

ORIGINAL

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

CALCS PLUS

TESTIMONY OF PHILIP FAIREY

DOCKET NOS. 040029-EG, 040660-EG

AUGUST 12, 2005

1. Please state your name, current position and address.

Philip Fairey

Deputy Director, Florida Solar Energy Center

1679 Clearlake Rd, Cocoa, FL 32922

2. Please provide us your educational background and any special credentials or training that you have received relevant to your testimony in this case.

Please see attached resume—Exhibit 1

3. Please provide us with your past and present professional association memberships and positions you have held in those associations.

Please see attached resume—Exhibit 1

4. Please provide us with a brief statement of your background and experience in the areas of building science, standards of building practice and programs involving residential energy efficiency and conservation.

Please see attached resume—Exhibit 1

5. Please provide us with a brief statement of activities in which you have initiated, supported, and/or managed the establishment and adoption of standards in the areas of residential building construction practices.

CMP 17

COM 3

CTR orig 18

ECR 19

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OPC 21

RCA 21

SCR 22

SGA 23

SEC 24

OTH 25

- 1 • Member of Florida Building Commission Energy Technical Advisory
- 2 Committee
- 3 • Principal developer of Florida’s Building Energy Rating System under
- 4 contract with DCA
- 5 • Principal developer of RESNET Rating Method and RESNET Standards
- 6 • Active involvement over the years in MEC and IECC code process, proposing
- 7 a number of changes to the code, many of which were adopted.
- 8 • Principal author of Section 404 of the IECC 2004 Supplement on
- 9 performance-based code compliance.

10 **6. How does the Florida Building Code measure and regulate residential**
11 **building energy efficiencies in Florida?**

12 The Florida Building Code uses a predominantly performance-based approach to
13 code compliance. It establishes a “baseline” building that is used to create an
14 energy budget. The proposed building must have energy use for heating cooling
15 and hot water that equals or is less than that energy budget of the baseline
16 building in order to achieve compliance. That same performance methodology is
17 used, under worst-case conditions, to create a few prescriptive compliance
18 “packages” that may be used in lieu of the performance approach.

19 **7. Are you familiar with other jurisdictions’ efforts to measure and regulate**
20 **residential building practices and, if so, can you summarize their various**
21 **approaches?**

22

1 Yes, I am familiar with many other jurisdictions' efforts. There are two basic
2 approaches to building code regulation and compliance: prescriptive and
3 performance. Prescriptive codes specify minimum requirements for each building
4 component, such as wall, ceiling, floor, etc. R-value without regard to the overall
5 energy use performance of the building. Performance codes specify the overall
6 performance that must be achieved on a whole building basis without specifying
7 specific minimum requirement for the individual components. Many codes allow
8 compliance by some combination of both methods but there are some code
9 jurisdictions that only allow compliance by one method or the other.

10 **8. Are there national standards for the development of systems for rating the**
11 **energy efficiency of buildings? If so, describe and indicate where the**
12 **standards may be found.**

13 Yes, the Residential Energy Services Network (RESNET) develops and maintains
14 national standards for Home Energy Rating Systems (HERS). These standards
15 cover accreditation of HERS Providers, training and certification of home energy
16 raters, quality assurance technical requirements for home energy ratings. See also
17 <http://www.natresnet.org/standards/default.htm>.

18 **9. How do you believe any residential program purporting to increase**
19 **residential building energy efficiencies should be measured and monitored?**

20 I believe the most effective way is through trained and certified third-party
21 inspections and testing.

22 **10. What is a building energy efficiency rating under Florida Law?**

23

1 My interpretation of the Law is that an energy efficiency rating is the statewide
2 uniform means of analyzing and comparing the relative energy efficiency of
3 buildings.

4 **11. Please give us a brief description of your involvement in the development and**
5 **implementation of the Florida Building Energy Efficiency Rating Law,**
6 **Florida Statute Chapter 553, Part VIII, Sections 553.90 et seq. and Florida**
7 **Administrative Code Rule Chapter 9B-60.**

8 Under contract with the Department of Community Affairs, I led FSEC's efforts
9 to develop and implement Florida's Building Energy Rating System or BERS.
10 We also assisted DCA with technical assistance in the development of Rule 9B-
11 60, which implements the Law and we are currently under no-cost contract with
12 DCA to provide administration of Florida's rating system.

