BEFORE THE FLORIDA
PUBLIC SERVICE COMMISSION

DOCKET NO. 070098-EI
FLORIDA POWER & LIGHT COMPANY

IN RE: FLORIDA POWER & LIGHT COMPANY'S PETITION TO DETERMINE NEED FOR FPL GLADES POWER PARK UNITS 1 AND 2 ELECTRICAL POWER PLANT

REBUTTAL TESTIMONY & EXHIBIT OF:

STEPHEN D. JENKINS

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MARCH 30, 2007

Q. Please state your name and business address.

A. My name is Stephen D. Jenkins. My business address is 4350 W. Cypress Street, Tampa, Florida 33607.

Q. By whom are you employed and what is your position?

A. I am employed by CH2M Hill, Inc., as Vice President, Gasification Services.

Q. Did you previously submit direct testimony in this proceeding?

A. Yes.

Q. What is the purpose of your rebuttal testimony?

A. My testimony responds to the original and supplemental testimony submitted by Mr. Richard Furman on behalf of certain intervenors in this proceeding. In summary, Mr. Furman's testimony contains many incorrect assertions and conclusions with respect to:

- the relative performance, availability and costs of Integrated Gasification Combined Cycle ("IGCC") and pulverized coal ("PC") technologies such as ultra-supercritical pulverized coal ("USCPC");
- the costs of electricity from both of these technologies; and

- the economic and technical viability of the capture and sequestration of carbon dioxide ("CO2") from both of these technologies.

As a professional working actively in the electric power industry with respect to the commercialization and use of IGCC technology, and using the best available industry information, I am able to conclude that Florida Power & Light Company's selection of USCPC technology for the FPL Glades Power Park Units 1 and 2 ("FGPP") is clearly the best choice to meet its needs for high availability, low cost, and fuel-diverse capacity in the time frame of its requirements. Mr. Furman's criticisms of FPL's technology choice lack merit, for the reasons discussed in my testimony and that of other FPL witnesses, and therefore his testimony should not be considered by the Commission.

Q. Do you have any observations concerning Mr. Furman's methodology for preparing testimony and supporting his opinions in this proceeding?

A. Yes. I reviewed the transcript of Mr. Furman's deposition taken on March 26, 2007 in this proceeding. It has been my sense, and I was able confirm from Mr. Furman's deposition, that nearly all of his 26 exhibits supporting his testimony are actually copies taken from other peoples' PowerPoint presentations. With minimal changes, this collection of exhibits has been used by Mr. Furman numerous times in making volunteer presentations outside of a testimonial setting on behalf of groups opposing various PC plants.

Mr. Furman conducted virtually no independent analysis of FGPP. Even the electric generation cost comparisons provided in Mr. Furman's testimony and exhibits are generic – not only were they prepared without using any FGPP data or information, but in fact they were prepared for presentations Mr. Furman made concerning other utilities' PC projects in Texas and Florida.

Mr. Furman's testimony and exhibits do not reflect the type or quality of analysis that utility engineers and managers rely on in making routine business decisions, much less decisions involving the investment of billions of dollars in complex electric generating assets designed to provide service to customers for decades. Accordingly, his recommendations should not be relied upon by the Commission for such purposes either.

Q. Mr. Furman states that "Many utilities around the country are choosing IGCC plants due to IGCC's much lower emissions of all pollutants and its capability to capture CO2." Do you agree with this statement?

A. No, I do not. Only a handful of utilities, not "many," are going forward with IGCC projects. Most new power generating plants using coal will use PC technology, not IGCC. There is a common misconception that IGCC has an inherent capability to capture CO2. It does not have such an inherent capability. Therefore, IGCC has not been chosen specifically for this purpose.

Q. Mr. Furman states that "Large size IGCC plants can be built by using multiple gasifiers. This improves system reliability, increases efficiencies and provides fuel flexibility." Do you agree?

A. No, there are several errors in Mr. Furman's statement. Most fundamental to his misstatement is the fact that currently available IGCC technology is more efficient than USCPC technology. Not one of the proposed coal-based IGCC power plants is expected to be more efficient than the FGPP. Moreover, as discussed in my direct testimony, IGCC plant availability has not been as high as that for PC units. Even with many of the planned design improvements, the availability of the next generation of IGCC plants may not be as high as what PC plants are already able to achieve. Modular design does not necessarily provide for increased efficiency. In fact, smaller gasifiers can be less efficient than larger gasifiers. Further, just because one uses multiple gasifiers does not mean that fuel (more correctly, feedstock) flexibility is increased. Gasifiers must be designed for specific feedstocks, although they do have some flexibility to handle some variability in those feedstocks. However, this is not an inherent characteristic of modularity as Mr. Furman states.

Q. Mr. Furman suggests that since gasification plants can operate at high availabilities, that IGCC plants will inherently have the same high availabilities. He states "These examples demonstrate that IGCC plants can operate at the 90% availability level required by electric utilities for base load plants." Is this an accurate conclusion?

