**BEFORE THE FLORIDA
PUBLIC SERVICE COMMISSION**

**DOCKET NO. 030623-EI
FLORIDA POWER & LIGHT COMPANY**

IN RE: COMPLAINTS BY SOUTHEASTERN UTLITY SERVICES, INC. (SUSI) ON BEHALF OF VARIOUS CUSTOMERS, AGAINST FLORIDA POWER & LIGHT COMPANY CONCERNING THERMAL DEMAND METERS

REBUTTAL TESTIMONY OF:

EDWARD C. MALEMEZIAN, P.E.

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

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AUGUST 16, 2004

Q. Please state your name and business address.

A. My name is Edward C. Malemezian. My business address is Ed Malemezian Consulting, Inc., 8009 SW Yachtsmans Drive, Stuart, Florida 34997-4823.

Q. By whom are you employed and in what capacity?

A. I am employed by Ed Malemezian Consulting, Inc. ("EMCI") as President and Principal.

Q. Please describe your education and professional experience.

A. I graduated from the University of Florida in 1970 with a Bachelor of Science in Electrical Engineering degree. I have been a registered Professional Engineer in the State of Florida since 1976. In January 1971, I began my career at Florida Power & Light Company ("FPL") in Miami, Florida, as a Relay Trainee, installing and maintaining protective relay equipment in FPL substations and Power Plants. This work continued through 1972 as a Relay Engineer. From 1973 through 1977, I rotated through several FPL service centers as a T&D supervisor, where I managed field operations, maintenance, and construction activities associated with FPL's substation, overhead, underground, and transmission facilities. This included the direct supervision of Bargaining Unit employees and related operations, engineering, and management functions.

In 1978, I was promoted to Meter Superintendent of Southern Division Meters in Miami, Florida, where I managed the daily operations of all Dade County Field Metering, Meter Test Shop, T&D Radio System, Connect and Disconnect Services, and the FPL System Standards Laboratory. In that position, I was responsible for the correct metering on 1 million customers. I directed the activities of ten supervisors and 140 Bargaining Unit employees, with an annual operating budget of $2 million. Among other responsibilities, I was directly involved in the operation of the Southern Division Meter Test Shop and FPL System Standards Laboratory, which eventually evolved into FPL's present Meter Technology Center ("MTC"). In 1981, I rotated through several training positions as a Distribution Engineer, Service Planner, and Service Planning Supervisor in order to better experience FPL's distribution engineering and customer interface activities. From 1982 through 1997, I worked with a number of titles: System Operations Engineer, Construction Services Staff Engineer, Distribution Engineering Staff Engineer, and Distribution Engineering Principal Engineer, as part of the General Office staff, in support of FPL's Power System operations. In these positions, I was responsible for various Meter Engineering activities at FPL. These included establishment of policies, procedures, and selection of equipment to ensure the correct metering on 3.7 million customers. I was the chief architect and project manager in the implementation of FPL's present, very efficient in-service, meter sample test program, and was responsible for its administration for a number of years. I also was a key participant in numerous multi-million dollar projects: Smart Meters, Power Quality Monitoring, MV-90 Load Profile Data Collection System, FPL's 1,000 MW 800,000 point On Call System, FPL's 500 MW CI Load Control System, FPL's 40,000 point residential AMR System, and others.

In 1998, I joined EDMpro.com, an unregulated business of FPL Energy Services, as Data Collection Manager. I managed the competitive metering activities of this Energy Data Management business, achieving success in working with utilities to obtain load profile data access for EDMpro.com clients.

In mid-2001, upon FPL's decision to close EDMpro.com, I retired from FPL and established EMCI. EMCI provides Metering Consulting Services to utilities, utility suppliers, and related companies, delivering solutions to clients that utilize my in-depth knowledge of all the important aspects of the metering industry: field, shop, engineering, project management, and competitive services. EMCI calls upon 33 years of utility experience, including approximately 26 years in metering, and a similar number of years participating in regional, national, and international professional, trade, and standards organizations to provide practical insight into the issues and practices used throughout the industry. I have delivered dozens of presentations at metering conferences, been interviewed or published numerous times in trade magazines, been quoted many dozens of times in industry reports, and even appeared on Public Television in a report on Smart Meters.

Q. Please describe your professional memberships and affiliations.

A My professional memberships and affiliations include: Institute of Electrical and Electronics Engineers (34 years), Florida Engineering Society (33 years), National Society of Professional Engineers (34 years), Registered Professional Engineer in the state of Florida (28 years), Southeastern Metermen's Association (9 years), National Fire Protection Association (1 year), Southeastern Electric Exchange Meter Committee (15 years), Edison Electric Institute working committees (6 years), American National Standards Institute ("ANSI") C12 metering standard committees (12 years), Automated Meter Reading Association (2 years), International Utilities Revenue Protection Association (2 years), and International Electrotechnical Commission Technical Committee 57 Working Group 14 (3 months).

Q. Are you familiar with ANSI Standards for Electric Meters?

A. Yes. I first gained familiarity with these ANSI standards in 1978 as part of my responsibilities as Meter Superintendent of Southern Division Meters. This family of standards serves as the "bible" of requirements for metering in the United States. I continued using these standards on a regular basis throughout my entire metering career at FPL and as a consultant today. In 1992, I became a working member of the ANSI committees assigned to review and revise ANSI C12.1, ANSI C12.10, ANSI C12.16, and ANSI C12.20, all of which deal with electric meters. I brought significant working knowledge on utility practices and on meter testing, particularly those with electronic components, to the ANSI committees. My suggestions for additional tests and improvements to existing tests have been adopted and included in these standards. I continue as an active participant in this standards work, as I feel it allows me to further contribute to the industry, while at the same time, allowing me to keep current on significant events affecting metering and meter testing. My knowledge and commitment to these efforts have been rewarded by the ANSI committee members electing me as one of a select few on the Editorial Committee responsible for final review of each of these standards just prior to publication.