13 **12. Are there any categories of ratings?**

14 Yes, there are three categories or Classes of Ratings. These classes are
15 determined by the nature of the data that are used in the development of the
16 rating.

17 **13. What services need to be performed to provide a rating under the various**
18 **categories?**

19 Class 3 ratings are developed based solely only on the information provided in
20 construction documents and are considered "projected" ratings because the
21 properties have not yet been constructed.

22

1 Class 2 ratings are developed based on inspection of the actual in-situ building,
2 where the energy characteristics of the building are inspected and confirmed.

3 Class 1 ratings are developed based on inspection of the energy characteristics of
4 actual in-situ building plus the results of specific tests that are performed on the
5 building to measure its air tightness and duct system integrity.

6 Class 2 and Class 1 ratings are considered “confirmed” ratings.

7 **14. What is the difference between the process of developing and completing a**
8 **code compliance form and a Class 3 rating?**

9 There is a basic underlying philosophical difference in that code compliance aims
10 to achieve minimum performance while ratings aim to achieve maximum
11 performance. Other than that, the technical differences are relatively small
12 because the Law requires that Florida’s rating system be compatible with state
13 building codes. Nonetheless, there are small differences because the “baseline”
14 building used in Florida’s code is not always exactly consistent with the HERS
15 Reference home, which, like Florida’s code baseline, is the national standard used
16 for comparison in rating systems. The Law also requires that Florida be
17 compatible with national rating system standards.

18 **15. Is there any relationship between an e-ratio developed in the process of code**
19 **compliance work and a BERS score developed in the process of a Class 3**
20 **rating? If so, explain.**

21 No, there is no relationship that can be directly correlated. In general, the lower
22 the e-Ratio the higher the BERS score but one cannot determine one number from
23 the other because their basic methods of determination are different.

1 **16. The Department has periodically reviewed both its building code and its**
2 **rules relating to regulation of rating systems. What was your role in these**
3 **activities?**

4 I serve as a voting member of the Florida Building Commission Energy Technical
5 Advisory Committee and as such am intimately involved in the periodic review
6 and maintenance of Florida's building energy codes. My organization is also
7 under no-cost contract with the Department for administration of Florida's rating
8 system and am intimately involved as their contractor in the periodic review and
9 maintenance of Florida's rating system.

10 **17. Did you provide any recommendation to the Florida Public Service**
11 **Commission when it adopted Rule 25-17.003(4)(a), F.A.C., as amended on**
12 **7/14/1996? If so, what was your recommendation and reasons therefore?**
13 **Please provide a copy of any written statement or letter that you submitted.**

14 As I recall, in consultation with the Florida Energy Office, we made a joint
15 recommendation to Mr. Jim Dean of the Florida PSC that Class A utility audits be
16 altered to use the Florida Building Energy Rating System for such audits and that
17 the rule be changed to require that utilities charge their customers for such
18 services and file a tariff with the FPSC for their full cost of such services to their
19 customers. I no longer have any written record of these transactions.

20 **18. How does Florida assure its citizens fair, impartial and accurate information**
21 **on the energy usage in their residences?**

22

1 In general, this assurance flows from the *Florida Building Energy Efficiency*
2 *Ratings Act* of 1993 (as amended in 1994), which requires that energy rating
3 system be uniform across the state and that energy ratings provided under the
4 auspices of the Act be conducted by trained and state-certified, independent third
5 parties.

6 **19. How would you measure a residential unit's energy efficiency?**

7 The best available means of assessing the relative energy efficiency of a
8 residential unit in Florida is Florida's building energy rating system.

9 **20. Recognizing that you are not an economist, but rather an educated layman,**
10 **how would you measure the cost effectiveness of any entity's program to**
11 **enhance the energy efficiency of a residential unit?**

12 I would say that the simplest means of determining the cost effectiveness of an
13 entity's efforts to enhance energy efficiency would be the cost of achieving the
14 increased energy efficiency divided by the amount of energy saved. In other
15 words, dollars expended per kWh avoided.

16 **21. In order to measure and monitor the success of any program to enhance the**
17 **energy efficiency of a residential unit, how would you assure accurate**
18 **information?**

19 The best currently available means of cost-effectively assessing energy savings in
20 homes is the Florida Building Energy Rating System.