A. No, it is not. Mr. Furman is confusing a basic gasification plant with a modern IGCC plant. Just because several individual gasifiers at a specific gasification plant may have a high availability does not imply that a complete, complex IGCC power plant that incorporates gasification, air separation, acid gas removal, sulfur recovery and power generation would have the same high availability. Each of these IGCC plant "islands" has its individual availability issues which have been shown to impact overall IGCC plant availability to a value lower than what the individual gasifiers achieve. This is highlighted in the fact that neither of the two coal-based IGCC power plants in the U.S. has achieved an availability level of 90% in the IGCC mode of operation (without using a back-up fuel for the power block). The IGCC plants being designed today will incorporate the thousands of lessons learned from the four coal-based IGCC plants in order to improve availability, efficiency, and operating performance. Tampa Electric plans to use many of the lessons learned from Polk Unit #1 in the design of its next full-scale IGCC plant. This includes using two gasifier trains. Even with these enhancements and design improvements, Tampa Electric notes that the new unit is expected to provide 85% availability, not 90% as Mr. Furman suggests.

Q. Mr. Furman's testimony states that "The Nuon utility in The Netherlands and Hunton Energy Group in Texas have announced plans to build 1200 MW IGCC plants using multiple gasification 'trains' and multiple combined-cycle units." Is this an accurate statement?

A. No. Mr. Furman is incorrect concerning the status of many of the proposed IGCC projects. As an example, Nuon is not building a 1,200 MW IGCC plant. Nuon is planning a 600 MW IGCC plant and an adjacent 600 MW gas-fired combined cycle plant. Hunton Energy has also noted that at this time that it has a site that could accommodate a 1,200 MW IGCC plant, using petroleum coke as the feedstock. However, Hunton Energy has also noted that at this time, they are only pursuing the development of one 600 MW IGCC plant.

Q. Mr. Furman's testimony states that "Proven commercially available technologies are not presently available for the proposed new coal boilers for mercury and CO2. This is one of the main reasons that we need to use gasification." Do you agree with this statement?

A. No, I do not. Selective catalytic reduction, a commercially proven emission control technology for nitrogen oxides, actually converts a portion of the elemental mercury in the flue gas stream to the oxidized form, allowing easier removal by the downstream emission control processes. Mercury reduction is a proven "co-benefit" of baghouses, wet flue gas desulfurization systems, and wet electrostatic precipitators, all of which are commercially proven and will be installed on the FGPP. In addition, dedicated large-scale mercury control for SCPC boilers actually is commercially available, and has been proven in tests on

large PC boilers to achieve high mercury removal. An example of this is the powdered activated carbon technology. This technology uses activated carbon which is injected into the flue gas stream. After the mercury is captured, the carbon is removed in the plant's particulate collection device, i.e. electrostatic precipitator or baghouse. FGPP will incorporate such mercury control technology. This is discussed in detail in FPL s direct testimony of David Hicks, and FPL's direct and rebuttal testimony of Kenneth Kosky.

Q. **Mr. Furman's states "In the first step of the IGCC process, coal is slurried with either water or nitrogen and enters the gasifier. It is mixed with oxygen, not air, which is provided to the gasifier from an air separation unit." Is this an accurate description of the first step of the IGCC process?**

A. No, it is not. It is incorrect to say that IGCC uses only oxygen, not air. Most commercially available gasification technologies are air-blown, not oxygen blown. Air and oxygen are both viable for IGCC. For example, the KBR IGCC technology being developed by Orlando Utilities and Southern Power in the Orlando area will use air, not oxygen. So will the Mitsubishi IGCC technology which has been selected by NRG Energy for development in New York State. In addition, one does not "slurry" coal with nitrogen. Coal is a solid, while nitrogen is a gas. Modern dry feed gasifiers do use nitrogen as a carrier gas, but no slurry is produced.

Q. Mr. Furman's states "The operating conditions in the gasifier vitrify the solids. In other words, the solids are encased in a glass-like substance that makes them less likely to leach into groundwater when disposed of in a landfill as compared to solid wastes from a conventional coal plant." Is this an accurate description of this portion of the IGCC process?

A. No, it is not. The operating conditions in modern gasifiers do not necessarily vitrify the solids. For example, the gasifier operating conditions planned for the KBR demonstration IGCC plant in Orlando will be approximately 1,800F, so that its solids will not be produced in a vitrified form. Further, the glass-like slag produced from specific types of gasifiers is not more or less likely to leach into groundwater than the coal combustion byproducts from a coal-fired boiler. Both would be required to be stored in a double-lined landfill, using leachate collection and treatment. This protects the ground, as well as the groundwater, from any such leachate. That is another reason why ash and slag from both gasification and coal combustion are excluded from regulation under RCRA Subtitle C, Hazardous Wastes.

Q. In describing the sulfur recovery section of an IGCC process, Mr. Furman states "The H2S that is removed from the syngas is usually converted into elemental commercial-grade sulfur using a Clauss plant." Is this an accurate description of this portion of the IGCC process?

A. No, it is not. The sulfur is not usually converted into elemental sulfur. In the two IGCC plants in the U.S., one makes elemental sulfur, while Polk Power Station here in Florida recovers the sulfur as sulfuric acid. Tampa Electric has stated that

their next planned IGCC plant will also recover the sulfur in the form of sulfuric acid.[1]

Q. Is Mr. Furman's overall description of how an IGCC plant works accurate?

A. No, it is not. The integration step, which is the most critical part of making IGCC work, is not mentioned at all in Mr. Furman's description of IGCC. This is highlighted in his statement that the combined cycle plant used in IGCC is the same configuration that is used in natural gas-fired combined cycle plants. In fact, it is very different. Not only are the burners for combusting syngas in the gas turbine a completely different design from what is used for natural gas, but most of the steam used in the steam turbine to make electricity typically comes from the syngas coolers in the gasification plant, not from the heat recovery steam generator in the power block. Because of this, the steam turbine in an IGCC plant is typically sized larger than it would be for a natural gas-fired combined cycle plant with a similar gas turbine, heat recovery steam generator, and steam turbine configuration.