Q. Are you familiar with the provisions in the Florida Administrative Code ("FAC") and the Florida Public Service Commission ("FPSC") rulemaking in the mid-1990s concerning electric metering?

A. Yes. I am very familiar with the FAC and the mid-1990s FPSC rulemaking as it applies to electric metering. During my metering career at FPL, FAC rules have been extremely important in determining policies and procedures regarding metering. An intimate working knowledge of the FAC rules on metering was required in the performance of many of my duties.

Around 1995, FPL assembled a team comprised of members from each Investor Owned Utility ("IOU") involved in electric metering in the state of Florida. This team was gathered to review and possibly seek revisions to the FAC rules as they pertained to electric meter testing. The IOU team's objective was to bring the FAC meter rules up to date, in order to better take advantage of the capabilities of modern meters, to the benefit of both the utilities and utility customers. Close cooperation between the IOU team, the FPSC staff, and other interested parties was required to ultimately secure approval for revised FAC Rules 25-6.022 and 25-6.052 through 25-6.058 in mid-1997. In my role as project manager for the IOU team, I gained even more intimate familiarity with these rules. Regular discussions with the PSC staff in that process allowed me to gain much greater insights into what the rules mean and why they were promulgated.

Q. How familiar are you with the Florida Power & Light Co. Test Procedures and Test Plans for Metering Devices document dated April 3, 1997?

A. I am extremely familiar with the document as I was its author. This test plan and procedure document was required to comply with FAC Rules 25-6.052 and 25-6.056, both as amended on 5/19/97. I wrote this test document from late 1996 through April 1997, again, gaining intimate familiarity with its content and intent. The document called upon my many years of knowledge and experience with FAC rules for metering, ANSI standards, FPL practices and procedures, FPL's previously approved plans for meter testing, and industry practices. This test plan was approved by the FPSC staff in late summer 1997. This document remains in effect today without any updates or modifications.

Q. Have you previously filed testimony in this docket?

A. No, I have not.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to respond to certain assertions made in the direct testimonies of Mr. George Clinton Brown of Southeastern Utility Services, Inc. and Mr. Bill Smith. Both testimonies include statements that are in error or only selectively tell part of the story concerning FPL's thermal meters. The inaccurate or misleading statements that I will address include the following: (1) that all meters in this docket tested outside the accuracy tolerances established by the FPSC, (2) their statements on the internal construction and stability of thermal demand registers, (3) that improper calibration can be the only cause of meter over-registration, (4) that statements attributed to FPL's meter testers concerning failure mechanisms are inappropriate and misleading, (5) that FPL's thermal meter testing and calibration processes do not comply with manufacturer's recommendations, (6) their statements on the effects of heat from the sun on thermal meter registration, (7) that the thermal demand meter is a simple measurement tool that will not gradually over-register demand, (8) Mr. Smith's suggested calibration process, (9) the effect of meter reading errors, (10) tapping on the reference standard, (11) the time required for stabilization after meter covers are removed, (12) their comments on sun shields, and (13) that independent meter tests point toward problems with FPL's thermal test boards.

In addition, my testimony will discuss the method proposed in the direct testimony of Mr. Sidney W. Matlock of the FPSC for determining the percent error to be used in calculating customer refunds or backbills.

Q. **Is Mr. Brown correct in concluding on page 4, lines 7-10 of his direct testimony that all the thermal demand meters in this docket tested outside the accuracy tolerances established by the FPSC?**

A. No, he is not. First of all, the table shown on page 3 of Mr. Brown's direct testimony does not properly list all of the meters at issue in this docket. The discrepancies between Mr. Brown's table and the fourteen meters actually included in this docket are discussed on pages 3 and 4 of Mr. Bromley's rebuttal testimony.

Document No. DB-4, submitted as part Mr. Bromley's direct testimony, provides test results for the fourteen meters that should be included in this docket.

Additionally, I would point out that only four of the fourteen meters were found to have demand errors greater than four percent of full scale. This conclusion is affirmed on page 5, lines 6-7 of Mr. Matlock's direct testimony. Ten of the fourteen meters tested within the demand accuracy tolerances established by the FPSC. These initial tests on all fourteen meters were conducted at load points that represented either 40% of full scale for meters on high scale or 80% of full scale for meters on low scale. FPSC Rule 25-6.052 (2)(a), FPL's approved Test Procedures and Test Plans for Metering Devices, dated April 3, 1997, Paragraph III D.3.c, and ANSI C12.1-2001, Paragraph 5.2.1.1, all state that "the performance of a mechanical or lagged meter or register shall be acceptable when the error of registration does not exceed four percent in terms of full-scale value, when tested at any point between 25 percent and 100 per cent of full-scale value." Therefore, all the initial tests on these fourteen meters were conducted in accordance with accepted practices and complied with the appropriate rules for meter testing by FPL.

Eight of the high scale meters were tested a second time at a load that represented 80% of full scale, and only then, did they test just outside the established limits. These second tests at 80 per cent of full scale were performed as a customer accommodation, but were not required by FPSC rules. I'll also note that the average percent of full scale associated with these customers' actual historical usage in the twelve months prior to the 1V meter change out is approximately 60 percent, as calculated from the prior demand data provided in Exhibit 5 of Mr. Brown's direct testimony.

Q. On page 5, line 7 of his direct testimony, Mr. Brown contends that thermal "... meters are pretty straightforward in their design and operation ...", yet he goes on for over a page on how thermal meters operate. Is Mr. Brown correct in his assertions that thermal meters are straightforward devices?