21

1 **22. If the program's direct costs are to be paid by someone other than the**
2 **program operator, how would you assure a program designed to be effective**
3 **yet minimize the cost burden on those that pay for it?**

4 I think I would require that the cost of providing the energy efficiency be less than
5 the amortized cost of the avoided energy use.

6 **23. How would you assure maximum quality control to verify the results claimed**
7 **for the program and the persistence of those results over time?**

8 I believe that the most cost-effective means of maximizing quality control and
9 verifying energy savings is Florida's Building Energy Rating System.

10 **24. What are the accepted duct testing method(s) recognized by Florida, other**
11 **state, national and international standards?**

12 Those methods specified by ASHRAE/ANSI Standard 152-2004, "Method of
13 Test for Determining the Design and Seasonal Efficiencies of Residential Thermal
14 Distribution Systems."

15 **25. What is the difference between the testing protocols? Which is more**
16 **accurate and why?**

17 At present, there is only one nationally accepted protocol as specified in the
18 answer to question 24 above.

19 **26. Was Pressure Pan testing ever accepted by the State? If, yes, then is it still**
20 **accepted as a valid testing protocol? If no, then why not?**

21 Yes, in the past, pressure pan testing was accepted by the state as a "threshold"
22 test for the determination of acceptable duct leakage. As of the most recent
23 change to rule 9B-60 and to national standards, it is no longer an accepted test

1 protocol for duct leakage. There are multiple reasons. Among them is the fact
2 that pressure pan testing does not actually determine the leakage rate of duct
3 systems, it only determines the probable location of likely problems but not the
4 extent of the problem. Additionally, the promulgation of a national consensus
5 standard (ASHRAE/ANSI Standard 152-2004) recognized by the American
6 National Standards Institute (ANSI), first published in 2004 provides the standard
7 protocol for the measurement of duct leakage.

8 **27. Were you involved in the original residential new construction study**
9 **conducted by FPL in 1993-94 that lead to their BuildSmart program? If so,**
10 **what was your involvement?**

11 Yes, I was project manager and co-principal investigator for the FSEC portion of
12 the study (field inspections, testing, monitoring and analysis). FPL's prime
13 contractor for the development of their program implementation guidelines was
14 Quantum Consulting. FSEC also provided technical advise to Quantum on
15 program implementation.

16 **28. What was the duct testing protocol used in that study?**

17 Multiple duct testing protocols were used in the study: two different pressure pan
18 methods, two different blower door subtraction method and the duct
19 pressurization test method (duct blaster) were all used and the results were
20 compared.

21 **29. Have you or your staff at FSEC been involved in reviewing the results of any**
22 **duct tests done in homes tested by either the Petitioner or Respondent? If so,**
23 **please describe circumstances and results.**

1 Yes, for both parties. As part of our quality control procedures for Florida
2 ratings, staff of our Energy Gauge office reviews the results from each rating.
3 During these reviews, duct test results are reviewed for reasonableness and ratings
4 are sometimes returned for revision prior to registration.

5 **30. Have you or your staff at FSEC done any audits (second ratings) on homes**
6 **rated by either the Petitioner or Respondent? If so, please describe**
7 **circumstances and results.**

8 Yes, FSEC staff has performed a follow up audit and rating on one central Florida
9 residence that was originally rated by the Respondent. The follow-up was
10 performed at the request of the builder. The results were that the follow up rating
11 produced a HERS Score of 84.5, while the original rating had reported a HERS
12 Score of 86. The follow up found that duct leakage was larger than reported in
13 the original rating for the home and that actual installed window area was greater
14 than that reported by the original rating. These differences caused the follow-up
15 rating to be lower than the minimum score of 86, which was required to obtain
16 the home's Energy Star label.

17 **31. Are you aware of any studies of the differences between initial code**
18 **calculations done on homes and their subsequent as-built energy efficiency**
19 **compared to the Florida code or a BERS rating? If not studies, have you any**
20 **anecdotal or individual case(s) evidence of any differences?**

21 Yes, such studies were accomplished as a part of the FPL BuildSmart project.
22

1 **32. Have you reviewed the initial pre-filed testimony of FPL’s witnesses as**
2 **submitted on July 15, 2005? If so, please comment on any concerns that you**
3 **have based on your experience and not included in your response to another**
4 **question.**

5 Yes, I have reviewed the pre-filed testimony of Mr. R. Steven Sim and Mr. Daniel
6 J. Haywood as filed on July 15. With respect to Mr. Sim’s testimony, I am not
7 familiar with the EGEAS model that was used to develop the DSM cost
8 effectiveness results and am, therefore, not able to comment on those results.

