ORIGINAL

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

CALCS PLUS

TESTIMONY OF NEIL MOYER

DOCKET NOS. 040029-EG, 040660-EG

AUGUST 12, 2005

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

Neil Moyer, Research Engineer

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 in Exhibit I

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

Please see attached resume in Exhibit I.

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 in Exhibit I.

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 18 ori9
ECR 19
GCL 20 1
OPC
RCA 21
SCR 22
SGA
SEC 23 1
OTH

None

6. Have you conducted any research concerning the practice of diagnostic testing of duct systems using methodology referred to as "Pressure Pan" testing? Please describe your research activities and the general results of the research.

No

7. Have you ever co-authored and manuals or publications concerning the use of Pressure Pans in diagnostic testing of duct systems?

Yes

8. Please list the titles and who funded the work?

Cummings, J., J. Tooley, N. Moyer, "DUCT DOCTORING: DIAGNOSIS AND REPAIR OF DUCT SYSTEM LEAKS. (DRAFT) 01-93", Florida Solar Energy Center, Rpt: FSEC-GP-48-92, Jun. 01, 1993

Tooley, J., N.Moyer, "The DUCT HANDBOOK – a Practical Field Guide and Reference", Building Science Corporation, 1994

Cummings J., Withers, Jr. C., Fairey, P., Guiney, W., Moyer, N., "CLASS 1 – FLORIDA ENERGY GAUGE CERTIFIED ENERGY RATER TRAINING MANUAL", Florida Solar Energy Center, July 1, 1998

9. Can the Pressure Pan method be used to quantify duct system leakage, in terms of total leakage and out leakage?

No

If yes, is there a direct conversion, via a mathematical equation, to quantify duct leakage in the system?

No

10. Please describe, in layman's terms, the basic advantages and disadvantages and limitations of using a Pressure Pan to quantify duct leakage.

The pressure pan was developed as a diagnostic tool to assist in locating duct leaks to the outside.

Advantages:

a. The procedure is relatively fast and requires only the use of a blower door capable of (de)pressurizing a building to 50 pascals of pressure with respect to outside.

b. It will indicate a general location of the leak(s) and give an indication of its severity.

Disadvantages:

- All of the duct system leakage must be outside of the building pressure boundary; that is if there is leakage to within the building's pressure boundary, then the leakage to outside may be masked (not seen or not seen as needed to be sealed).
- The test tends to exaggerate the leakage between the duct system and the grills and registers.
- Pressure pans do not measure leakage rates.

- Pressure pan readings are sometimes hard to interpret. For example, if two registers or grills are close together, the pressure reading will be low. If the zone containing the duct work is affected by the pressurization of the blower door, then the readings will tend to be low.
- For best results, the house must be (de)pressurized to 50 pascals – leakier or larger houses may require multiple fans to accomplish this.

11. In general, will testing with a pressure pan locate and quantify the leakage from:

a. A supply register inadvertently covered by drywall?

No

b. A hole in the ductwork greater than 5 feet from the register covered by the register?

Maybe

c. Any leakage involved with an air handler assembly and associated plenums located in the garage or attic?

Maybe

d. Supply or return junction boxes and components more than 5 ft away from the Pressure Pan connection?

Assuming that you are referring to leakage at those points – maybe

e. A return disconnect located in a conditioned space?

No

12. Please explain the term Qn as it relates to duct leakage.

Qn is normalized duct leakage. It is the leakage (airflow) measured using a duct tester when the duct system is (de)pressurized to 25 pascals divided by the conditioned floor area. It may represent total duct leakage or outside leakage, depending on the type of duct test completed. It is not the leakage created by the operation of the air handler fan – it is only a test method to determine the normalized leakage rate for the duct system.

13. What does Qn=.05 mean in layman's terms?

It means that for every 100 square feet of conditioned floor area, there is 5 CFM25 of duct leakage (or about 1 square inch of hole in duct per 100 square feet of conditioned floor area. Also, it means that the system is relatively tight.

14. How is Qn determined using accepted duct testing methods?

The total house duct leakage (airflow) at 25 pascals in cfm is divided by the total conditioned floor area.

15. How is Qn determined by using the Pressure Pan method?

It cannot be.

