and is an integral part of the FSEC research program. Adequate funding of FSEC's library is

critical to the research program and the outreach activities. OCO funding for the library for the past four years has been as follows:

	FSEC Operating Funds	Special Library Book Fund	Total Library Fund
1981-82	$ 5,000	$ 20,000	$ 25,000
1982-83	5,000	20,000	25,000
1983-84	12,500	-	12,500
1984-85	5,000	- *	5,000

*Special funds unknown at this time.

As shown above, total funding for the last two years has decreased significantly, due to FSEC not getting any special library funds. Restoration of the library book fund is critical.

Future program emphasis will be given to pursuing additional outreach activities, expanding the continuing education program to include new target groups, utilizing videotechnology for increased accessibility to FSEC programs, providing more effective visitor services and maintaining a high quality library.

Five-year capital equipment requirements include development of a complete word processing system with multiple remote terminals and high-quality printing ($35,000) and the special library book funding as mentioned above ($20,000 per year).

2.1.6 Staffing - The present FSEC staff numbers 105 and consists of 53 state line positions, 4 auxiliary line positions, 10 contract line positions, 4 part-time positions and 34 student positions. The staff is composed of 34 engineers and professionals (I&R and A&P), 33 support persons (Career Service) and 38 OPS employees (students and part time).

For FSEC to continue success in attracting external research funds and to investigate the projects outlined in this plan, 10 additional staff members will be needed over the next five years. Since FSEC's programs emphasize experimental and data acquisition activities, they require significant technical support. The following table lists the year, title, class code and salary rate of the proposed additional staff members.

YEAR	TITLE	CLASS CODE	EMPLOYEE TYPE	SALARY RATE
1985-86	Editor (Technical)	3757	CS	$ 13,676
	Elec. Technician II	7234	CS	11,004
				24,680
1986-87	Laboratory Engineer	9166	I&R	$ 34,000
	Illustrator II	3706	CS	11,609
				$ 45,609
1987-88	Chemical Engineer	9166	I&R	$ 35,000
	Fiscal Assistant II	1418	CS	11,004
				$ 46,004
1988-89	Materials Engineer	9166	I&R	$ 36,000
	Engineer I	4627	CS	16,307
				$ 52,307
1989-90	Laboratory Technician II	5027	CS	$ 12,925
	Word Processing Systems Op. II	0090	CS	9,438
				$ 22,363

2.2 Projections

FSEC's program development has been based on a well-planned procedure. This process can be briefly described as follows:

- All solar technologies are reviewed and evaluated at least once a year.
- Solar technologies closest to the marketplace and with the greatest potential for Florida are given priority.
- Technology research and development is primarily oriented toward practical applications.
- Technology research and development is based on experiments and the development of experimental data bases. Analytical verifications, including the development of design and sizing tools, parallel the experimental development.

Through this planning process have evolved the program areas discussed in section 2.1. Presented on the following page is a table depicting the time schedule for the capital equipment presented in the previous sections. In addition, FSEC's Office of Policy and Planning and Policy Advisory Board develop, review and comment on plans and actions. The Three L Complex mentioned in the previous section is key to meeting future growth.

Time Schedule

Year	Photovoltaics	Buildings	Testing	Advanced Technology	Other	Total
1985-86	PV Testing and Certification Facilities $40,000	HVAC and Appliance Efficiency Laboratory $55,000	Infrared scanner $45,000	Hydrogen Laboratory $40,000	—	180K
1986-87	Stand-alone PV Systems and Storage Laboratory $50,000	HVAC and Appliance Efficiency Laboratory $50,000	Infrared scanner $55,000	Hydrogen Laboratory $30,000	—	185K
1987-88	Stand-alone PV Systems and Storage Laboratory $60,000	HVAC and Appliance Efficiency Laboratory $45,000	Test equipment update $45,000	OC-OTEC Deaeration Facility $10,000	HVAC equipment $30,000	190K
1988-89	Data Acquisition System update $15,000	Data Acquisition System update $20,000	Indoor Solar Simulator $60,000	OC-OTEC Deaeration Facility $40,000	HVAC equipment $30,000 New roofs $30,000	195K
1989-90	Materials Laboratory $70,000	Materials Laboratory $20,000	Materials Laboratory $10,000	OC-OTEC Deaeration Facility $40,000	Transformer $25,000 Word Processing System $35,000	200K

3. FINANCIAL RESOURCES

3.1 Funding

FSEC has built its programs and activities on the stable operating base afforded it by the Florida Legislature. Another major part of FSEC's budget is external funds from contracts and grants. The following table presents the FSEC operating budget for the past seven years, and the budget for 1984-85.