The description also fails to mention a critical part of the "integration" portion of an IGCC plant: utilizing the nitrogen produced in the air separation unit in the gas turbine for the purpose of augmenting power production and for reducing NOx emissions. In short, Mr. Furman's testimony does not convey at all a sense of the difficulty and complexity that is involved in integrating the different portions of an IGCC power plant.

[1] Also note that the process that converts the H2S in the syngas stream to sulfur is a Claus plant, not a Clauss plant as reported in Mr. Furman's testimony.

Q. Is Mr. Furman's comparison of PC and IGCC costs of electricity, in his Exhibit RCF-5 appropriate or accurate?

A. No, it is not. As he stated in his deposition, Mr. Furman has not used information concerning FGPP such as its capital costs, variable operations and maintenance costs, heat rate, expected delivered fuel costs, environmental compliance costs or any of the detailed information provided by FPL in its filing in this proceeding. As he admitted in his deposition, Exhibit RCF-5 was not even prepared for this proceeding. That said, however, Mr. Furman's Exhibit RCF-5 provides some very interesting comparisons if one were to assume that its data pertained to this case and was accurate. In order to attempt to make a point about the cost of electricity from various technologies, Mr. Furman compares USCPC technology using coal with IGCC using petroleum coke. This is not an accurate comparison. Further, using the data in Exhibit RCF-5 for the case where both technologies would use coal, the cost of electricity produced by USCPC technology would be lower than the cost of electricity from an IGCC plant using coal.

Q. Is Mr. Furman's description of the use of petroleum coke for power generation accurate?

A. No, it is not. Mr. Furman is apparently unaware that many power plants in the U.S. (and especially here in Florida) do use petroleum coke as a fuel, often blended with coal. His statement that the use of petroleum coke requires additional FGD systems is not correct. Rather, in order to utilize petroleum coke, one would typically increase the sulfur dioxide ("SO2") removal capability of the FGD system to treat the additional SO2 emissions produced from the combustion

of the sulfur in the petroleum coke (the sulfur content of petroleum coke tends to be higher than that of eastern bituminous coals). Such design enhancements include additional limestone handling and grinding capacity, more sprays or spray levels (for spray towers), addition of organic chemicals to improve mass transfer, and increased liquid to gas ratio in the absorber towers. Adding more FGD systems is not the appropriate method for the utilization of petroleum coke. Several of the utilities in Florida use petroleum coke, and they have not added more FGD systems just because of the petroleum coke. They have made changes or enhancements to their existing FGD systems, as described above. Mr. Furman also fails to mention the supply limitations inherent in the significant quantity of petroleum coke that would be required to supply an approximately 2,000 MW IGCC plant for many years. This point is discussed in the testimony of FPL's witness Seth Schwartz.

Q. Mr. Furman attempts to show that CO2 capture from IGCC plants is just as viable and low cost as it would be on a gasification plant. Is this an accurate conclusion?

A. No, it is not. Mr. Furman's testimony on CO2 capture begins with a very common misconception by those that do not have a good understanding of IGCC technology: he begins with a discussion of IGCC, but attempts to make his point by using the Great Plains Synfuels plant as the example for CO2 capture for IGCC. The Great Plains Synfuels plant is a coal gasification plant. It is not an IGCC plant and does not generate electricity. Therefore, it does not include any of the basic IGCC subsystems such as an air separation unit or a combined cycle

power block. At this time, there are not any IGCC plants that have CO2 capture systems, as this technology is not economically viable at this time. Further, Mr. Furman states that IGCC is capable of CO2 capture at significantly lower costs than what PC plants can do, despite the fact that no IGCC plants in the world presently capture CO2. In the newly released MIT report, "The Future of Coal," the status of carbon capture and sequestration ("CCS") is described as follows: "neither IGCC nor other coal technologies have been demonstrated with CCS."

Q. Is Mr. Furman's use of Exhibit RCF-6 appropriate?

A. No, it is not. In using data from other people's presentations, Mr. Furman notes the source of the data in Exhibit RCF-6 as coming from GE. This is information from a report prepared several years ago by the DOE, EPRI and Parsons. This is not the most recent data available to or utilized by the IGCC industry for CO2 capture.

Q. Is Mr. Furman's use of the data in his Exhibit RCF-7 appropriate for comparing the costs of electricity for technologies with CO2 capture?

A. No, it is not. However, Mr. Furman's own Exhibit RCF-7 supports the finding that without CO2 capture, PC is a lower cost alternative than IGCC. None of the more recent studies and data, including the new MIT study, supports a conclusion that SCPC with CO2 capture would be significantly more expensive than IGCC with CO2 capture.

FPL's choice of USCPC technology is consistent with "Recommendation #1" from the new MIT study, which states as follows: "New coal combustion units

should be built with the highest thermal efficiency that is economically justifiable. Any carbon charge will make the economics of higher efficiency coal plants more attractive than those of lower efficiency plants. In addition, continuous advancements in R&D make it likely that further reductions in heat rates will be possible. For pulverized coal plants this means super critical pulverized coal (SCPC) plants today and ultra-super critical pulverized coal (USCPC) plants soon. A 500 MWe USCPC plant will emit about 100 tonnes per operating hour less than a sub-critical plant, avoiding about 21% of the CO2 emissions. [See Chapter 3, Table 3.1]. For IGCC plants this means attention to higher efficiency and high availability operation."

