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ENVIRONMENTAL LAW CLINIC AT STANFORD UNIVERSITY

March 7, 2007

Blanca Bayo
Director, Office of the Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, FL 32399

RE: Docket No. 070098-EI, Florida Power & Light Company's Petition to Determine Need for FPL Glades Power Park Units 1 and 2 Electrical Power Plant

Dear Ms. Bayo,

Please find enclosed an original and 15 copies each of the initial direct testimony of David A. Schlissel and Richard C. Furman filed on behalf of Intervenors, The Sierra Club, Inc. (Sierra Club), Save Our Creeks (SOC), Florida Wildlife Federation (FWF), Environmental Confederation of Southwest Florida (ECOSWF), and Ellen Peterson.

Thank you for your attention to this matter

Sincerely,

Michael Gross
Earthjustice
111 S. Martin Luther King Jr. Blvd.
Tallahassee, FL 32301
(850) 681-0031

CMP ____
COM 5
CTR Orig
ECR ____
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SGA ____
SEC ____
OTH ____

cc: All Official and Interested Parties

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ORIGINAL

BEFORE THE PUBLIC SERVICE COMMISSION

In re: Florida Power & Light Company's Petition to Determine Need for FPL Glades Power Park Units 1 and 2 Electrical Power Plant
_______________________________________/

DOCKET NO.: 070098-EI

DIRECT TESTIMONY OF

RICHARD C. FURMAN

ON BEHALF OF

THE SIERRA CLUB, INC.

SAVE OUR CREEKS

FLORIDA WILDLIFE FEDERATION

ENVIRONMENTAL CONFEDERATION OF SOUTHWEST FLORIDA

ELLEN PETERSON

MARCH 7, 2007

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I. BACKGROUND AND WORK EXPERIENCE

Q. Please State Your Name and Address for the Record.

A: My name is Richard C. Furman. My address is 10404 S.W. 128 Terrace, Perrine, Florida 33176.

Q: What Is Your Occupation?

A: I am a retired consulting engineer, and I volunteer my time to advise utilities, government agencies, environmental groups and the public about the potential benefits of using coal gasification technologies. I have testified in previous permit hearings for proposed coal plants concerning emission control technologies, applicable emission regulations and alternative technologies concerning Mercury, NO_x, SO_2, particulate and CO_2 emissions and their associated costs.

Q: How Long Have You Been Retired?

A: Since February 2003.

Q: What Was Your Occupation Before You Retired?

A: 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.

Q: What Did You Do Before You Were An Independent Consulting Engineer?

A: Prior to my work as a consulting engineer, I managed Florida Power & Light's coal conversion program and fuels research and development program, which included the first conversion of a 400 megawatt (400MW) power plant from oil to a coal-oil mixture to reduce oil consumption after the second oil embargo. Prior to this, I directed the engineering study for the conversion of New England Electric's Brayton Point Power Plant, which was the first major conversion of a power plant from oil to coal after the first oil embargo.

My first engineering job was working for Southern California Edison Company to modify their power plants for two-stage combustion to reduce nitrogen oxide emissions in 1969.

Q: Please Summarize Your Formal Education.

A: I received my B.S. in Chemical Engineering from Worcester Polytechnic Institute in 1969 and a M.S. in Chemical Engineering from Massachusetts Institute of Technology in 1972. I was a researcher at MIT for the book entitled New Energy Technologies by Hottel and Howard. After researching for this book, I decided to do my Master's thesis on coal gasification because of its potential as a future energy source and its environmental benefits. My Master's thesis at MIT was entitled Technical and Economic Evaluation of Coal Gasification Processes. I was also a teaching assistant at MIT for the courses of Principles of Combustion and Air Pollution and Seminar in Air Pollution Control. A copy of my resume is attached as Exhibit RCF-1.

Q: How Does Your Education and Experience Prepare You to Provide Expert Testimony in this Case?

A: Both my education and work have required an in-depth understanding of past, present and new forms of energy technologies that can be used for power plants. My education and work experiences also involved an in-depth understanding of all the various fuels for power plants including the different types of coals, fuel oils, natural gas, petroleum coke, synthesis gas, biomass and refinery wastes. My graduate education and subsequent work experiences have provided me with a detailed understanding of the techniques and costs for controlling power plant pollution including mercury, NO_x, SO_2, CO, particulate matter and CO_2 emissions. My prior work for 3 major electric utililty companies allowed me to make use of this knowledge to help develop and utilize new fuels and emission control technologies for power plants. My current volunteer experience allows me to keep informed about the latest developments in new energy technologies, coal gasification technologies, fuels for power plants, techniques for controlling power plant emissions, costs associated with the application of these technologies for power plants and the development of new technologies that may be applicable to power plants.