16. Have you performed research on the leakage of air handlers in unconditioned spaces?

No

If so, please describe? On average, what is the leakage of an air handler using standard installation procedures in Qn terms? No research performed

17. **Have you appeared before any state policy-making bodies concerning the use of the Pressure Pan in determining duct leakage?**

Yes

18. If yes, please describe what governing bodies, the date(s) of your appearances and the purpose of your testimony?

FLORIDA BUILDING COMMISSION Energy TAC

July 1, 2002

Purpose was to describe residential duct system testing and pressure pan testing.

What was the result on the issue on which you testified?

DCA02-DEC-173 Petitioner asked for clarification of section 13-610.1.A.1 as to who is a "State approved performance tester"?

Ann Stanton, DCA staff, briefly described the Building Energy Rating System (BERS) for members who may not have known about the program. Geyslaer and Bailey declared some type of contractual relationship to the petitioner, the Florida Power & Light Co.

ACTION: After considerable discussion, Glenn moved that only Class 1 BERS raters may serve as a "State approved performance tester" under section 13-610.1.A.1. The motion was approved unanimously.

DCA02-DEC-175 Petitioner asked for clarification of section 13-610.1.A.1.of the code to answer the question: "What is a total duct system?"

ACTION: On a motion from Glenn, the TAC voted 5 – 3 that section 13-610.1.A.1 of the code means that total duct system leakage means ALL duct leakage to unconditioned space.

DCA02-DEC-174 Petitioner asked for clarification of section 13-610.1.A.1 of the code to answer the question: "What is performance testing?"

ACTION: On a motion from Crum, the TAC voted 5 – 2 that performance testing as per section 13-610.1.A.1 shall be in accordance with the criteria in Chapter 4 Duct System Airtightness Test, of the Class 1 – Florida Energy Gauge Certified Rater training Manual, Version 1.3, July 1, 1998, excepting section 4.3.

19. **Were associates of Florida Power and Light present at the meeting(s) you attended?**

Yes

20. **Is the Pressure Pan protocol accepted by Florida as a viable method to quantify duct leakage fro the State Energy Code or the State BER's system?**

No

21. **To the best of your knowledge, is the Pressure Pan methodology for quantifying duct leakage accepted as a viable method anywhere else in the country?**

No

If so, where? nowhere

21. **Does that conclude your testimony? yes**

Resume

Neil Moyer

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Building Science Consultant

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EDUCATION

California State University Sacramento, 1981, Electrical & Electronic Engineering (Bachelor of Science Degree)

State University New York at Morrisville, 1979, Engineering Science (Associates of Science Degree)

EMPLOYMENT BACKGROUND

1999- Present	Florida Solar Energy Center
1996-1998	Building Science Corp., Westford, MA. Building diagnostician, senior researcher and trainer
1994-1996	Self employed building diagnostician and trainer
1985-1994	Natural Florida Retrofit, Inc., Montverde, FL. Energy conservation contracting & training

CURRENT ACTIVITIES

- Principal Investigator - Building America Industrialized Housing Partnership. Providing technical assistance that results in the construction of thousands of energy- efficient industrialized houses

every year to at least Energy Star Standards while enhancing durability, indoor air quality and cost effectiveness.

- Principal Researcher - Energy Smart Schools. Assist in development and delivery of advanced building science training, certification, and support for design, engineering, and facilities professionals who are involved in the construction and maintenance of Florida's school facilities.
- Principal Investigator - Retrofit of hurricane damaged residences in east central Florida. Five homes will undergo a pre-retrofit analysis and testing to determine the current energy usage profile and expected energy savings, enhanced comfort, indoor air quality and related benefits.

CAPABILITIES

- Building diagnostics, including energy, moisture, and IAQ problems. The buildings range from homes that are small single story low-income shelters to large multi-story multi-million dollar complexes.
- Commercial building diagnostics, including moisture and IAQ problems. This includes small single story office buildings to large multi-story multi-million dollar complexes.
- Training building diagnostics tools (blower door, duct tester, infrared, tracer gas) and techniques (building & duct airtightness, pressure & moisture diagnostics,).