Q. Is the comparison that Mr. Furman makes in his Exhibit RCF-8 appropriate?

A. No, it is not. It is not appropriate to compare CO2 emissions for SCPC without capture to IGCC with capture. In doing this, he shows that the CO2 emissions from IGCC would be 90% lower than those for SCPC. If this comparison were done appropriately, it would show that the CO2 emissions from SCPC and IGCC would be about the same for both the "no capture" and "capture" cases. In fact, since the efficiency of SCPC tends to be somewhat higher than that for IGCC, the CO2 emissions from SCPC would actually be somewhat lower than those from IGCC for both of these cases. This is because SCPC would be using less coal per kilowatt-hour of electricity generated. Mr. Furman's Exhibit RCF-8 does not make appropriate comparisons.

Q. Is Mr. Furman's description of the availability of Tampa Electric Company's Polk Power Station IGCC unit accurate?

A. No, it is not. While Mr. Furman correctly points out that the availability of Polk Power Station Unit #1 can reach 90% when using the back-up fuel, he fails to mention that there is an additional cost to Tampa Electric's customers to maintain this availability, due to the cost of the backup fuel oil being much higher than the cost of the solid feedstocks used in the IGCC plant, i.e. coal and petroleum coke. By analogy, if one were to provide backup fuel to a hypothetical IGCC plant located where FGPP is proposed to be located, one would need to factor in the costs of a natural gas pipeline extension and natural gas to back-up the gasifier from a reliability perspective, or the increased costs of purchasing and transporting diesel fuel oil if that were the backup fuel. None of this is mentioned in Mr. Furman's testimony.

Q. Mr. Furman states that "For larger size plants, multiple units are being proposed which will improve system availability and reduce costs by making use of standard, modular designs." Is this an accurate statement?

A. No, it is not. While it is expected that using multiple modules will improve IGCC availability, it does not reduce cost. The use of multiple, smaller gasifier trains actually increases the cost of the total plant, as it would in other similar industrial process plants. Larger modules benefit from economies of scale.

Q. Mr. Furman states that "The much taller PC stack also decreases property values in a much larger surrounding area." Can you comment on this statement?

A. Yes. In reviewing Mr. Furman's resume, I did not see any reference to his experience in real estate valuation, so I do not know if he is professionally qualified to make conclusions in this area. My personal observation is that Apollo Beach, adjacent to Tampa Electric's Big Bend Station and its four pulverized coal generating units, is a thriving community of middle and upper middle class housing developments, mostly constructed after the units at Big Bend went into service. I worked at Big Bend Station and know the area well. The nearby stacks at Big Bend are approximately 499 feet tall, the same size as the stack proposed for the FGPP. Recently, developers announced a new residential development in Apollo Beach. A study of real estate values in Apollo Beach will likely show that property values have increased substantially since Big Bend (with its "tall stacks") first went into service in 1970. Casual observations about real estate values aside, one also questions how much Mr. Furman's point would matter, even if true, given that the FGPP is proposed to be located on a very large parcel of land that is a considerable distance from most development, as explained in Mr. Hicks' direct testimony.

Q. Mr. Furman states that "The Italian experience with IGCC, while using refinery residues as fuel, is relevant to discussions of coal-fired or petcoke-fired IGCC, because essentially the same equipment is utilized in both instances, differing only in the feed preparation and how solids are removed." Is this an accurate statement?

A. No, it is not. It is neither appropriate nor accurate to compare the liquid feedstock IGCC plants in Italy to the four coal-based IGCC plants in the rest of the world. These plants differ not only in the feed preparation and how solids are removed, as Mr. Furman suggests, but in many other ways. Gasification of liquid feedstocks, such as refinery wastes, is different from the gasification of solid feedstocks. Even the chemical constituents of liquid and solid feedstocks are different, so that the designs of the gasification and gas treating systems are different. Further, when using coal as the feedstock (versus using liquid feedstocks as in the Italian plants), there is considerably more erosion, corrosion, ash removal system wear, fly ash deposition and plugging in syngas coolers, and a host of related issues dealing with the black water systems. Even the black water produced in coal-based gasification systems is different from the black water produced in liquid feedstock-based gasification systems. It is inappropriate to state that the Italian experience with IGCC is relevant to coal-based IGCC.

Q. Mr. Furman provides a description of how IGCC technology and performance guarantees are commercially offered. Is this an accurate description?

A. No, it is not. The companies listed do not all offer IGCC technology. Some only offer the gasification portion of the facility, but not other portions, which are typically provided from other companies, some under specific technology licenses. At this time, the nature of the commercial offerings is not fully known, since no company has yet signed a contract for a complete lump-sum, turn-key IGCC power plant with one of the companies named by Mr. Furman. While it is expected that the IGCC alliances (which typically include the gasification suppliers, engineering companies and power block suppliers) will offer guarantees, the nature of these guarantees is not yet publicly known. Unless Mr. Furman has been a part of the contracting for one of the proposed coal-based IGCC power plants -- and from his deposition testimony one knows that he is not -- he would not likely have the specific knowledge sufficient to make the claim that "IGCC can obtain sufficient performance warranties."

Q. Mr. Furman states that "The standard IGCC unit is now 300 MW. Most manufacturers are supplying 600 MW plants which consist of two 300 MW units." Is this an accurate description of what is being commercially offered?