9 With respect to Mr. Haywood’s testimony, it is not clear to me how the program
10 intends to achieve savings any greater than 10% as compared with code
11 minimums. The “Flexible” approach requires 20% savings while the
12 “Prescriptive” approach requires only 10% savings, while there appears to be no
13 significant difference in incentives. The only incentive difference that I was able
14 to discern was a \$50 builder incentive for reaching the ENERGY STAR® level of
15 performance, which may or may not be reached with the “Flexible” approach.
16 Thus, it would appear that the program design is effectively rewarding the lower
17 10% savings level of the “Prescriptive” approach by not providing any significant
18 incentive to reach the greater 20% savings required as a minimum by the
19 “Flexible” approach. Considering the administrative costs per home are estimated
20 at \$400 for even the 10% savings level, the \$50 incentive for doubling that energy
21 savings seems quite small and it seems doubtful to me that this incentive would
22 induce many builders to participate at the higher level of performance.

1 **33. Have you reviewed the responses to the Petitioner's 1st Set of Interrogatories**
2 **and for Production of Documents filed by FPL on July 30, 2005? If so,**
3 **please comment on any concerns that you have based on your experience and**
4 **not included in your response to another question.**

5 No, I have not reviewed these documents.

6 **34. In administering Florida's rating law (§ 553.90 et seq., FS), please explain the**
7 **processes you use to assure quality control and to assure that Florida's**
8 **citizens receive the best, un-biased, accurate and verifiable information**
9 **about the energy efficiency of their home and as compared to other like**
10 **homes.**

11 The quality control procedures FSEC's Energy Gauge Office employs as a
12 nationally accredited Home Energy Rating System (HERS) Provider are as
13 prescribed by RESNET Standards (see
14 <http://www.natresnet.org/standards/default.htm>). In addition, the Energy Gauge
15 Office reviews each rating that is performed prior to registration of the rating and
16 occasionally performs field verification on ratings that appear questionable.
17 Florida's rating system software is configured so as to prevent the printing of the
18 ratings until they have been registered with our office and entered into the State's
19 database of ratings, which the Energy Gauge Office maintains. Florida raters are
20 also required to maintain proficiency by completing continuing education training
21 and passing written and practical exams on a triennial basis. FSEC's Energy
22 Gauge Office provides this training and the exams.

23

1 **35. Are you aware of any methods used by FPL to assure adequate quality**
2 **control and provide accurate, reliable monitoring and performance data on**
3 **their BuildSmart program? If so, please describe and evaluate.**

4 Other than meeting the Florida Building Energy Rating System requirements for
5 training and certification of Raters and review by the Energy Gauge Office of
6 Ratings that are submitted for registration, I am not aware of any additional
7 internal FPL quality control procedures or provisions within their BuildSmart
8 program. There may be some, however, I am not aware of their existence or the
9 specifics of their requirements. I am not aware of any current field monitoring of
10 home energy use by FPL at the current time.

11 **36. Do you have any recommendations, based on your experience as**
12 **administrative agent for the state's rating program, as to how the FPL and**
13 **the Commission may improve its monitoring and performance measuring**
14 **capabilities? If so, discuss.**

15 The Commission could require that all residential energy savings for utility
16 programs that are subject to energy conservation cost recovery be verified through
17 registered Class 2 (inspected in the field) or Class 1 (inspected and tested in the
18 field) confirmed Building Energy Rating System performance ratings.

19 **37. What has been the trend for the number of certified raters for the years 1995**
20 **to 2005? Please describe the significance of the number of certified raters**
21 **during this time period. What is the approximate ratio of raters directly**
22 **employed by utilities to those who are not? What is the approximate number**
23 **of active raters (10 ratings +/-year) and what is the approximate comparison**

1 **between active utility raters and others during that time frame? Please**
2 **describe the significance to trends in these categories and reasons for the**
3 **trends.**

4 This data required to answer this question will take much more time to develop
5 than has been provided by this subpoena.