II. SUMMARY OF TESTIMONY

Q: What Is Your Expert Opinion About the Proposed Plant?

A: My testimony shows that an IGCC plant in Florida can provide electricity at a lower cost than the proposed ultra-supercritical pulverized coal plant. Many utilities around the country are choosing IGCC plants due to IGCC's much lower emissions of all pollutants and its capability to capture CO_2. My testimony shows that an IGCC plant can eliminate between 50 – 90 % of the air pollution that the proposed plant will emit. Various studies have shown that IGCC plants can capture CO_2 at much lower costs than pulverized coal plants. Comparisons of recent permit applications for IGCC plants versus the proposed plant show significantly lower emissions for the IGCC plants. The Clean Air Act specifies that gasification should be evaluated to determine the Best Available Control Technology (BACT).

The additional value of an IGCC plant is its ability to use various fuels including coal, petroleum coke, natural gas, biomass and waste materials. This will enable IGCC plants to respond to future changes in fuel costs and changes in environmental regulations. This will provide significant cost savings during the life of the IGCC plants. The modular design of IGCC plants provides additional system reliability, increased efficiencies, fuel flexibility and any possible size.

Commercial IGCC plants have been in operation in the U.S. for more than 10 years. Tampa Electric Company has announced that they will build an additional 630 MW IGCC plant for operation in 2013. Chuck Black, the president of Tampa Electric Company, was quoted in Time Magazine (November 2006) as saying "it's our least cost-generating resources, so we count on it and use it every day as part of our system". Today there are approximately 130 gasification plants worldwide that produce fertilizers, fuels, steam, hydrogen and other chemicals, and electricity. Of these 130 plants, fourteen are IGCC plants. These IGCC plants have a capacity of 3,880 MW(net) and have almost one million hours of operation..

The 510 MW and 545 MW IGCC plants that started operation in Italy in 2000 and 2001 have demonstrated that IGCC plants can be built with more than one gasifier and operate with more than 90% availability without a spare gasifier. All 4 of GE's coal gasification plants that where recently built in China have been operating at greater than 90% reliability for the past 3 years. These examples demonstrate that IGCC plants can operate at the 90% availability level required by electric utilities for base load plants.

Large size IGCC plants can be built by using multiple gasifiers. This improves system reliability, increases efficiencies and provides fuel flexibility. 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.

A recent DOE report lists 28 IGCC projects that are planned in the U.S. by utilities and independent power producers.

The Great Plains Synfuels Plant has been gasifying coal since 1984 to produce synthetic natural gas. It produces enough synthetic natural gas to be able to supply the fuel for 1000 MW of combined-cycle power plants. Since 2000 this gasification plant has been capturing its CO_2 and transporting it 205 miles by a new pipeline where it is sequestered underground and used for enhanced oil recovery. This demonstrates that CO_2 can be captured, transported and sequestered from a commercial gasification plant. No method of CO_2 capture is commercially available or economically viable for the proposed pulverized coal power plant.

The Eastman Chemical Company has been removing the mercury from their gasification plant for more than 20 years. Recent testing indicates that the mercury levels in the cleaned gas are at non-detectable levels.

IGCC plants produce much less solid wastes and less potential for ground water contamination than the proposed pulverized coal plant.

IGCC plants use 30% to 40% less water than pulverized coal plants.

III. PULVERIZED COAL COMBUSTION AND GASIFICATION TECHNOLOGIES

Q. What are the Differences Between Combustion and Gasification?

A: It is important to understand the difference between combustion which is used in a coal power plant and coal gasification which is used in an IGCC plant. Exhibit RCF-2 shows the differences between combustion and gasification. The coal boiler operates at 1800 F and atmospheric pressure. The coal gasifier operates at 2600 F and 40 atmospheres pressure. The flow meters show the pounds of material that need to be processed for the same amount of electricity. Prior to gasification the nitrogen is separated from the air and the oxygen alone is used in the gasifier. Therefore for the same amount of electricity the gasifier produces 173 pound of synthesis gas versus 1000 pounds of exhaust gas from the boiler. Since the gasifier operates at higher pressure there is also a much smaller volume of gas that needs to be treated for pollutants and therefore the size of the equipment and capital cost is much smaller. The exhaust gas volume that needs to be treated from a coal boiler is 160 times larger than the volume of the synthesis gas that can also be cleaned of pollutants. The form of the pollutants from the gasifier makes it possible for very efficient recovery of potential pollutants using proven commercially available equipment that is operating in the natural gas and petrochemical industries. Proven commercially available technologies are <u>not</u> presently available for the proposed new coal boilers for mercury and CO_2. This is one of the main reasons that we need to use gasification.