A. No, it is not. Mr. Furman mischaracterizes or does not understand the basic IGCC reference plant. The IGCC reference plants being planned will not consist of two 300 MW units. The combined cycle power blocks are typically being designed on a basis of two 232 MW (approximately) "FB class" gas turbines, and one 320

MW (approximately) steam turbine generator, for a total of about 784 MW (gross). These values vary based on feedstock, gasification technology, power block supplier, and altitude. They are not separated into 300 MW "units" as Mr. Furman describes.

Q. Mr. Furman states that "Therefore the 630 MW unit that Tampa Electric is building for operation in 2013 consists of two units the same size as their existing unit that has been operating for the past 10 years. Therefore there is no additional scaleup required." Is this an accurate statement?

A. No, it is not. The proposed IGCC unit planned by Tampa Electric will not consist of two units of the same size as their existing unit. The gasifier on Polk Unit #1 was designed to provide sufficient syngas to load one GE Frame 7FA gas turbine, with a heat input of approximately 1,755 mmBtu/hour of syngas, and with nitrogen diluent, generating 192 MW. The total plant net output (including the steam turbine generator) is approximately 250 MW. The 630 MW (net) IGCC plant that Tampa Electric has announced for Polk Unit #6 would need to produce sufficient syngas to fully load two much larger "FB class" gas turbines that would require approximately 2,100 mmBtu/hr, an increase of about 20%. The overall system would require scale-up in the feedstock handling and slurry preparation, slag handling, syngas clean-up and other systems to handle the additional throughput. It is expected that the proposed unit would also operate at higher pressures, requiring some additional design considerations. In addition, Tampa Electric will incorporate many of the lessons learned into the new unit, in order to

improve efficiency and availability over Polk Power Station Unit #1. It will not just be two units of the same size as Polk Unit #1.

Q. Mr. Furman uses his Exhibit RCF-21 to compare gasification plant availability to IGCC availability. Is this an appropriate comparison?

A. No, it is not. Mr. Furman incorrectly tries to make the case that the high availability of GE gasifiers in China (in gasification service, but not IGCC) means that IGCC plants would have the same high availability when using coal and producing electricity. As noted previously, the availability of the individual systems in an IGCC plant impacts the overall IGCC plant availability, so that IGCC availability is lower than that of a gasification plant. For example, all four coal-based IGCC plants have experienced negative impacts on overall IGCC facility availability due to their power blocks. IGCC availability is lower than the availability of a plant that only includes coal (or liquid feedstock) gasification, without power generation.

Q. Mr. Furman states that "Older IGCC plants built in the early 1990s such as Polk and Wabash that operate without a spare gasifier have demonstrated availabilities above 85%." Is this an accurate statement?

A. No, it is not. These plants have not demonstrated availabilities above 85%, except when they have used back-up fuel. It is not considered IGCC operation when the coal gasification island is not in service producing syngas. Additional costs are imposed on an IGCC plant when it is designed to operate alternatively as a combined cycle on fuel oil or natural gas. Those costs must be accounted for and

evaluated in determining whether to incorporate backup fuel operation in an IGCC plant.

Q. Mr. Furman states that "Major vendors of IGCC plants such as GE, Shell and ConocoPhillips will warrant that new IGCC plants will achieve greater than 90% availability with a spare gasifier." Are you aware of these vendors making such guarantees?

A. While the industry expects that the use of such spare equipment is likely to improve IGCC availability, no suppliers have yet contracted for 90% availability guarantees for IGCC. Therefore, there is no reasonable basis for Mr. Furman's assertion that major vendors of IGCC plants will provide a 90% availability guarantee with a spare gasifier. In addition, the IGCC reference plant offered in the industry does not include a spare gasifier. A spare gasifier train is an additional option at considerable additional cost.

Q. Mr. Furman's testimony includes a description of the CO2 capture at the Great Plains Synfuels plant, and uses this to conclude that CO2 capture and sequestration are economically viable for coal gasification. Do you agree with this conclusion?

A. No, I do not. CO2 capture and sequestration are costly, in both capital expense and O&M cost. The only reason that Great Plains Synfuels captures the CO2 from their coal gasification (not IGCC) process is that they are paid for the CO2 by EnCana and Apache Canada for use of the CO2 in enhanced oil recovery in the Weyburn oil fields in Canada. Prior to being able to sell the CO2, it was vented to the atmosphere. Further, the current use of the CO2 is solely for enhanced oil

recovery, not for sequestration. In enhanced oil recovery, the objective is the minimum use of CO2 and the maximum release of oil from the geologic formations; it is not to maximize the sequestration of CO2. The geology for enhanced oil recovery is very different from that needed for long-term CO2 sequestration. In enhanced oil recovery, easy release of the CO2/oil mixture is desired; conversely, in sequestration, permanent storage of all of the CO2 is the ultimate objective.

Q. Mr. Furman states that "Leachable ash and scrubber sludge from the PC plants can cause ground water contamination." Do you agree with this statement?

A. No, I do not. Due to the use of well-designed double-lined storage systems with leachate collection for coal combustion byproducts, groundwater is protected from contamination. Further, PC plants no longer produce "scrubber sludge." This was a technology that was used in the 1960s and 1970s. However, many modern PC plants have flue gas desulfurization ("FGD") systems that produce byproduct gypsum, which is commercially saleable for use in manufacturing cement and wallboard. A good example is Tampa Electric's Big Bend Station. The FGD systems there do not produce "scrubber sludge" and never have. They produce commercial grade gypsum, which is transported to a nearby wallboard plant. The FGD systems for FGPP will also produce gypsum, not "scrubber sludge." As noted previously, PC technology can also produce the same vitrified slag that IGCC can produce. This has been done world-wide in PC boilers, including almost 40 years of operation of Tampa Electric's PC units.