YEAR	STATE OPERATING BUDGET	OPERATING CAPITAL EQUIPMENT	CONTRACT FUNDING
1977-78	$1,000,000	$ 71,375	$512,880
1978-79	1,363,000	125,208	218,803
1979-80	1,774,527	149,211	654,826
1980-81	1,953,206	118,169	603,471
1981-82	2,118,122	198,016	592,147
1982-83	2,338,224	157,734	1,836,762
1983-84	2,397,695	52,655	1,269,100
1984-85	2,472,259*	79,027	1,200,000**

*Budgeted amount. Does not include salary increases.
**Projected. Funding as of 8/27/84 is $186,213.

Note that these figures show moderate increases in state operating funds for the past three years. The one area of decrease is the operating capital equipment funds. These funds are especially important to FSEC, since they reflect the ability to develop experimental facilities and data collection systems. As previously stated, experimental facilities are a key ingredient in FSEC's programs.

Also a part of the FSEC operating budget is the FSEC's legislated support of the University of Florida at $150,000 per year, and Florida Institute of Technology at $200,000 per year. These research programs have produced significant results and will continue to be included as an integral part of the FSEC funding.

FSEC controls expenditure of its operating funds through the division directors and project managers. All purchasing and travel forms require a minimum of two FSEC signatures and are processed by UCF's Purchasing and Travel Offices. FSEC's Business Affairs Office, staffed by the associate director for business and four support employees, acts as the central office for all purchasing, travel and budget matters.

The Business Affairs Office and the FSEC director prepare budgets which are submitted to UCF. UCF then submits the FSEC budget as a part of its budget to the Board of Regents Office in Tallahassee. FSEC's state budget is allocated by the Florida Legislature as a part of the SUS budget. Special provisionary language for FSEC is included in the legislative budget document.

One improvement that could be made would be the stationing of a purchasing agent at FSEC. A purchasing agent would greatly aid in the processing of purchase orders by eliminating the need for UCF to act on every FSEC purchase.

3.2 Equipment

In July of each year, FSEC allocates expense and OCO funds to each of its 12 organizational functions. Each organizational function develops a plan for the expenditure of its allocated operating budget. The Business Affairs Office coordinates and oversees all FSEC expenditures.

An ad hoc OCO committee develops a plan in the fall of each year for expenditure of the OCO allocations. Generally, one major OCO purchase is made each year. Last year that purchase was a VAX 11/750 computer. Computer purchases are coordinated by a computer planning committee.

The entire expenditure process is overseen by the FSEC Executive Committee, which meets weekly. The oversight of the executive committee ensures that purchases are necessary and fully utilized.

Investment in capital equipment and facilities has helped FSEC receive external contracts for research and development. Approximately $100,000 spent on the photovoltaics program has brought in more than $2.1 million in external contracts. An equal investment in the low-energy building design program has brought in more than $1 million in external funds. This external contract work has also enabled FSEC to hire researchers and technicians on nonstate or contract line positions.

4. PERSONNEL

4.1 Recruitment, Selection and Salaries

All FSEC personnel are selected using the UCF processes for I&R, A&P and Career Service employees. Personnel recruitment requests are reviewed by the UCF Equal Opportunity/Affirmative Action Office and/or personnel department.

FSEC's selection process for all employees is as follows:

1. A personnel selection committee narrows the candidates to approximately five.

2. Each candidate is interviewed by three to five people. Written comments are solicited from each interviewer.

3. The interviewers meet as a committee and recommend the top candidate to the FSEC division director.

4. Final selection is made by the FSEC director in consultation with the appropriate division director.

5. Documentation of the FSEC selection is forwarded to UCF for final approval and action.

Salaries for I&R and A&P positions are determined by the FSEC director, in consultation with the appropriate division director. The deputy director and associate director are also consulted. The salaries for I&R and A&P positions are competitive with the market for personnel skilled in solar energy. New employees are not placed at salaries above existing personnel in an equivalent position level. Salary increases for I&R and A&P are set by the Legislature, UFF and UCF policies.