6 **38. What is the interrelationship between the states BERS system and the**
7 **Energy Star Homes program? What are the similarities and differences? Is**
8 **there a threshold to achieve an Energy Star home using the BERS system?**
9 **What is that threshold and how was it developed?**

10 The EPA ENERGY STAR® program has as its basic qualification criteria a HERS
11 (BERS) score threshold of 86 points. EPA also allows “Builder Option
12 Packages” or BOPs to be used as qualification for the ENERGY STAR label. BOPs
13 are prescriptive packages that are constructed by EPA contractors using worst
14 case conditions designed to ensure that all homes, which conform to the BOPs,
15 will meet or exceed the HERS score threshold of 86 points. The threshold for
16 achieving ENERGY STAR status using Florida’s BERS system is the same – a score
17 of 86 points or greater using a Class 2 or Class 1 confirmed BERS rating. The
18 threshold was developed by EPA so as to provide energy savings of
19 approximately 30% as compared with the HERS Reference Home, which has
20 been historically based on the 1993 Model Energy Code.

21 **39. Are you aware of any minimum charges required to be charged for BERS**
22 **Audits, If so, what are the minimum charges for each classification? If, yes,**

1 **to the best of your knowledge, are there exceptions for charging these**
2 **minimums by individuals/businesses in State statutes or rules?**

3 Yes, PSC Rule 25-17.003(4)(a), F.A.C. requires that utilities charge their
4 customers for BERS ratings (Class A audits). It further requires that they file a
5 tariff with the PSC for the full cost of providing these energy rating services. I
6 have seen the tariff filings from some of the utilities in the past but I do not recall
7 the exact values quoted. However, it is my recollection that, in general, the
8 utilities have quoted higher tariffs for Class 1 and Class 2 confirmed Ratings than
9 for Class 3 projected ratings. I am not aware of the existence of any exceptions to
10 this utility requirement in any State statute or Rule.

11 **40. Does this conclude your testimony?**

12 Yes.

1 **Resume**

2 **Philip Fairey**

Florida Solar Energy Center

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1679 Clearlake Road

phone: (321) 638-1005

Cocoa, FL 32922-5703

fax: (321) 638-1010

3

4

5 **EMPLOYMENT BACKGROUND**

6

7 **1990-present:** *Deputy Director*, FSEC. Assist the Director in matters of policy, budget
8 and planning. Represent FSEC at public and institutional engagements and on
9 committees on which it is asked to serve. Act on behalf of the Director in his absence.
10 Perform contracted research.

11

12 **November 2002-January 2005:** *Interim Director*, Florida Solar Energy Center (FSEC).
13 Responsible for all matters of policy, planning, budget and personnel. Responsible for a
14 staff of approximately 150 individuals and a budget of approximately \$3 million in state
15 funds plus \$10 million in contracts and grants funds annually. FSEC is the largest and
16 most active state-supported renewable energy and energy efficiency research, training,
17 testing and certification institute in the United States. An institute of the University of
18 Central Florida, the Center functions as the state's energy research, training and
19 certification center.

20

1 **1986-2000:** *President*, Building Consultants Group, Inc. A small consulting firm
2 specializing in building forensics. Measurement, diagnosis and remediation of building
3 science problems related to moisture control, indoor air quality, energy use, building
4 materials, design and construction.

5
6 **1986-1990:** *Program Director* for Buildings Research, Research & Development
7 Division, FSEC. Research and development of advanced building energy-efficiency and
8 cooling and dehumidification concepts and systems. Responsibilities include overall
9 program development, supervision of fifteen to twenty research professionals, research
10 contract management and administration, and experimental and analytical buildings and
11 energy research.

12
13 **1980-1986:** *Research Scientist*, Research & Development Division, FSEC.
14 Responsibilities included development of research plans, preparation of major research
15 proposals, supervision of three to five professionals, administration and management of
16 research contracts, design and management of the FSEC Passive Cooling Laboratory,
17 lectures at workshops and seminars, administration of building design competitions,
18 responses to public inquiries and analytical and experimental research.

19
20 **1979-1980:** *General Manager*, Building Systems, Inc. Responsible for design and
21 construction of factory-built modular homes in the Carolinas.