Q. Mr. Furman refers to PC as being "an older, less efficient technology" compared to IGCC. Is this accurate?

A. No, it is not. The USCPC technology planned for FGPP is neither old nor less efficient technology. USCPC is now being utilized worldwide for efficient coal-fired power generation. Further, not one of the planned "next generation" coal-based IGCC plants in the United States will be more efficient than the FGPP.

Q. Mr. Furman states that "The disadvantage of PC plants is that they are only capable of using coal. Therefore PC plants can not respond to changing market conditions or changing emission standards." Do you agree with that statement?

A. No, I do not. PC plants, including the FGPP, are often designed to use petroleum coke in blends with coal, in order to lower fuel costs and be able to respond to market conditions. In Florida, several of the PC plants use petroleum coke blended with coal for these specific reasons. Some PC plants have also incorporated the use of biomass in order to provide additional fuel flexibility. Over the years, Tampa Electric's power plants have co-fired several different fuels with coal, including petroleum coke, biomass, shredded tires, and processed trash from Disney World. PC plants are not only capable of using coal.

This next portion of my testimony addresses Mr. Furman's supplemental testimony and exhibits.

Q. Mr. Furman states that "During my entire engineering career, I have worked on new energy technologies, alternative fuels for power plants, and pollution control for power plants. Prior to my retirement, I was an independent consulting engineer for 22 years to various utility companies, government agencies, process developers and research organizations on the development, technical feasibility and application of new energy technologies and alternative fuels for power plants." Can you tell from his resume whether or not he has actually worked on the design, permitting, construction or operation of coal gasification or IGCC power plants?

A. No, I cannot. There is no mention of any gasification work except some consulting work several years back (although no specific projects are mentioned) and his thesis while a student in the early 1970s. The commercial development of all of today's modern IGCC technologies occurred after Mr. Furman worked in this area as a student. Based on Mr. Furman's deposition, he is not working on any of the planned IGCC plants using modern IGCC technology.

Q. Mr. Furman states that "Mr. Jenkins has presented a very narrow view of gasification technology and IGCC plants by specifying only four coal-based IGCC plants." Why does your testimony discuss only the four coal-based IGCC power plants?

A. As I have already noted, it is appropriate for this project and this docket to compare the coal-fired FGPP with coal-based IGCC. It is also not appropriate to compare liquid feedstock gasification with coal-based IGCC. This is due to the issues that I have previously pointed out, including the significant differences

between operating a gasification plant and an IGCC plant that generates electricity, as well as the many differences in design, sizing, feed handling and preparation, gasifier sizing and output, syngas cleaning, acid gas removal, and slag removal, as well as the impacts of these systems on total plant availability. Mr. Furman has, in large part, attempted to make his case by citing information from liquid feedstock-based gasification plants, not coal-based IGCC plants. Gasifiers are only a part of an overall complex IGCC power plant. Designing and operating a large, complex IGCC power plant is quite different from operating a basic gasification plant. For my testimony, it was not appropriate to compare the performance of boilers that make only steam to boilers that are a part of a modern power plant that generates electricity, or to compare boilers that burn gas or oil to boilers that burn coal.

The fact is that there are only four coal-based IGCC plants in the world. Mr. Furman's comparisons trying to directly link what he may know about a basic gasification plant to what is in a complex, well-integrated IGCC plant is like one saying that just because one has read magazines about how to operate a small internal combustion engine and then talked to others that operate such engines, that one is then an expert on how to design and operate a modern automobile, complete with the internal combustion engine, fueling system, cruise control, exhaust system, emission control systems, chassis, windows, electronics, transmission, drive train, wheels, tires, instruments and controls and a radio. Obviously, this is not a logical conclusion. Attempting to link the costs,

availability and performance of gasification plants, particularly those that use liquid refinery wastes, to an IGCC plant that uses coal for power generation, is neither an accurate nor meaningful comparison.

Q. Mr. Furman attempts to describe the size of proposed IGCC plants by stating "Therefore any size IGCC plant can now be built as shown in my Exhibit RCF-20. This exhibit shows the 1200 MW IGCC plant that has been announced by Nuon, in The Netherlands. This utility has been operating a 300 MW IGCC unit for more than 10 years with coal and biomass. Nuon's new 1200 MW plant will have the flexibility to use coal, biomass and natural gas and will consist of four 300 MW units." Is his description correct?

A. No, it is not. The capacity (size) of the IGCC plant will depend directly on the capacity of the gas turbines, as the gasifiers are typically sized so that one gasifier produces sufficient syngas to fully load one gas turbine. One would not design a smaller 500 MW IGCC plant using today's gasifier and gas turbine technology combinations, as it would neither be cost-effective nor efficient to design a plant where the gas turbines would always be operated at less than design capacity. In addition, as I discussed previously, the proposed Nuon plant consists of a 600 MW IGCC unit and a 600 MW combined cycle unit, not a 1,200 MW IGCC plant. Further, the existing Nuon plant has not been in operation over 10 years using biomass in the feedstock blends. The blending of biomass began in 2004 at Nuon's IGCC facility.

Q. Mr. Furman describes the primary objective of the IGCC plant at Polk Power Station, and states that "Its primary purpose was to demonstrate the technical and economic feasibility of an IGCC unit at full commercial scale." Do you agree with his statement?