Salaries for new Career Service employees are normally set at base level by the UCF Personnel Office. Career Service employee salaries at FSEC are a very definite problem due to the proximity of Kennedy Space Center and the higher salaries offered by the Space Center and its contractors. FSEC Career Service employees are also hindered by the inability to be promoted

or to get discretionary merit increases. Career Service employees are the low members of what is essentially a class system. The entire structure of Career Service employees within the University System needs to be studied and altered. Promotions and discretionary merit increases are imperative.

4.2 Security, Working Conditions and Projections

One of the most serious problems at FSEC has been the inability to assign meaningful working titles and to promote I&R personnel. Our experience has shown that, in general, the I&R titles are not sufficiently descriptive of the applied research and development and nonacademic type activities done at FSEC. Appropriate working titles that include a means for promotion would provide:

- A method of recognizing individual contributions
- A process that would benefit both the individual and the Center
- A means to provide monetary rewards.

Attempts to establish descriptive working titles and promotion criteria began in early 1978. For two years, FSEC worked with UCF to resolve this issue using the existing job titles and requirements of UCF/UFF class titles. No workable agreement was reached.

In 1981 after several proposals were rejected by the chancellor's office, FSEC adopted an internal working title and promotion process.

4.2.1 Underlying Principles - The underlying principles of the "FSEC Working Titles" system are as follows:

- All titles, requirements, steps and ranks of the FSEC Working Titles System are internal. They are not recognized by the Board of Regents or United Faculty of Florida. All employment contracts use the official BOR position title.
- The only employees eligible for FSEC Working Titles are those in I&R positions. Career Service and A&P positions are not eligible. Working titles may be applied to positions funded from state, external or temporary sources.

- o An employee may choose to participate in the new FSEC Working Title system or retain the official position title used on his/her employment contract. There is no time limit on this title selection option. Generally, once a working title is designated the employee may not use any other working title. However, provision will be made for lateral transfer from one title to another if the situation warrants (e.g., a significant change in employee's responsibilities, function, etc.). In a lateral transfer, the rank remains the same, but the title modifier/functional title changes.

- o Employees who participate in the FSEC Working Title System will have their initial title, step and rank assigned by the FSEC directors.

- o The FSEC Working Title System was reviewed by the FSEC Executive Committee and received UCF approval from Dr. F. Juge on October 21, 1981. It was adopted by the FSEC staff on December 10, 1981.

4.2.2 FSEC Working Titles - The FSEC Working Titles contain a maximum of three words consisting of one word selected from each of the columns below (rank, title modifier, and functional title). Step number will not be part of the working title.

Rank	Step	Title Modifier	Functional Title
Associate	1, 2	(No modifier)	Analyst
(No Modifier)	1, 2	Educational	Architect*
Senior	1, 2	Governmental	Attorney*
Principal	1, 2	Information	Coordinator
		Policy	Engineer*
		Research	Physicist*
		Systems	Scientist
		Testing	Specialist
		Other**	Other**

* These functional titles require that the individual be educationally trained in the field or hold a valid professional license in the field.

** Other title modifiers that could be used are Laboratories, Technology, etc., and other functional titles that could be used are Economist, Chemist, etc.

Examples of titles are: Associate Engineer, Engineer, Senior Engineer, Principal Engineer; or Associate Systems Analyst, Systems Analyst, etc.; or Associate Education Specialist, Education Specialist, etc.; or Associate Policy Analyst, Policy Analyst, etc.

Note that each rank contains two steps or levels (1 and 2). Each step change will be considered a promotion.