22

1 **1975-1979:** *Owner*, Piedmont Shelters, Inc. Responsible for design and construction of
2 custom solar homes in the Carolinas.

3

4 **1969-1973:** *1st Lieutenant*, U.S. Army. Administrative officer for U.S. Army Depot,
5 Federal Republic of Germany.

6

7

8 **RESEARCH EXPERIENCE**

9 Principal responsibility for 30 research contracts totaling more than \$11 million.

10 Experimental and analytical expertise in fields of moisture transport and control, roof and
11 attic systems, radiant barrier technology, advanced cooling and dehumidification systems,
12 natural ventilation systems, pressure and air flow control systems, building energy-
13 efficiency and conservation systems, industrialized housing systems, indoor air quality
14 (IAQ), utility Demand Side Management (DSM) and building energy analysis software
15 tool development.

16

17 Initiated, developed and guided FSEC's building science research programs since 1980.

18 Developed research basis for performance of Radiant Barrier Systems (RBS) resulting in
19 creation of new energy conservation alternatives. Initiated research on moisture sorption
20 in buildings, proved its importance and guided development of FSEC 3.0, a sophisticated
21 hourly building simulation software model for these and other complex building science
22 phenomena. Conceived and developed a novel, high-efficiency, solar-driven desiccant
23 dehumidification and cooling system. Conceived an effective enthalpy storage drywall

1 system capable of overcoming intermittent heat and moisture loads in buildings. Guided
2 FSEC's research on uncontrolled pressure and airflow phenomena in buildings,
3 participating in the development of field and laboratory research projects and directing
4 the development of detailed simulation and modeling capabilities. Conceived, developed
5 and patented photocatalytic VOC destruction methods and devices. Conceived and
6 developed the Florida Building Energy-Efficiency Rating System and the *EnergyGauge*[®]
7 building energy analysis software tools.

8

9 **HONORS AND AWARDS**

- 10 U.S. Patents #5,604,339 and #5,744,407
- 11 RESNET Lifetime Achievement Award, 2003
- 12 Researcher of the Year, University of Central Florida (UCF) Foundation, 1987
- 13 College Award for Excellence in Research, UCF Foundation, 1987
- 14 National Award for Innovation in Energy, U.S. Department of Energy, 1984
- 15 College Award for Excellence in Research, UCF Foundation, 1983
- 16 Outstanding Student Award, Clemson University, 1974

17

18 **EDUCATION**

- 19 Master, City and Regional Planning, Clemson University, 1975
- 20 B.A., Architecture, Clemson University, 1969

21

1 **OTHER PROFESSIONAL ACTIVITIES**

2 ASHRAE Member: Research Chairman, TC 4.4, *Thermal and Moisture Transmission*,
3 1988-89; Chairman, TC 4.9, *Building Envelope Systems*, 1989-1991; Member,
4 ANSI/ASHRAE Standard 140-2001 Standards Project Committee, *Standard*
5 *Method of Test for the Evaluation of Building Energy Analysis Computer*
6 *Programs*, 2001-present

7 Energy TAC Member, Florida Building Commission, 1998-present

8 RESNET Member: Chairman, *Training and Certification Task Force*, 2000-
9 2005; Chairman, *Software Evaluation Task Force*, 2000-2005; Board of Directors
10 member, 1998-present; President, 2004-present.