PRESENTATIONS (partial listing)

- Energy Managers Workshop
- Introduction to building diagnostics: Duct systems
- ALA Health House Builder Introduction
- Energy Star Homes Forum
- State of Florida Energy Gauge Class 1 Training & Re-certification Training
- Energy &Environmental Building Association Conferences (EEBA)
- Affordable Comfort Conferences
- Florida Environmental Balancing Bureau (FEBB) Recertification Seminar

- Duct Diagnostics and Repair Seminars
- Diagnosing Moisture Problems
- IAQ - Avoiding the Problem
- Florida Dept of Education: Designing the Failure Proof Building
- ASHRAE: Ventilation in Hot Humid Climates
- USDOE Building America: Project highlights
- Broan-Nutone: Ventilation in SE USA
- American Lung Association Health House: Certification Program
- Huber Engineering: Building Envelope System

ACHIEVEMENTS

- Instructor/trainer ALA's Health House Program
- Co-author and instructor 2-week course on FSEC's 'Designing the Failure Proof Building'.
- Residential building consultant/diagnostician dealing with moisture / mold / mildew related problems, indoor air quality issues, and air distribution problems and complaints. Major clients include Pulte Homes, Town and Country Homes, Cambridge, Homes, DiVosta Homes, Palm Harbor Homes, Southern Energy Homes, Environments For Living, and Hovnanian Enterprises.
- Revised and teach the Florida EnergyGauge Class 1 Rater Training Program. (Rater #392)
- Presenter-trainer for EEBA, Affordable Comfort, FSEC, and AEC (Alternate Energy Corporation). Residential and commercial buildings: includes building pressure diagnostics, airtightness testing, zonal thermal and air boundaries, air distribution system diagnostics, and combustion safety diagnostics.
- Developed and implemented short and long term monitoring protocols for the Building Science Consortium's involvement in DOE's Building America project.
- Investigation of Cooling and Dehumidification Energy Use and Indoor Thermal Conditions in Polk County Schools Permanent Replacement Classroom Buildings
- Co-diagnostics of numerous commercial building failures (either moisture related and/or indoor air quality problems) caused by rain penetration and/or building/zonal pressures. These including

state and federal office buildings, courthouses (state and county), computer facilities (state and insurance), educational facilities (elementary, secondary, high school and colleges - both state and private), hotels and motels (private), nursing home facilities (private) and museums (state).

- Received EEBA's 1993 Joule Award for Innovation which significantly impacts the building industry.
- Designed and developed MAD-AIR™ models [Mechanical **A**ir **D**istribution **A**nd **I**nteracting **R**elationships]. These models show the zonal pressure interactions of duct system leaks, interior door closure, and building airtightness. Currently manufactured and sold by a private company.
- Designed and prototyped a multi-channel computer controlled pressure differential monitoring system. Capable of measuring six channels of differential pressure with 0.1 pascal resolution and displaying on laptop computer screen in "EKG" format.
- Co-developed many diagnostic testing protocols including pressure differential testing techniques used in residential and commercial buildings, including those currently being used in the "Uncontrolled Air Flow" project funded by the State of Florida.
- Team member of numerous residential/commercial duct & envelope failure assessment & monitoring projects: FSEC-Florida and AEC-North Carolina.
- Certified Thermographer # 1613 Infraspection Institute
- Co-developed and trained duct leakage classes for FSEC-FP&L, City of Lakeland, City of Gainesville, Duke Power, Florida Power Corp, Virginia Power, North Carolina Power, Alternate Energy Corporation, State of Maine, and Bonneville Power.

PUBLICATIONS (partial listing)

- Hodgson, A.T., N. Moyer and D. Beal (2005). "Effect of residential ventilation techniques for hot and humid climates on indoor concentrations and emission rates of volatile organic compounds." February 2005, LBNL-57030, Lawrence Berkeley National Laboratory, Berkeley, CA.
- Chasar, D., Moyer, N., McIlvaine, J., Beal, D. and Chandra, S. (2004). "Energy Star Manufactured Homes: The Plant Certification Process," Proceedings of ACEEE 2004 Summer Study, American Council for an Energy Efficient Economy, Washington, DC, August 2004. *Peer reviewed*