A. The fact that it took Mr. Brown over a full page to describe the operation of thermal meters is indicative that they are pretty complex devices, dependant on the correct operation of a number of components working in harmony in order to function properly. Mr. Brown's descriptions of thermal meter operation are, for the most part, correct. He is, however, grossly in error on page 5, line 16 when he states that "... when current is flowing through the meter, one of the bi-metal coils is heated through a resistive ...." In actuality, a representative amount of load current flows through the resistive heaters of both bi-metal coils, generating differential heat in the two bi-metal coils, which is a direct function of the amount of real power being delivered to the customer. This is a fundamental concept in the operation of thermal meters and reinforces Mr. Brown's own admission that he is not knowledgeable in this area.

Q. On page 2, line 23 of his direct testimony, Mr. Smith contends that "... the thermal demand meter is a relatively simple measurement tool with few critical parts." Is Mr. Smith correct in his assertions that the thermal meter is really a very simple device with few critical parts?

A. No. He is not correct. In comparing the thermal demand meter against its chief competitor of the 1970s and 1980s, the mechanical demand meter, we agree that the thermal meter was a simpler device. This relative simplicity was one of the primary reasons FPL chose it over the mechanical demand meter. Fewer moving parts contributed to the stability and reduced maintenance required of the thermal meter. But to characterize the thermal meter as a simple device with few critical parts is a gross misrepresentation of the facts. One merely needs to review Duncan / Landis & Gyr's Bulletin 841, attached as Exhibit E to Mr. Smith's direct testimony, to see how complicated the thermal meter really is. This bulletin begins with 13 pages of pictures, theory of operation, calibration instructions, repair and maintenance instructions, followed by 6 pages of specifications and application guidelines, followed by two pages of troubleshooting instructions, ending with 12 pages of application diagrams. These are not the instructions for a simple device. As with any metering device, each one of the components that go into the thermal meter are critical to its proper operation. Changes in the characteristics of any one of these components will affect demand registration. Considered in that light, every one of the components can be considered critical. Mr. Smith is clearly in error with his statement that there are "few critical parts" in the thermal meter.

Review of Figures 2, 3, 5 and 6 and reading the first seven pages of text in Landis & Gyr Bulletin 841 reveals the critical nature of most all components in the thermal meter. Instructions are given in painstaking detail for proper procedures to use for calibration and repair of the thermal meter. If the parts were not critical, then such care would not be required by the manufacturer. Among the components that are deemed absolutely critical to the proper operation of the thermal meter are: the zero calibration spring, the full scale calibration spring, the front bi-metal coil, the rear bi-metal coil, the front heater elements, the rear heater elements, the integrity and thermal characteristics of the front heater housing, the integrity and thermal characteristics of the rear heater housing, the front bearing, the rear bearing, the balance and positioning of the red pusher pointer assembly, the balance and positioning of the black maximum pointer, the condition of the grease in the damping assembly, the condition of the electrical connections in the range changing switch, and the condition of the three dozen or so soldered connections in the potential and current circuits of the meter. Many of the components are mechanical in nature and subject to some wear and tear and malfunction. If that were not the case, then Landis & Gyr would not have found it necessary to include so many pages in Bulletin 841 on how to replace them.

Q. Are both Mr. Brown and Mr. Smith correct in their assertion that only improper calibration can cause thermal demand meters to over register?

A. No. They are clearly incorrect in this assertion. Both Mr. Brown, on page 6, lines 4-21 of his direct testimony and Mr. Smith, on page 3, lines 19-25 of his direct testimony, have overlooked a number of fundamentals in trying to support and promote their positions. As discussed in the previous answer, thermal meters contain a number of components critical to the stability of the meter. I am not an expert in materials science, but as an engineer, I know that all mechanical components are constructed of materials that can change characteristics over time. I also know that regular and continued temperature cycling, such as that which occurs under the cover of meters, accentuate changes in the characteristics of materials.

When one looks at the effects of the characteristics of the zero calibration spring and the full scale calibration spring, one can appreciate how a slight change in the spring constant of either spring can cause changes in the calibration of the meter. These changes could occur in either direction, over-registration or under-registration, depending on the direction of the change and to which spring it applied.

Similarly, the balance and match in characteristics of the two bi-metal coils are critical to the continued stability of the calibration of the meter. Mr. Brown states on page 6, lines 9-10 of his direct testimony that "the bi-metal coils are subjected to an aging process prior to assembly into a meter, and therefore are stable indefinitely." This statement is an open admission that the bi-metals change characteristics over time. Aging is simply a method that attempts to cycle the material in such a manner that delivers most of this change before the component is manufactured into a finished product. Aging is always a trade off in balancing the time (and expense) up front against stability in the future. If this were a perfect world and materials always behaved perfectly, then the claim of "stable indefinitely" might have some merit. However, all is not perfect, so it is reasonable to conclude that the bi-metal coils change characteristics over time. As in the case with the springs, the changes in the bi-metal coils could result in the meter over-registering or under-registering, depending on the direction of the change and which bi-metal coil was affected most.

Similarly, the balance and electrical match in characteristics of the resistive heater elements are critical to the continued stability of the calibration of the meter. Changes in their characteristics will result in over-registration or under-registration conditions.

Similarly, the physical integrity and match in thermal characteristics of the heater housings are critical to the continued stability of the calibration of the meter. Changes in their characteristics will result in over-registration or under-registration conditions.

Changes in the front and rear bearings due to corrosion or foreign objects could affect registration. Generally these conditions result in under-registration, but it is possible that if the corrosion or trash were in place during calibration, but subsequently cleared out, then the meter would later over-register.