4.2.3 Typical Requirements and General Description - The typical requirements and general description for each rank/step are:

Rank	Step	Typical Requirements and General Description
Associate	1, 2	Bachelor's or master's degree in the related education area. Position is entry level and requires general supervision. Associate Step 2 level typically requires two years experience at Associate Step 1 level.
(No Modifier)	1, 2	Bachelor's or master's degree in the related education area and 4 years relevant experience at the Associate rank level. Doctorate degree in related education area may be used as substitute for some experience. Acts with some degree of independence and may serve in project management capacity on selected projects or under supervision of project director on other projects. Step 2 level typically requires two years experience at Step 1 level.
Senior	1, 2	Bachelor's or master's degree in related education area and 4 years relevant experience at the (No Modifier) rank level. Doctorate degree in related education area may be used as substitute for some experience. Requires independent research capacity and may involve project management. Typically requires professional certification for professional titles. Senior 2 level typically requires two years experience at Senior 1 level.
Principal	1, 2	Master's or doctorate degree in related education area and 4 years relevant experience at the Senior rank level. Acts independently or as supervisor of a number of

professionals. May also manage or have technical responsibility for assigned projects. Typically requires professional certification for professional titles.

Principal 2 level typically requires two years experience at Principal 1 level.

4.2.4 Promotion - Promotion Criteria: In addition to time in rank, promotion to a higher step/rank will also be based on the individual's job performance, grant/contract activity (including the ability to attract external funds and prepare proposals), publications, peer recognition within professional area, creative activities, committee work, and professionally related public service.

1. General Promotion Criteria

a. Promotion to (No Modifier) from Associate

Individual must meet typical requirements of (No Modifier) rank and show outstanding performance in job-related activities. Other criteria to be considered are grant/contract activity and publications.

Promotion to Senior from (No Modifier)

Individual must meet typical requirements of Senior rank and show outstanding performance in job-related activities. Individual must also have demonstrated independence in problem solving and analytical work; limited project management; grant/contract activity, including the ability to attract external funding and prepare proposals; and publications.

b. Promotion to Principal from Senior

Individual must meet typical requirements of Principal rank and show outstanding performance in job-related activities. Individual must have demonstrated outstanding project management capacity or outstanding ability to act as a specialist or consultant in areas of recognized expertise. He or she must be able to obtain and manage contract/grant activities and prepare proposals. He or she also must have published in his or her field and have achieved peer recognition. The individual's creative activities, committee work, and professionally related public service will also be considered.

2. Salary Increases

Promotional salary increases for step or rank changes shall be granted to full-time employees in the amount of half-pay steps using the UCF salary schedule. These increases are based on the availability of sufficient discretionary salary funds. If, for example, the UCF/UFF contract does not allow for discretionary salary funds (i.e., all salary increases are automatic), then the increases cannot be specified by FSEC. However, where no discretionary funds are available in the year of promotion, the salary increase will receive priority and take effect when discretionary funds become available. Individuals who receive promotional increases will also receive any automatic increases and also be eligible for discretionary and merit increases.

3. Promotion Procedure

a. Promotions will be considered once a year (at a date to be announced). They may be initiated by the appropriate FSEC director, employee, or mutually.

b. FSEC employee has primary responsibility for providing evaluation material and copies of his or her annual activities reports. Other materials supporting the request for promotion, such as copies of publications/proposals, are encouraged. Only those materials developed since the last promotion are to be included. The evaluation material is to be submitted to the FSEC director.

c. The evaluation material will be reviewed and a recommendation made by the FSEC Promotion Committee. The FSEC Promotion Committee is to be appointed by the FSEC director.

d. FSEC Director will act on the recommendations of the FSEC Promotion Committee for final approval or rejection. In the event of a dispute with regard to promotion decision, the aggrieved employee will be provided a process by which to appeal.

4.2.5 Adequacy of Space, Equipment, Supplies and Personnel - The adequacy of office and other space is presented in the next section on Facilities. Equipment and supplies have been discussed in Section 3.2. Future personnel needs have been presented in Section 2.1.6

5. PHYSICAL FACILITIES

FSEC's buildings were constructed as part of the University of Florida's GENESYS program in 1964. Since that time, the buildings have been extensively modified by the addition of dedicated research and testing laboratories, which were built with OCO or contract funds. No Fixed Capital Outlay (FCO) funds have been allocated to FSEC. The table on the following page details FSEC's net assignable area of 26,086 sq. ft. by use and number of employees.