11 ASTM C-16 Member: Chairman, C-16.21 Task Group 101 on *Radiant Barrier Systems*,
12 1988-91

13 HERS Council Technical Committee Member: December 1995-96

14 Florida Green Building Coalition Founding Member; Chairman, Standards Committee,
15 1999-present.

16
17 **CONSULTING EXPERIENCE**

18 CH2M Hill, Orlando, Florida, October 1991 to 1999

19 New Jersey Housing Authority, February to September 1997

20 Crews & Bodiford, PA, August 1996 to June 1997

21 Hughes Masonry, Louisville, KY, December 1992 to July 1995

22 Sinkler & Boyd, P.A., Charleston, SC, December 1992 to July 1995

23 Holland & Knight, Orlando, FL, July 1994 to March 1996

- 1 Moody, Salzman & Robertson, Gainesville, FL, May 1993-May 1994
- 2 Ryland Homes, Columbia, MD, April 1993
- 3 Piper & Marbury, Washington, DC, April 1993
- 4 Myrtle Beach Air Force Base, Myrtle Beach, SC, August 1993
- 5 Pulte Home Corporation, Bloomfield Hills, MI, March 1993
- 6 Honigan, Miller Schwartz & Cohn, Detroit, MI, March 1993
- 7 Barton Malow Company, Rochester, MN, February 1992
- 8 Frost & Dale, P.A., Bartow, FL, February 1992
- 9 Arvida Contractors Limited, West Palm Beach, FL, February 1991
- 10 Boose, Casey, Ciklin, et al., West Palm Beach, FL, February 1991
- 11 William Lyon Company, Newport Beach, CA, May 1990
- 12 Newport Hotel Associates, Washington, DC, April 1990
- 13 CBY Associates, Washington, DC, 1989-90
- 14 University of Minnesota, Mechanical Engineering College, 1987-90
- 15 General Electric Company, 1988
- 16 Howard Johnson Company, Inc., 1988
- 17

1 **MAJOR RESEARCH CONTRACTS**

2 ***Florida Energy Plan***, Florida Energy Office, *Project Manager*, May 2003 - January
3 2004 (\$249,000)

4
5 ***Florida EnergySmart Schools Program***, Florida Energy Office, *Project Manager*,
6 December 2001-present (\$542,997)

7
8 ***NASEO Energy Smart Schools Project***, National Association of State Energy Offices,
9 *Project Manager*, May 2001-present (\$1,285,794)

10
11 ***AHU Location Multiplier Development Project***, Florida Department of Community
12 Affairs, *Principal Investigator*, November 2000-March 2001 (\$15,000)

13
14 ***Operation Open for Business***, Florida Department of Community Affairs, *Project*
15 *Manager*, March 1999-December 2000 (\$275,000)

16
17 ***Long-Term Community Redevelopment***, Florida Department of Community Affairs,
18 *Project Manager*, March 1999-December 2000 (\$235,000)

19
20 ***Desiccant Algorithms for Florida's Commercial Building Code***, Gas Research Institute,
21 *Project Manager*, April 1998-May 2001 (\$238,000)

22

1 **DOE/SEP Special Codes and Standards Project**, U.S. Department of Energy (DOE)
2 and Florida Energy Office, *Project Manager*, April 1998-March 2001 (\$316,000)

3
4 **End-Use Monitoring for FPC**, Florida Power Corporation, *Project Manager*, February
5 1998- March 2001 (\$550,000)

6
7 **Florida Building Energy Rating System Privatization**, Florida Energy Office, *Project*
8 *Manager*, November 1995-December 1999 (\$900,000)

9
10 **Energy Efficient New Homes Program (Energy Star)**, U.S. Environmental Protection
11 Agency, *Project Manager*, October 1995-November 1999 (\$913,745)

12
13 **Comparison of Duct System Computer Models That Could Provide Input to the**
14 **Thermal Distribution Standard Method of Test (SPC152P)**, American Society of
15 Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and
16 Brookhaven National Laboratory (BNL), *Investigator*, October 1995-September
17 1996 (\$90,000)

18
19 **Florida Building Assessment Systems Initiative**, Florida Energy Office, *Principal*
20 *Investigator*, June 1995-September 1996 (\$75,000)

21
22 **Analysis of Energy Efficiency Options for the Abacoa Development Project,"**
23 MacArthur Foundation, *Investigator*, May-September 1995 (\$26,000)

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Florida Building Energy-Efficiency Rating Systems, Florida Department of
Community Affairs, *Principal Investigator*, September 1993-June 1995
(\$200,000)

FPL BuildSmart Research Project, Florida Power & Light Company, *Project Manager*,
July 1993-December 1995 (\$1,035,000)

Uncontrolled Air Flow in Non-Residential Buildings, Florida Energy Office, *Project*
Manager, October 1992-April 1996 (\$500,000)

Evaluation of Available Insulation Technologies, Florida Power & Light Company,
Principal Investigator, September 1992-August 1993 (\$115,000)

Duct Repair Training Program, Florida Energy Office, *Project Manager*, July 1991-
January 1993 (\$150,000)

Solar Cooling Research Project, U.S. Department of Energy, San Francisco Operations
Office, *Principal Investigator*, October 1986-September 1991 (\$2,000,000)

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