- Chasar, D., Moyer, N., Chandra, S., Rotvold, L., Applegren, R. (2004). "Cold Climate Case Study; High Efficiency North Dakota Twin Homes," Performances of Exterior Envelopes of Whole Buildings IX International Conference, Clearwater Beach, Florida, December 2004. *Peer reviewed*
- Chandra, Subrato, Danny Parker, David Beal, David Chasar, Eric Martin, Janet McIlvaine, Neil Moyer (2004). Alleviating Moisture Problems in Hot, Humid Climate Housing. Position Paper for NSF Housing Research Agenda Workshop, UCF Feb. 12-14, 2004.
- McGinley, W. Mark, Alaina Jones, Carolyn Turner, Subrato Chandra, David Beal, Danny Parker, Neil Moyer, Janet McIlvaine (2004). Optimizing Manufactured Housing Energy Use. Symposium on Improving Building Systems in Hot and Humid Climates, Richardson, Texas, May 17-19, 2004.
- McIlvaine, Janet, David Beal, Neil Moyer, Dave Chasar, Subrato Chandra (2004). Achieving Airtight Ducts in Manufactured Housing. Symposium on Improving Building Systems in Hot and Humid Climates, Richardson, Texas, May 17-19, 2004.Report No. FSEC-CR-1323-03.
- Moyer, Neil, Chasar, Dave, Hoak, Dave, Chandra, Subrato (2004). "Assessing Six Residential Ventilation Techniques in Hot and Humid Climates," Proceedings of ACEEE 2004 Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, DC, August 2004. *Peer reviewed*
- Moyer, N.,"Moisture Problems in Manufactured Housing," Home Energy Magazine, March/April 2002
- Moyer, N., Beal, D., Chasar, D., McIlvaine, J., Chandra, S., "Moisture problems in manufactured housing - - probable causes and cures", ASHRAE IAQ 2001, November 4-7, 2001, San Francisco, CA
- Chandra, S., Moyer, N.A., Beal, D., Chasar, D., McIlvaine, J., Withers, C., "The Building America Industrialized Housing Partnership (BAIHP): Enhancing energy efficiency, durability and indoor air quality of industrialized housing", XXIX IAHS World Congress on Housing, Ljubljana, Slovenia, May 21-25, 2001
- Cummings, J., D. Shirey, C. Withers, R. Raustad, and N. Moyer. "Evaluating the Impacts of Uncontrolled Air Flow and HVAC Performance Problems on Florida's Commercial and

Institutional Buildings", Final Report, FSEC-CR-1210-00

- Parker, D.S., J.K. Sonne, J.R. Sherwin, and N. Moyer, November 2000. "Comparative Evaluation of the Impact of Roofing Systems on Residential Cooling Energy Demand." Contract Report FSEC-CR-1220-00, Florida Solar Energy Center, Cocoa, FL.
- Cummings, J.B., C.R. Withers, N. Moyer. 1999. "Field Research to Verify the Accuracy of the Air Leakage computation Methodology of the ASHRAE Standard 152P; Final Report" FSEC-CR-1083-99 Florida Solar Energy Center, Cocoa, FL, May 1999.
- Cummings, J.B., C.R. Withers, N. Moyer, P. Fairey, and B. McKendry. 1997. "Uncontrolled Air Flow in Nonresidential Buildings". INvironment Professional. Volume 3, Number 9. September 1997.
- Cummings, J.B., C.R. Withers, N. Moyer, P. Fairey, and B. McKendry. "Field Measurement of Uncontrolled Air Flow and Depressurization in Restaurants". Given at 1996 ASHRAE Symposia. *ASHRAE Transactions*, 1996, Vol.102, Part 1, p.859.
- Tooley, J.J. and Moyer, N., The Duct Handbook: a Practical Field Guide and Reference, Building Science Corporation, Montverde, FL, 1996.
- Cummings, J.B., C.R. Withers, P. Fairey, B. McKendry, and N.A. Moyer, 1995, "Indoor Air Quality Impacts of Uncontrolled Air Flow and Depressurization in Eight Commercial Buildings in Central Florida". Proceedings of the Eighth Annual Indoor Air Pollution Conference. Tulsa, OK, September, 1995.
- Cummings, J.B., Tooley, J.J., and Moyer, N., Duct Doctoring; Diagnosis and Repair of Duct System Leaks , Florida Solar Energy Center, Cape Canaveral, Florida, May 1993.