5.1 Fixed Capital Outlay Projects

FSEC's programs, staff and workload have steadily increased to a magnitude that now demands expansion of the permanent facilities. The first priority and the core of the proposed expansion is the construction of a Library/Laboratory/Learning (Three L) Complex. The Three L Complex will house an expanded library, new laboratory facilities, a visitors and public information center, and additional office space.

Other FCO projects are: the construction of a storage building, paving of additional vehicle access and parking areas, and refurbishment of the four original buildings.

5.1.1 Library/Laboratory/Learning Complex ("Three L" Complex) - The construction of a Library/Laboratory/ Learning Complex -- which will house an expanded library, laboratory facilities, a public information center, and additional office space -- is essential to FSEC's continued growth. The Three L Complex will be designed as an energy showcase incorporating the latest solar and conservation building techniques. The Complex will contain a visitors area with self-explanatory exhibits on solar energy applications and interactive exhibits to educate visitors on renewable energy -- the first such visitors area devoted to renewable energy in the nation. Beyond that, the complex will bring together the FSEC Education and Information Division, whose staff and functions are presently dispersed throughout three buildings.

Florida Solar Energy Center
Net assignable square feet by use
May 1984

#	Building Name	Research & Testing Laboratories	Library	Public Information	Graphics	Office	Secretarial Suites	Computer & Word Processing	Machine Shop	Electrical Shop	Conference/ Auditorium	Storage	TOTAL
1901	Research & Development	626		395	631	1,666	330	88				176	3,912
1902	Testing & Operations					1,386	131	466	1,180	695			3,858
1903	Administration		1,590	91		1,382	152	127			450		3,792
1904	Auditorium		200								3,765	405	4,370
1905	Photovoltaic House	1,359											1,359
1906	Test Bldg. 1	105											105
1907	Test Bldg. 2	1,536				50							1,586
1908	Daylighting Lab	148											148
1909	Passive Cooling Lab	1,551											1,551
1910	Manufactured Building					1,154	125						1,279
1911	Flexible Test Facility	500											500
1912	Storage Bldg. (metal)											200	200
1913	Storage Bldg. (metal)											288	288
1914	Storage Bldg. (metal)											200	200
1915	Storage Bldg. (metal)											200	200
1916	SE RES Prototype 1	747											747
1917	SE RES Prototype 2	716											716
1918	SE RES Prototype 3	635											635
— —	Trailer (rented)					544		96					640
		7,923	1,790	486	631	6,182	738	777	1,180	695	4,215	1,469	26,086
	Full-Time Employees	1	3	4	3	42	6	4	2	3			68
	No. Sq. Ft./F-T. Employee		87	121	210	147	123	194	37	30			
	Student Assistants	7	1	2	2	5	6	3	3	3			32
	All Employees	8	4	6	5	47	12	7	5	6			100
	No. Sq. Ft./Employee		65	81	126	132	61	111	15	15			

1. Library

The FSEC library is one of the nation's top alternative energy resource centers. It assists the FSEC professional staff and more than 6000 visitors a year, guiding them in consumer, student and professional research. Located in 1590 sq. ft. of Building 1903, the library has a 200 sq. ft. storage annex made by enclosing what had been the Auditorium stage.

Current library holdings include 5800 books, 1200 bound and unbound periodicals, 10,500 documents, 43,000 microfiche publications, 6000 slides, and 200 current periodical subscriptions. The library also comprises office space for three full-time employees, one student assistant and limited desk area for visitors and staff. The holdings and work areas have literally overflowed available space.

The Special Libraries Association recommends one linear foot of shelf space for every three bound technical periodicals, four books or 10 documents. For FSEC holdings, this translates into 2850 linear feet of shelf space. The FSEC library stack area can hold only 1400 linear feet. Present holdings require an additional 700 sq. ft. of space for necessary shelving.

Beyond shelf space, the FSEC library needs additional areas for staff, public service, information and circulation desks as well as card catalogs, periodical display racks and file cabinets. Currently, staff members occupy 65 sq. ft. per individual. Present needs and continued growth require a library of 6,000 sq. ft.