A. No, I do not. From the perspective of my experience as an employee of TECO, the primary purpose of the unit was to provide base load electricity for TECO's customers, as described in many of the papers and presentations given by TECO staff during the initial development of the project.

Q. Mr. Furman states that "Mr. Jenkins testimony does not completely or accurately represent this very successful commercial demonstration of an IGCC plant," referring to Polk Power Station Unit #1. Please describe the basis of your knowledge concerning the Polk Power Station.

A. I was Tampa Electric Company's Deputy Project Manager for the Polk Power Station Unit #1 IGCC project and have personal knowledge of the project's basic objectives, design parameters, operation, and availability issues. In contrast, Mr. Furman had no involvement with that IGCC project, either in its design, permitting, construction or operation. The only information Mr. Furman has gained about Polk Power Station came from reading about it and from one or more short site visits.

Q. In his supplemental testimony, Mr. Furman again attempts to make the point that the capture of CO2 is economically viable. Do you agree with his conclusion?

A. No, I do not. As I have noted, the equipment and systems needed for CO2 capture are high in capital and O&M cost. CO2 capture is neither low in cost nor easy to do. Mr. Furman attempts to make his case for the commercial status of CO2 capture and sequestration ("CCS") technology on IGCC by inappropriately using experience with coal gasification plants. As noted in the MIT study, "neither IGCC nor other coal technologies have been demonstrated with CCS." Mr. Furman's application of CO2 capture experience to either SCPC or IGCC is neither accurate nor appropriate. While some CO2 is captured in the Coffeyville and Eastman gasification plants (along with the H2S in the syngas stream), it is a small part of the total CO2 volume. It must be separated from the hydrogen prior to further use of the syngas for the production of chemicals. Most of the CO2 at the Coffeyville facility is vented. The portion of the CO2 that remains is used in the manufacture of urea, due to its high market value. CO2 capture is only economically viable when the producer of the CO2 is being paid for the CO2 or if the CO2 has value in the end products.

Q. Mr. Furman suggests that it is simple and easy to scale up from the demonstration size IGCC plant to the 600 MW (net) IGCC reference plant, simply by doubling the size. He states that "To provide larger size plants multiple units of this same 300 MW size are already in commercial use." Is this an appropriate way to accomplish this?

A. No, it is not. The 600 MW (net) IGCC reference plants being planned at this time are not provided in individual 300 MW units. Also, they will actually produce more syngas, in order to fully load modern gas turbines at a rate about 20% greater than what the existing coal-based IGCC plants are using. The gas turbines in the existing coal-based IGCC plants generate about 192 MW using syngas and nitrogen diluent. The gas turbines proposed for use on the new IGCC reference plants will generate about 232 MW, a 20% increase. As I noted previously, many design considerations and changes will be required in moving from the existing scale to the commercial IGCC reference plant. It is not simply a doubling of what is already in use.

Q. Mr. Furman attempts to show that the cost of electricity from USCPC would be greater than that from IGCC. He states "If the track record of these new USPC plants follows that of SCPC plants then the additional costs for the proposed FGPP plant will be much greater than the IGCC alternative." Is this an accurate statement?

A. No, it is not. As noted earlier, Mr. Furman is using outdated information. The best source of cost information for FGPP is FPL's testimony and exhibits, which has not been analyzed or considered in Mr. Furman's testimony. The most recent

general information on the costs of PC and IGCC technology (EPRI and DOE) show that PC technology is less expensive than IGCC technology. Mr. Furman's own Exhibits RCF-5 and RCF-7 show that the cost of electricity from SCPC without CO2 capture is less than that for IGCC without CO2 capture. According to EPRI's latest study, the cost of electricity from SCPC units, with CO2 capture, is on par with that from IGCC technology. EPRI notes that the values in that study have a large "range of uncertainty," so that the costs of SCPC and IGCC with CO2 capture can be considered to be the same. Putting these elements together, it is clear that the costs of electricity from SCPC are lower than the costs of electricity from IGCC, without CO2 capture. Based upon available information concerning CO2 capture, if this were someday to be required, the most one can conclude at this point in time is that there is not a clear basis to prefer one technology over the other. This is consistent with the findings in the recent MIT report.

Q. Mr. Furman attempts to show that an interruption in coal supply caused by a strike should be considered as a major impact on the overall availability of FGPP, and a reason that IGCC would have a higher availability. Is this an accurate assumption?

A. No, it is not. Mr. Furman fails to acknowledge that the design of the FGPP units permits them to use a wide range of coals from domestic and international sources, as well as petroleum coke, in order to take advantage of market conditions and protect the units' fuel supply. Mr. Furman also fails to acknowledge the large amounts of coal that FPL will maintain on site, typically

about 60 days supply, which provides a substantial buffer from the immediate effects of supply interruptions, and also enables FPL to obtain fuel from other sources as may be necessary. Mr. Furman also does not mention whether his proposed petroleum coke supply is susceptible to supply interruption due to the far smaller amounts of petroleum coke available in the market, compared with coal, and the much smaller number of suppliers.

Q. Referring to the operation of IGCC units on backup fuel, Mr. Furman states that "...the cost savings of higher availabilities more than offset these additional fuel costs." Is this an accurate statement?

A. The cost savings of higher availabilities are not necessarily greater than the cost of using back-up fuel. This is a very complicated economic comparison which must be performed for each case, and the result is impacted greatly by the difference in cost between the primary fuel (coal) and the back-up fuel (fuel oil).