Changes in the balance and positioning of the two pointers could affect registration. Generally these conditions result in under-registration, but it is possible that if pointer problems were in effect during calibration, but subsequently cleared out, then the meter would later over-register.

Changes in the condition and viscosity of the silicone grease in the dampening assembly could affect registration. Changes in the characteristics of the silicone grease could result in under-registration or over-registration, depending on whether the grease increases viscosity (hardens) or decreases in viscosity (thins and runs out). Both of these conditions have been observed and experienced at FPL in the past, and confirmed to affect registration in the directions noted.

Changes in the conductivity of the electrical connections in the range changing switch and in the three dozen or so soldered connections in the potential and current circuits of the meter can affect registration. Changes in the conductivity of these connections could result in under-registration or over-registration, depending on whether increased resistance was introduced to the retarding, front thermal element or the driving, rear thermal element.

Depending on the nature of the changes experienced above, it is impossible to predict which of them might have occurred and whether they occurred suddenly at a discrete point or points in time or gradually over the time the meter was in service.

Last, as a parting observation on the topics discussed above, since we are not operating in a perfect world, it is clearly reasonable to expect that materials will change over time. We recognize that fact and Landis & Gyr recognizes that fact. The claims of Messrs. Brown and Smith have no factual basis and are clearly in error. If Landis & Gyr could have made a meter with perfectly made parts, and one with parts that never changed characteristics, they could have and would have left off all the adjustment screws. These adjustment mechanisms are there to allow the meter to be brought back within calibration limits after the parts within the meter have changed characteristics over time.

Q. What other indications are there that both Messrs. Brown and Smith are incorrect in their assertion that thermal demand meters cannot gradually over-register and therefore, the only plausible explanation (for over-registration) is improper calibration?

A. The fact of the matter is that six of the fourteen meters in this docket were never calibrated by FPL. Therefore, their assertions have no basis. These meters were purchased new by FPL from Landis & Gyr in 1989 through 1992. Landis & Gyr 100% tested these meters before they left the factory. They were calibrated to have zero error just before they were boxed by Landis & Gyr for shipment. These meters, upon receipt by FPL, were all tested per the then new meter acceptance procedures at that time. These new meters were as-found tested by FPL and found to have zero error. Therefore, there was no need for FPL to remove meter covers and recalibrate any of these six new meters. As a result, the as-left tests were also recorded as zero error. These would be noted as 0 / 0 on the meter test reports. For the meters to be improperly calibrated and tested, both Landis & Gyr and FPL would have had to make identical mistakes, in both the direction and amount, in their demand meter testing processes. This is an extremely unlikely event and not at all reasonable to assume to have occurred.

Subsequent to the initial tests on these six meters (performed when they were new in the 1990s), FPL never tested these meters again until they appeared at FPL's Meter Technology Center in August 2002, as part of the 1V meter retirement project. As-found testing performed in August 2002 indicated that these six meters all had changed registration in-service from the zero error condition when they were initially placed in service. One could assume that the only reasonable explanation for these changes in registration is that one or more of the materials discussed previously changed characteristics in a manner that caused the meters to either gradually or suddenly over-register some time after they were placed in service and before they were removed for testing in 2002. However, one thing is known for certain, FPL did not improperly calibrate these meters.

Q. **What is the relevance of Mr. Brown's assertion on page 7, lines 1-5 of his direct testimony, and repeated by Mr. Smith on page 3, lines 1-17 of his direct testimony, that FPL meter testers were questioned and were "... unaware of any mechanism that can cause these thermal meters to gradually over-register demand" ?**

A. Their assertion is an attempt to mislead the Commission into believing that the only explanation for over-registration is improperly calibrated meters. Mr. Herbster, Mr. Faircloth, and Mr. Teachman are all involved in testing meters, not repairing meters. FPL does not repair these meters. Since the meter testers never have cause to repair these thermal meters, they never have reason to open them up and take them apart in order to investigate why they are in error. Without the need to fix them, they would not be expected to know the answer to this question, as posed to them at their depositions. When meters were determined to be too far out of tolerance to be adjusted, the meter testers simply place red Property Disposal Report (PDR) stickers on the meters to signify that they should be disposed.

Q. Both Mr. Brown, on page 8, lines 11-17 of his direct testimony, and Mr. Smith, on page 9, line 6 through page 11, line 16 of his direct testimony, contend that "FPL's stated calibration procedures do not comply with the manufacturer's recommendations for calibration." Are Mr. Brown and Mr. Smith correct in their assertions that FPL does not test thermal meters in accordance with manufacturer's recommendations regarding the use of test covers?

A. No, they are incorrect in their assertions. Their first assertion states that a test cover is required for calibration testing by the manufacturer, as referenced in Landis & Gyr Bulletin 841, Technical Manual on the TMS and TMT thermal demand meters. However, page 5 of Bulletin 841, actually states that ".... Thermal demand meters should always be tested with the covers in place. When the cover is removed from the meter, the cooler outside air rushes in and ..... For this reason, any calibration of the meter must be done quickly, after the cover has been removed, preferably within 20 seconds .... The efficiency and accuracy of calibrating thermal demand meters can be improved by the use of test covers that have 3/8" diameter holes …." In reading the preceding excerpt from Landis & Gyr Bulletin 841, it is clear that two methods for calibrating meters are acceptable to the manufacturer: one which involves quickly removing the cover and one which involves the use of special test covers. FPL has elected to use the first method, namely quickly removing the meter cover, making the required calibration adjustment, replacing the cover, then waiting an appropriate time to recheck the adjusted registration. Messrs. Brown and Smith contend that the method employing test covers is the only acceptable method recommended by the manufacturer. Landis & Gyr Bulletin 841 positively contradicts their contention. Further, FPL believes its method is more efficient and far superior to that of using test covers for many reasons. First of all, FPL meter testers are very skilled and adept at quickly removing meter covers, performing the adjustment on the appropriate calibration screw, and then quickly replacing the cover. In their depositions, both meter testers Faircloth and Herbster said that they were able to perform calibration adjustments in 15 seconds or less total elapsed time for the cover being off the meter. Note that Messrs. Faircloth and Herbster's stated 10 to 15 second time frame for the covers being off was well under the 20 seconds suggested by Landis & Gyr as the (maximum) preferred time.