2. Laboratory

FSEC research concentrates on technologies appropriate for the state of Florida. Expanded laboratory facilities for the study of solar systems and for materials evaluation are essential for the progress of these technologies. The Center has built facilities for special projects: the Photovoltaic House, the Photovoltaic Flexible Test Facility, the Daylighting Lab, three Photovoltaic Prototypes, the Passive Cooling Laboratory and the Collector Test Buildings. Even these buildings have not meliorated the critical shortage of research and testing laboratory space.

More than 1200 solar collectors and solar water heating systems have gone through the Center's testing department. This work has helped the solar industry improve the efficiency of collectors (39 percent improvement since 1977) and also has provided a large measure of consumer protection. Further refinement of solar water heater designs will help stabilize the state solar industry and ensure consumer satisfaction. As large solar water heating systems proliferate, it will be necessary to investigate complex material problems associated with their operation; no facility is presently available for this important work.

Currently, FSEC has two solar systems research laboratories. One is a converted classroom in one of the original four buildings; the other is located in Test Building II. The two laboratories are separated by 630 feet and comprise only 1326 sq. ft. Operating the labs separately is extremely inefficient, and the space allocated to them is severely inadequate considering the depth, thrust and importance of our investigation of solar systems.

Building design research is important in Florida, where buildings consume 41.6% of the energy used each year. FSEC is a world leader in research on energy-efficient building design for hot, humid climates like Florida. The majority of this research is conducted in the Passive Cooling Laboratory and the Daylighting Laboratory (a total of 1699 sq. ft.). The absence of a materials testing laboratory, however, is inhibiting the research and impeding its transfer to practical applications.

A combined solar systems laboratory and new materials evaluation laboratory of 9000 sq. ft. is critical to the continuity and productivity of these programs. A laboratory in which researchers can simulate a variety of environmental conditions will help to answer urgent questions about solar system standards and freeze protection mechanisms.

3. Learning

The Three L Complex will provide working and office space for the entire Education and Information Division, which is now housed in three buildings. This will bring together the Public Information Office, graphics studio, library, Continuing Education Office, and visitors center as well as the Education and Information Division staff.

The Public Information Office (PIO) is responsible for desseminating research information and compiling and editing all FSEC publications. Its publications catalog now lists more than 300 titles, including professional papers, contract reports, conference program documents, proceedings, and general publications dealing with design, installation, consumer and legal aspects of solar energy. The PIO annually distributes more than 75,000 publications in response to more than 15,000 requests for information. The PIO has an area of 486 sq. ft., which must provide for storage of 100,000 publications and offices for three professionals, one secretary, one intern and one student assistant. The present space allows for 81 sq. ft. per individual.

The PIO also coordinates a complete graphics studio. Within the 631 sq. ft. graphics area are three professionals, two students, and their work stations and equipment: a phototypesetting system, a posistat camera, five drafting tables, a photocopy stand, three light tables, two storage cabinets and miscellaneous storage stands, four vertical and horizontal filing systems, and miscellaneous photographic, drafting, design and illustration supplies.

The Three L Complex will house an expanded public information-graphics area of 4000 sq. ft. to accommodate present staff and activities, storage for documents and graphics supplies, a darkroom for film processing and printing, and an audiovisual studio with slide/tape and video capability.

Another part of the learning aspects of the Complex will be a visitors area. This area will contain self-explanatory and interactive exhibits on solar energy, a viewing room for films on solar topics, and an information booth for distribution of FSEC publications and documents. FSEC is visited by approximately 6000 people annually, and that number is steadily increasing. At present there are no means for handling these visitors other than directing them to the library or allowing them to take a self-guided, unsupervised tour of FSEC grounds, at substantial risk to expensive and sensitive research and test equipment. Considerable professional staff time is diverted to answering routine questions and disseminating information. Not only will the visitors area better accommodate these visitors, it will also be a one-of-a-kind national resource center. The new public information-graphics-visitors center will comprise 6000 sq. ft.

4. Additional Benefits

The Three L Complex will also satisfy the need for more offices by freeing up space currently used for library, laboratory and learning functions. Two years ago an office trailer was purchased, and last year a second office trailer was rented. These solutions are temporary, at best. Excluding the space of the two trailers, FSEC has 4484 sq. ft. for use by 42 professional staff members and six student assistants, or 93 sq. ft. per individual. Space needs for secretarial functions also are critical. FSEC has five secretarial suites (at a total of 738 sq. ft.), which are staffed by six full-time secretaries and six clerical students (61 sq. ft. per individual).