Q. What Is Integrated Gasification Combined Cycle (IGCC)?

A. Integrated Gasification Combined Cycle (IGCC) is the efficient integration of the coal gasification process with the pre-combustion removal of pollutants and the generation of electricity using a combined cycle power plant. Due to the high pressure and low volume of the concentrated synthesis gas that is produced it is capable of higher levels of pollutant removal at lower costs than pulverized coal (PC) combustion.

Exhibit RCF-3 shows the various parts of an IGCC plant that will be described.

IGCC is a method of producing electricity from coal and other fuels. In an IGCC plant, coal is first converted to synthesis gas (also called syngas) composed primarily of hydrogen, carbon monoxide and carbon dioxide. After removing particulate matter, sulfur, mercury and other pollutants, the cleaned syngas is combusted in a combined-cycle power plant to produce electricity.

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. The coal is partially oxidized at high temperature and pressure to form syngas. The syngas leaves the gasifier, while the solids are removed from the bottom of the gasifier. 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.

After leaving the gasifier, the syngas undergoes several clean-up operations. Particulate matter is removed. Next, a carbon bed can be used to take out mercury. Finally, sulfur (in the form of H2S) is removed from the syngas in a combination of steps that usually involve hydrolysis followed by an adsorption operation using MDEA (methyldiethanolamine) or Selexol. The H2S that is removed from the syngas is usually converted into elemental commercial-grade sulfur using a Clauss plant.

The clean syngas enters a combustion turbine where it is burned to produce electricity. The heat from the exhaust gases is captured in a heat recovery steam generator (HRSG) and the resulting steam is used to produce more electricity. The combustion turbine, combined with the HRSG, is the same configuration commonly used for natural gas combined cycle (NGCC) plants. In Europe and Japan, some IGCC units have installed selective catalytic reduction (SCR) to control nitrous oxides (NO_x) emissions from the turbine, but in the United States, NO_x emissions at existing IGCC plants have been reduced with diluent injection only.

Q: What are the Other Advantages of Using Gasification Plants?

A: Gasification, which is also called Partial Oxidation, can use a wide range of fuels and can produce a wide range of products as shown in Exhibit RCF-4.

The fuel flexibility of gasification is demonstrated by its ability to use all types of coal, petroleum coke, biomass, refinery wastes, and waste materials. The synthesis gas that is produced consists of mainly carbon monoxide (CO) and hydrogen (H2) which are used as the raw materials to produce (or synthesis) a wide range of chemicals. This synthesis gas can also be used as fuel directly for a combined cycle power plant called an IGCC (Integrated Gasification Combined Cycle) plant. It can be further processed in a shift reactor to produce hydrogen and carbon dioxide (CO_2). The hydrogen can be used as a fuel or used to improve fuel quality in a refinery. The CO_2 can be used for enhanced oil recovery to produce addition oil from aging oil fields. The CO and H2 can also be further processed by the Fischer-Tropsch Process to produce liquid fuels. This demonstrates the wide range of products that can be produced by gasification. The production of multiple products from a single plant is called polygeneration. Economic analyses have indicated that polygeneration of fuels, chemicals and electricity improves the profitability of gasification plants.

IV. COST OF ELECTRICITY FROM PULVERIZED COAL AND IGCC PLANTS

Q. Did You Compare the Cost Of Electricity Produced from a New IGCC Plant in Florida With the Cost Of Electricity from a New Ultra-Super Critical Pulverized Coal Plant in Florida?

A. Yes.

Exhibit RCF-5 shows that the costs of electricity for the three types of proposed Pulverized Coal (PC) Plants are higher than the cost of electricity for an IGCC plant using Petroleum Coke (PetCoke) in Florida. Although the IGCC plant has a higher capital cost than the PC plants it has a significantly lower fuel cost when using petcoke. The U.S. petroleum refineries in the Gulf coast produce over 25 million tons per year of fuel-grade petcoke that can be used by IGCC plants. This petcoke can provide over 10,000 MW of new generating capacity in the U.S. At the present time almost all of this petcoke is exported to other countries that allow the higher emissions of SO_2 that petcoke produces. The use of petcoke in the U.S. requires the installation of additional FGD systems to PC plants which is usually cost prohibitive. IGCC plants can effectively remove the sulfur from petcoke and sell it as a value added product. Florida's proximity to the Gulf coast refineries enables Florida's utilities to make use of this waste material while reducing emissions and lowering their cost of electricity. Therefore the lowest cost alternative for Florida is the use of IGCC plants utilizing petcoke. Three companies have recently announced that they plan to build petcoke IGCC plants in the U.S. For the past 10 years Tampa