Second, the use of test covers is not without its own set of problems. Test covers have (at least) two 3/8 inch diameter holes drilled in the front of each cover. These holes are always open, allowing cooling air to constantly enter the front of the meter. This cooling air is present for the entire three hour or so testing cycle, as contrasted with a 10 to 15 second cooling period created in the FPL process. I contend that the FPL process is a closer representation of real world conditions than the process using test covers. In fact, during the early 1980s, I recall Landis & Gyr experienced calibration problems created by the use of test covers. Something changed in the placement of holes in their factory test covers or nameplates that affected the position through which the cooler air, streaming in through the test cover holes, hit the meter and its thermal elements. This resulted in a miscalibration of the meter by Landis & Gyr. FPL and all other utilities performing acceptance tests found that many, if not all, of these new meters required recalibration before they could be placed in service. Landis & Gyr eventually tracked down the problem to test covers, and made appropriate modifications to fix things in approximately 1983.

FPL disagrees with Landis & Gyr's statement that the use of test covers improves the efficiency of the testing and calibration of thermal demand meters. Perhaps it makes sense for Landis & Gyr, with 100% brand new meters, all of the same manufacturer and type, but it does not for FPL. The use of test covers presents a logistical nightmare in a production test facility like FPL's Meter Technology Center. Through the years, FPL has purchased thermal demand meters from Duncan / Landis & Gyr, Westinghouse / ABB, Sangamo / Schlumberger, and General Electric. Throughout time, each manufacturer made several models of thermal meters, as in the case of the Landis & Gyr model TH, which was replaced with the TR which was replaced with the TMT. Further, each came in one version for single phase and a different one for polyphase. Sometimes self-contained and transformer rated meters were different in sizes, too. The bottom line impact of all these different models of thermal meters would be a requirement to have many different sizes and types of test covers in order to fit all the variation in meter covers and placement of calibration screws. This translates to many test covers to store, time to select the correct test cover, and many "removed" covers to store and eventually get back on the right meter.

Finally, the testing efficiencies asserted for using test covers totally disappear unless the majority of meters passing through the shop require calibration. If you are going to incorporate test covers in your thermal testing process, then you probably need to use them on every meter going through the shop. It takes time and effort to do this. Meters that are new need to be tested but rarely need calibration. Meters that become the subject of a complaint test, witness test, sample test, and those to be disposed of, all receive as-found tests only, without any calibration on their first pass through the shop. Test covers are not practical or efficient for meters that do not require calibration.

Q. Continuing on with Messrs. Brown and Smith's contention that FPL fails to follow manufacturer's recommended procedures for calibration, can

you comment on their assertion that 45 minutes are required for stabilization after adjustments are made?

A. The situation described by Messrs. Brown and Smith is one where a meter has been tested (for the appropriate 45 minutes or more) and found to be in need of adjustment. The FPL process would be to remove the cover, make the adjustment, and then replace the cover, as described in the previous answer, all in 10 to 15 seconds. At this point the meter should be very close to zero error, and certainly within the 2 percent error accuracy tolerance as established by FPL's approved test procedures for adjusted meters. Further testing is not required by FPL's approved test procedures, FPSC rules or by Landis & Gyr's recommendations. Page 5 of L&G Bulletin 841 states ".... After calibration adjustments …if other tests are to be made, the cover should be replaced as soon as possible. If it is desired to recheck a calibration point after the cover has been removed and replaced, the present load on the meter must remain constant for a minimum of 45 minutes after replacing the cover …" I don't see any requirement by the manufacturer that a reading must be taken. Further, Landis & Gyr Bulletin 841 takes a very conservative approach, one which reflects that Landis & Gyr does not know how long meter testers might actually have the cover off of the meter. As a manufacturer, Landis & Gyr is providing instructions that reflect all reasonable possibilities. Their stated 45 minutes reflects the worst case situation. FPL has elected to take this additional read after a minimum of 10 minutes for stabilization as a reasonable practice to help verify the accuracy of the original adjustment. A period of ten minutes was established by FPL as being more than adequate for this verification check, for a number of reasons: first, the meter has just gone through a full 45 minute test and adjustment, if necessary, to zero error; second, after 10 minutes, the response characteristic of a thermal meter causes the red indicating pointer to reach 80% of the value it would ultimately attain (reference L&G Bulletin 841, Figure 4) versus 99.9% after 45 minutes; third, FPL meter testers are looking for movement of the red pointer away from the desired calibration point, versus an absolute determination in how far the pointer might be off; and fourth, 10 minutes has been determined by FPL to be a sufficient amount of time to wait in order to look for movement – in other words, if it has not moved after ten minutes, it is not going to move any noticeable amount more by waiting another 35 minutes.

Q. Continuing on with Messrs. Brown and Smith's contention that FPL fails to follow manufacturer's recommended procedures for calibration, can you comment on their assertion that adjustments are made without backlash compensation?