Q. Mr. Furman states "Mr. Jenkins should have also pointed out that coal-slurry-fed gasifiers (such as GE and ConocoPhillips) operate on a feedstock that is very much like a liquid feedstock in that powdered coal is first mixed with water to form a pumpable, liquid-like slurry." Is this an accurate statement?

A. No, it is not. Mr. Furman's comment ignores the significant differences between coal slurry and liquid feedstocks. Once the coal has been delivered, stored, reclaimed, handled, crushed and slurried, coal slurry may seem similar to some of the liquid gasifier feedstocks. However, there are great differences in chemical composition, ash content, viscosity, erosivity, corrosivity, ash melting

temperatures, sulfur content, and many other characteristics which have significant impacts on design and operation. It is not accurate to compare the costs, performance or availability of a coal-based IGCC plant to one which uses solely liquid feedstocks. Further, it is neither appropriate nor accurate to compare liquid-based gasification plants to coal-based IGCC plants which generate electricity.

Q. Mr. Furman disagrees with your description of the equipment and systems needed to capture CO2. What was his suggestion?

A. Mr. Furman recommended that a water shift reactor be placed in what is called "sweet shift" configuration, meaning after the acid gas removal system, instead of using the sour shift configuration that I noted in my direct testimony. It is interesting that he recommends such a configuration. Sour shift, not sweet shift, is the preferred method used in CO2 capture. In fact, the Great Plains Synfuels, Eastman Chemical and Coffeyville Resources plants, which Mr. Furman cites as the examples for CO2 capture, all use the sour shift configuration that I refer to in my direct testimony.

Q. Mr. Furman disagrees with your statement that "gas turbines for the combustion of concentrated hydrogen streams are not yet commercially available at large scale." Is your original statement still accurate?

A. Yes, it still is. As Mr. Furman notes, there are many industrial-sized gas turbines which combust gas streams that have high hydrogen content. These smaller gas turbines are used in refineries and other industrial facility applications (but not in large power plants) where these high-hydrogen concentration gases are

combusted primarily for generating power for the industrial facility's internal power needs. However, there are no large-frame gas turbines, of the type utilized in the IGCC reference plant configuration, using hydrogen fuels at this time. Both GE and Siemens are working on development programs to be able to commercially offer their large frame gas turbines in anticipation of the need to combust high hydrogen concentration syngas streams in IGCC configuration in the future. GE has even stated that they are "taking orders" for their 7FB gas turbine for this application. However, they also noted that while the gas turbines themselves may soon be "commercially available," they still have much work to do to prove them in actual IGCC service. In addition, while the gas turbines may soon be available, GE has noted that the fuel systems for handling the hydrogen stream, along with the nitrogen injection and natural gas (or fuel oil) back-up fuel lines are not yet ready or commercially available. This is a critical issue with gas turbines, because the combustion of hydrogen is very different than the combustion of syngas or natural gas. Mr. Furman's attempt to show that the experience in industrial size gas turbines applies directly to IGCC size units is not accurate.

Q. Mr. Furman seems to disagree with your description of the status of CO2 capture for IGCC. Is your original statement still accurate?

A. Yes, it is. I have addressed the CO2 capture issue previously. My direct testimony related specifically to the commercial status of CO2 capture on IGCC plants. Mr. Furman has again attempted to use the experience with CO2 capture in gasification plants, not IGCC plants, to make his point. As noted in the MIT

study, "The Future of Coal," "neither IGCC nor other coal technologies have been demonstrated with CCS." While several IGCC plants that plan to include some level of CO2 capture have been recently announced, the specific CO2 capture technology must still be developed. The DOE, EPRI and the IGCC industry are planning to go forward with several CO2 capture research and development programs over the next several years in order to prove this technology with IGCC. Once that is done, CO2 capture technology would be commercially available for use with IGCC. With the parallel research and development programs for CO2 capture from PC units, the technology is also expected to be CO2 capture ready at about the same time and at about the same costs, as noted by EPRI and DOE.

Q. Will you please summarize your testimony?

A. In contrast with FPL's presentation of evidence prepared by employees and outside consultants who are practicing experts in their fields, Mr. Furman's testimony relies almost entirely on recycled presentations that he prepared as a volunteer opposing new PC plants. The presentations themselves are made from pieces of presentations prepared by other people and used in other settings. As such, his testimony demonstrates virtually no analysis of FPL's actual proposed FGPP.

Given these deficiencies, it is not surprising that his testimony fails to demonstrate any reasonable basis for rejecting FPL's selection of USCPC technology, and certainly no basis for concluding that FPL should have selected IGCC technology instead.

Mr. Furman's testimony is also seriously flawed by continually pointing to reports of international experience with gasification of liquid feedstocks – not coal-based IGCC – and asserting that reliable gasification in applications not involving production of electricity somehow proves that IGCC will be just as reliable.

FPL's technology choice is sound and well supported by the most accurate and up to date information. In contrast, Mr. Furman's testimony should not be relied upon for accurate information in making decisions in this docket related to the selection of technology for power generation at the FGPP.

IGCC may be a good choice for future projects where total capacity needs are much smaller, higher costs and lower availability are acceptable, and the capacity is not required until after late 2013. However, based on FPL's need for fuel diverse generation on a timeline that will satisfy customers' growing needs, FPL made the correct decision in selecting USCPC technology.

Q. Does this complete your rebuttal testimony?

A. Yes, it does.