Space for research students is another problem. Seven students and one professional are housed in the Photovoltaic House and the Passive Cooling Laboratory. Use of these research facilities as offices diminishes their research productivity.

The Three L facility will be constructed on the northwest portion of FSEC's present property. The U.S. Air Force lease on the property, which extends through 2003, can be extended.

Total gross area of the proposed "Three L" Complex will be 38,000 sq. ft. (25,000 net sq. ft.) as follows:

Function	Present Area ft^2	New Building Area ft^2
Library	1,790	6,000
Laboratory		
Systems Lab	1,326	4,500
Materials Lab		4,500
Computer Lab	777	900
Learning		
Public Information-Graphics-Visitor Area	1,117	6,000
Offices		3,100
TOTAL:		25,000

5.2 Provisions

FSEC's organizational structure contains an Office of Policy and Planning staffed by an associate director. The Office of Policy and Planning requests input from FSEC staff members and plans for all new facilities and

programs. This planning process also includes parking and temporary structures.

FSEC does not use any hazardous materials in its experimental programs. Electrical safety is carefully monitored by the Testing and Operations Division personnel.

The one possible hazardous material at FSEC is a main 750 KVA transformer that is cooled by polychlorinated biphenyl (PCB). The use of PCB is currently banned by federal regulations, but in the past some 750 million pounds of this material was manufactured and used for a variety of purposes, principally for the cooling of electrical equipment such as transformers. FSEC has carefully monitored its PCB transformer and has been under a maintenance contract since 1981. At present the transformer presents no health hazard, but eventually the transformer will have to be replaced. Requests for replacement of the transformer have begun.

6. COMPUTERS

6.1 Impact and Needs

Computer equipment is an integral and indispensable part of all FSEC laboratory and research activities. FSEC's electronic data processing equipment comprise four major components - the new Digital VAX 11/750, the PDP-11/34 and PDP-11/23, 16 microcomputers and four word processors. Research areas requiring computer support include solar water and pool heating systems, photovoltaics, daylighting, low-energy building design, testing and certification for government and industry, and numerous system simulation studies. Projects funded by the U.S. Department of Energy (DOE), Florida Public Service Commission (PSC), Solar Energy Research Institute (SERI), Gas Research Institute (GRI), Massachusetts Institute of Technology (MIT), Florida Power and Light (FPL), National Aeronautics and Space Administration (NASA), Bonneville Power Administration (BPA), Southern California Edison, San Diego Gas and Electric, and Shell Chemical all require computer support. In addition to University of Central Florida's IBM computer, computers at Florida Institute of Technology and the Solar Energy Research Institute have been used to complete contract work. Expected future projects requiring computer support include Open-Cycle Ocean

Thermal Energy Conversion (OC-OTEC), Southeast Residential Experiment Station (SE RES), and additional projects funded by GRI, DOE, FPL and SERI.

FSEC's new DEC VAX series includes:

- o 11/750 processor
- o 3 Mb memory
- o 456 Mb on 1 disk drive
- o 1600 BPI tape drive
- o 8-line interface (and 16 line from 11/34
- o Floating point
- o Battery backup

The old peripherals on the PDP-11/23 have been replaced with newer models having much lower maintenance costs and higher reliability. The VAX computer is also capable of running the large simulation programs which do not fit on the PDP-11/23. The PDP-11/34 will continue to be used in in-house data collecting research projects at FSEC. In this application, the PDP-11/23 would be stripped of its high maintenance cost peripherals and used as a data collection/manipulation device.

Expansion of the VAX to the full required capability will take place in coming years. The initial purchase allows utilization of funds on hand at the present time.

The 16 microcomputers are used for research projects, data collection, and terminals for the VAX 11/750.

Computer usage and purchasing is controlled by a computer planning committee. The computer planning committee carefully reviews current and future needs and make recommendations for purchase and expansion. All computer purchase orders must be approved by the computer planning committee and signed by the FSEC director.