A. Backlash compensation describes the situation where the black maximum pointer exerts a very small frictional force on the red indicating pointer as the red pointer drives the black pointer upscale. With proper viscosity of grease and without obvious drag of the black pointer on the scaleplate, the backlash is almost negligible. If, upon testing, the meter is found to under-register, Messrs. Faircloth and Herbster, two of the meter testers at FPL, indicated in their depositions that they adjust the full-scale adjustment screw in the direction that moves the red indicating pointer upscale. In this configuration, the black maximum pointer is pushed upscale by the red pointer, providing the appropriate amount of backlash. Therefore the backlash compensation assertions made by Messrs. Brown and Smith are not applicable to this situation. If, upon testing, the meter is found to over-register, then Messrs. Faircloth and Herbster, two of the meter testers at FPL, indicated in their depositions that they adjust the full-scale adjusting screw in the direction that moves the red indicating pointer downscale. In this configuration, the black maximum pointer would not provide the small amount of backlash compensation to the red indicating pointer. While not a desirable practice, if it were to occur, the effect of this action would result in the possibility of the demand slightly under-registering in normal operation in the future. If any backlash were present in normal operation, it would tend to retard the movement of the combined red and black pointers. Last, as Mr. Bromley explains in his rebuttal testimony, six meters were new and, when tested, did not require any calibrating adjustments by FPL.

Q. Continuing on with Messrs. Brown and Smith's contention that FPL fails to follow manufacturer's recommended procedures for meter testing and calibration, can you comment on their assertion that some of FPL's meter testing is performed at less than 50% of Full Scale?

A. FPL's meter testing conforms to all applicable codes and standards for demand testing. FPSC Rule 25-6.052 (2)(a), FPL's approved Test Procedures and Test Plans for Metering Devices, dated April 3, 1997, Paragraph III D.3.c, and ANSI C12.1-2001, Paragraph 5.2.1.1, all state that "the performance of a mechanical or lagged meter or register shall be acceptable when the error of registration does not exceed four percent in terms of full-scale value, when tested at any point between 25 percent and 100 per cent of full-scale value." These codes and standards have contained acceptable test points as being between 25 percent and 100 percent of full scale for a long, long time, at least 40 years by my quick research. If Mr. Brown or Mr. Smith have a problem with these test points, I suggest they approach the appropriate regulatory or standards bodies to petition that these rules or standards be changed. To my knowledge, neither Mr. Brown nor Mr. Smith has made such an attempt.

Landis & Gyr Bulletin 841, on page 6, states that "....the calibration test point can be made at any point from 50% of full scale to 100% of full scale." The use of the word "can" indicates some latitude in interpreting Landis & Gyr's preferred range for a calibration test point. It might be different had L&G used the word "must" or even "should", but they did not use either of those more emphatic terms. In any case, the language in the Landis & Gyr Bulletin 841 certainly does not take precedence over FPSC Rule 25-6.052 (2)(a) which authorizes a calibration test point range of 25 percent to 100 percent of full scale.

Q. On page 9, line 14 through page 10, line 15 of his direct testimony, Mr. Brown describes the effect of heat, including heat from solar radiation, on thermal demand registration. Does heat from solar radiation affect thermal demand registration, and if it does, does it cause under-registration or over-registration?

A. Mr. Brown presents confusing and somewhat conflicting information on the effect of heat from solar radiation on thermal demand registration. The effects of heating from solar radiation on demand registration are really very straightforward and simple to understand. As has been explained in several documents attached as Exhibits to previous FPL witnesses deposed by SUSI, and on page 5 of Mr. Brown's direct testimony, the thermal meter works on the principal of differential heat applied to the front (retarding or "cool") thermal element and the rear (driving or "hot") thermal element. The bi-metal coils in each of the two elements are wound in opposite directions in order to cancel out the effect of ambient, background temperatures. This technique works extremely well when the temperature contained under the meter cover is consistent and not rapidly changing. For this background cancellation to work properly, it is imperative that the temperature gradient inside the meter, from the front to back, be reasonably close to zero. Direct, bright solar radiation striking the front of the meter could heat the front of the meter more than the rear of the meter, setting up a potentially significant temperature gradient from front to rear. Since the front, retarding thermal element is now exposed to higher "ambient" temperatures than the rear, driving thermal element, the red thermal indicating hand is driven downscale by the ambient temperature differential set up by the uneven heating. The amount of under-registration would be proportional to the intensity of the heating and inversely proportional to the length of time it is applied. After some period of time, the temperature under the cover would stabilize and the gradient from front to back would be reduced. Once the external heating is removed, the red indicating pointer returns to exactly the point it should be due to the electrical load measured by the thermal demand meter. In the course of investigating this phenomena, as triggered by Mr. Brown's inquiries, approximately 150 meters were tested by FPL to evaluate this external heating effect and found to behave exactly in the manner described above, whereby the external heating caused either no demand mis-registration or some demand under-registration. Demand registration on the meters returned to their starting point after the external heating was removed and the meters were allowed to return to ambient temperature. Only one meter was ever found that over-registered after the external heating was removed.

Q. Having concluded that heating from solar radiation might cause under-registration in demand indication, should the Commission be concerned about its impact on demand billing?

A. No, not at all. Demand billing would not be affected by these instances of under-registration. Demand billing reflects the maximum demand experienced by the customer during a given month. A single 30 minute period is all that is required to set this demand. For external heating to be a factor in the positioning of the black maximum pointer, the under-registration due to heating from solar radiation would need to occur at the time of peak demand. For instance, if the maximum external heating caused under-registration occurred at 4:00 PM, but the customer's electrical load peaked at 6:00 PM, it would be totally moot as to where the red indicating pointer was at 4:00 PM. If one believes that the maximum external heating caused under-registration were to occur simultaneously with the time of electrical peak load, then to be a factor, the customer would have to experience the external heating masked peak for each of the thirty days in the month. All you would need would be a single cloudy day for the red and black pointers to measure the customer's true peak load. Therefore, heating from solar radiation should have little to no impact on demand billing.

Q. On page 4, line 8 through page 6, line 13 of his direct testimony, Mr. Smith describes his suggested calibration procedures for thermal demand meters. Are Mr. Smith's suggested calibration procedures correct?

A. For the most part, Mr. Smith's suggested calibration procedures are consistent with manufacturer recommendations and with FPL's own procedures. There are, however, several notable exceptions worthy of discussion. In Mr. Smith's step 4, page 4, lines 14-16, I would not check the black pointer for friction until after I had performed my as-found tests. Moving the pointer up and down the scale could obliterate any problem in friction or grease that might have been present. Further, as discussed earlier, I would not use test covers. This comment continues in his step 5.

In step 7, page 4, lines 23-25, I would not adjust the zero calibration until after I had completed my as-found test for the full scale calibration test.

In step 9, page 5, lines 9-13, I would not test at 75% of full scale. As noted earlier in my testimony, the FPSC rules allow FPL to test demand at any point from 25% to 100% of full scale. For customer request tests or FPSC complaints, I would test demand at the customer's actual historical average percent of full scale, as determined by the customer's previous demand history. The rationale and process for selecting this test point is described in pages 13-15 of Mr. Bromley's direct testimony and on page 6, lines 5-15 of Mr. Matlock's direct testimony.

In step 2, page 5, lines 19-23, I cannot see how it is possible to read a reference standard with 100 whole number marks out to two digits past the decimal point (I believe that this is what Mr. Smith is suggesting). Mr. Smith is also in error in his formula for percentage error. His formula provides the absolute percent registration of the point under test. First, he is calculating percent registration versus a percent error, even though he calls it percent error. Second, the prescribed method for expressing percent error of demand meters is stated in terms of full scale. This method has been in the rules and standards for at least 40 years. If Mr. Smith has a suggestion to make to the appropriate rulemaking and standards bodies, again, he is free to do so. In the meantime, FPL must follow the rules, as approved by the FPSC for calculation of percent error.

Q. On page 7, line 14-24 of his direct testimony, Mr. Smith describes the effect that reading errors on the thermal reference standard have on the resulting accuracy calculations. What point is he trying to make in asserting that this reference standard has ".... A resolution of 100 increments. Therefore if read to the nearest increment without interpolation the results would be skewed ...."?

A. It is true that the thermal demand test board reference standard has 100 tick marks on its scale. These marks are very close together, making interpolation very difficult, at best. Therefore, FPL meter testers have stated in their depositions that they generally round their readings off to a whole number, without interpolation. Mr. Smith's analysis of the data from the 3,900 1V meters tested bears this out. Unfortunately this is the best that can be done with the equipment at hand. A similar situation exists in the ability to accurately read the demand pointer position of the meters under test. These too, have crowded scale plates, with 70 or so increments on them. In summary, it is very difficult or impossible to read the test board reference standard and meters under test any closer than is presently being done by FPL. Also, it is my understanding that each one of the readings for the reference standard and for the meter under test, for all the meters in this proceeding, were agreed to by Mr. Brown and FPL. Accordingly, this should not be an issue for this proceeding.

Q. **On page 8, lines 1-7 of his direct testimony, Mr. Smith describes his perceived problem that tapping the reference standard is improper. Is Mr. Smith correct that tapping is bad?**

A. No. Tapping on meters, both reference standards, meters under test, and regular meter reading, is a long standing process that has been practiced by folks needing to accurately read meters. This practice of tapping on meters is universal in that it is generally used in all industries where meters and gauges are required to be read. Meter tester Brian Faircloth stated on page 56, line 8 through page 58, line 18 of his deposition, that he was taught about tapping while receiving training on the thermal test board from his predecessor at the thermal test board. Landis & Gyr Bulletin 841, on page 4, says to ".... Tap meter lightly while making this adjustment...." Even though taken out of context, this statement demonstrates that tapping the meter cover, while not required, is an accepted practice.

Q. On page 14, lines 4-13 of his direct testimony, Mr. Smith describes the need for sun shields on thermal demand meters. Has Mr. Smith uncovered a problem that FPL was deficient in not installing (external) sun shields on its thermal demand meters?

A. No, absolutely not. Shielding the two thermal elements is very important. Heating from solar radiation can have an effect on the registration of thermal demand meters. As discussed in an earlier answer, external heating can cause temporary under-registration in these meters. However, I am confused over Mr. Smith's revelation of this issue as relevant to the 14 meters in this docket. In the distant past (30 to 40 years ago), certain meters were especially sensitive to the effect of heating from solar radiation. The Landis & Gyr TR thermal is an example of this type of meter. The TR had it thermal elements located above the disc, just under the top surface of the meter cover. The original TR meters were supplied with painted covers in order to block or shield solar radiation from beaming down on top of the two thermal elements. Later TR meters were shipped with clear covers and a clip-on metal sun shield just inside the cover, blocking perhaps 50% of the top surface of the meter.

When the polyphase TMT was introduced by Landis & Gyr in 1974 to replace the TR, it was provided with an internal, non-removable metal sun shield that can readily be seen by looking into the top front of the meter. The metal sun shield is clearly visible inside the TMT, fully covering the top of the two thermal elements. The 14 meters at issue in this docket all are equipped with this factory installed sun shield. For this reason, I am confused by Mr. Smith bringing up sun shields as an issue with TMT demand meters, since these meters already have them. Perhaps Mr. Smith is confusing the TR with the TMT. In reading his background material from page 1 of his direct testimony, I see that Mr. Smith left Duncan / Landis & Gyr in 1972, two years before the TMT was introduced. I would therefore expect he is more familiar with the TR than the TMT.

Q. Mr. Brown, on page 8, lines 19-24 of his direct testimony, and Mr. Smith, on page 15, lines 1-20 of his direct testimony, describe concerns with differences in test results conducted by independent meter tester versus tests conducted by FPL. Please comment.

A. FPL takes great pains to ensure meters are accurately tested. Not having been a participant in any of the independent testing puts me at a serious disadvantage in explaining why differences in test results occurred. However, there are two comments I can make. First, FPL's test was conducted in a controlled environment compared to the uncontrolled conditions in Mr. Brown's carport. Additionally, FPL test results determined an over-registration error that was greater than the error determined by the independent test, so I'm not sure what issue Mr. Brown is raising.

Q. On page 16, lines 6-24 of his direct testimony, Mr. Smith describes concerns with the procedures used in the calibration of FPL's thermal demand meter test boards. Are any of Mr. Smith's concerns warranted?

A. No. FPL takes appropriate measures to ensure these thermal test boards are calibrated accurately. The FAC rules, FPL's approved Test Procedures and Test Plans for Metering Devices, dated April 3, 1997, and ANSI C12.1 are all silent on the requirement for calibrating demand test boards. Therefore, FPL utilizes the manufacturer's recommendations as a minimum set of requirements for calibration of the test boards. The two thermal boards are both Catalog Number 1132 by Eastern Specialty Company. Eastern Specialty Bulletin No. 134, page 7, section 18, provides guidance on the method to be employed in testing the calibration of the thermal board's reference standard. Through the years, FPL has performed these calibration tests on a yearly basis, a practice that remains in effect today.

As a follow-up to Messrs. Brown and Smith's concerns on the calibration accuracy FPL's thermal test boards, FPL conducted a test using product transfer standards ("PTS") to verify the calibration accuracy of the two thermal test boards. This test involved taking two production (regular) demand meters into the standards laboratory to determine their accuracy with a high degree of certainty. The PTS meters were then taken to the thermal boards, loaded up with 10 other demand meters, where they were all tested as demand meters. The registration of the PTS meters were compared against the reference standard and conclusions were then drawn on the accuracy of the thermal reference standard. The results of those tests are as follows:

Standard Reference Meter		PTS #1	PTS #2
Test Board 3:	1.21	1.22	1.22
Test Board 4:	1.21	1.20	1.20

As a result of these PTS tests, FPL concluded that the reference standard meters in both thermal test boards were reading within acceptable accuracy limits.

Q. On page 9, lines 4-17 of his direct testimony, Mr. Matlock describes a proposed method for determining the percent error to be used in calculating customer refunds or backbills. Is Mr. Matlock's proposed method consistent with FPSC rules?

A. For the most part, Mr. Matlock's proposed method is consistent with FPSC rules. **There is, however, one exception worthy of discussion.** Rule 25-6.103(3) states that "… when a meter is found to be in error in excess of the prescribed limits, the figure to be used for calculating the amount of the refund or charge … shall be that percentage of error as determined by the test." In the case of the demand meters, the "test" requirement of Rule 25-6.103(3) is provided by Rule 25-6.052(2), which states that the error of registration is defined in terms of full scale value. Determination of demand error expressed in terms of full scale value has been in the rules and ANSI standards for at least 40 years. Therefore, the literal interpretation of Rules 25-6.103(3) and 25-6.052(2) require calculation of percentage of error in terms of full scale value and not in terms of "... the correct (true) value ..." as proposed by Mr. Matlock on page 9, Step 4 of his direct testimony. As Mr. Matlock states on page 7, line 21 through page 9, line 3 of his direct testimony, Rule 25-6.058 does not specifically provide a method to determine the amount billed in error for demand meters. However, at the time Rule 25-6.058 was last amended on 5/19/97, the associated rulemaking process provided a ready opportunity to include method(s) for billing calculations associated with demand errors, had they been felt necessary. Since no such effort was made in amending Rule 25-6.058, one can conclude that the parties involved in the 1997 rulemaking considered the provisions of Rule 25-6.052(2) to be the appropriate method used for determination of the amount billed in error on demand meters. Rule 25-6.052(2) requires calculation of percentage of error in terms of full scale value.

Q. Also included in Mr. Matlock's proposed method, discussed on page 9, lines 6-10 of his direct testimony, are provisions to "... calculate the average billing demand from the complete billing cycles contained in the refund/back bill period ... (and) ... to retest the meter at this average billing demand ..." Is Mr. Matlock's proposed demand test point

consistent with FPL's modified process for customer requested meter tests discussed on page 13, line 13 through page 15, line 13 of Mr. Bromley's direct testimony?

A. Yes, it is consistent with the customer request test process FPL modified in late 2003. FPL's process uses the "... customer's percentage of full scale reading as determined by the average of the customer's actual previous 24 months percentage of full scale readings." The only point of difference between the FPL process and Mr. Matlock's proposed method is in determination of the number of months of historical data to be used: FPL's method uses the 24 months prior to the meter change, Mr. Matlock's method uses the actual months in the refund / backbill period. Both methods are similar and intended to select a demand test point reflective of the customer's actual average demand usage prior to the meter change. In addition, FPL's process states that no meter will be tested at less than 40 percent of full scale value, while Mr. Matlock is silent on this issue.

Calculations and data presented in Exhibit SWM-2 of Mr. Matlock's direct testimony, however, use the customer's maximum billing demand during the refund period (12 months) versus the average billing demand during the refund period. FPL believes that the customer's average demand is more reflective of the customer's actual average usage than is the customer's maximum demand. Using the average demand smoothes out the effects of highs and lows, and therefore is more reflective of a customer's typical usage than would be provided by using the maximum value for the demand test point.

Q. Does that conclude your rebuttal testimony?

A. Yes, it does.