Electric has been using petcoke in their 250 MW IGCC plant and have recently announced that they will build an additional 630 MW IGCC plant for operation in 2013. Tampa Electric's President Chuck Black was recently quoted as saying: "it's our least cost-generating resource, so we count on it and use it every day as part of our system" in the November 2006 issue of Time Magazine, Inside Business.

The sources of data for Exhibit RCF-5 - Cost of Electricity Comparison Chart for Florida are:

1. Capital, O&M and all non-fuel costs are based upon: Department of Energy/NETL Presentation, Federal IGCC R&D: Coal's Pathway to the Future, by Juli Klara, presented at GTC, Oct. 4, 2006.

2. Efficiencies and fuel consumption calculations are based upon: EPA Final Report, Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies, July 2006.

3. Fuel costs are based upon: Department of Energy, Energy Information Administration, Average Delivered Cost of Coal and Petroleum Coke to Electric Utilities in Florida, 2005 and 2004.

Q: What are the Additional Costs for Capturing CO_2 from Pulverized Coal and IGCC Plants?

A: IGCC plants are capable of capturing CO_2 at much lower costs than pulverized coal plants. The capture, transporting and sequestering of CO_2 is being done on a commercial scale at the Great Plains Synfuels Plant which will be described in later testimony. Studies performed by the DOE, American Electric Power

(AEP), GE and others all show that IGCC plants will be more cost effective than pulverized coal plants when carbon reductions are required.

Exhibit RCF-6 by GE shows the additional cost that must be added to super-critical pulverized coal (SCPC) plants and IGCC plants for CO_2 capture. The table shows the energy penalty and added capital costs for CO_2 capture. The use of a cost for carbon emissions in planning is reasonable given the high likelihood that carbon will be regulated in the future. This exhibit shows the Cost of Energy (COE) for plants designed with the capability to remove CO_2. The COE with CO_2 capture for PC plants will be an unacceptable 8.29 cents/kwh compared to the COE with CO_2 capture for IGCC plants of 6.90 cents/kwh. This is a 66% increase for PC plants compared to a 25% increase for IGCC plants.

Q. Do the Other Studies Confirm these Results of Significantly Lower Costs for Capturing CO_2 in IGCC Plants?

A. Yes.

Exhibit RCF-7 is from a recent U.S. Dept. Of Energy (DOE) Presentation that shows significantly lower future electric costs for IGCC plants than pulverized coal plants. It is important to note that this study was for a mid-west location and petcoke was not included as a potential fuel for the IGCC plant.

This DOE study shows a 30% increase in COE for IGCC with CO_2 capture versus a 68% increase in COE for PC with CO_2 capture. This confirms the GE results which show a 25% increase in COE for IGCC with CO_2 capture versus a 66% increase in COE for PC with CO_2 capture.

This exhibit shows that the cost of electricity from an IGCC plant using coal and located in the midwest is 5.26 cents per kilowatt-hour compared to 4.97 cents per kilowatt-hour for the Pulverized Coal (PC) plant. Therefore the significant emission reductions by using IGCC will only increase the cost of electricity by 0.29 cent per kilowatt-hour. This chart also shows that with future requirements to reduce carbon dioxide (CO_2) emissions the cost of electricity for PC plants will increase to 8.35 cents per kilowatt-hour while only increasing to 6.84 cents per kilowatt-hour for the IGCC plant. That amounts to an increase in the cost of electricity of 3.38 cents per kilowatt-hour for the PC plant. Therefore the IGCC plants will be less expensive to operate in the future. The net result is much cleaner air now and lower cost electricity in the future.

V. AIR POLLUTANT EMISSIONS FROM PULVERIZED COAL AND IGCC PLANTS

Q: Are the Emissions from Ultra Super-critical Pulverized Coal (USPC) Plants Significantly Higher Than IGCC Plants? If So, Explain.

A: Yes.

Exhibit RCF-8 shows the much lower emissions that are produced from Integrated Gasification Combined Cycle (IGCC) plants than Ultra Super-critical Pulverized Coal (USPC) plants. I prepared this exhibit to show that by using IGCC plants to produce the same amount of electricity as USPC plants will dramatically reduce emissions. The use of IGCC plants will produce:

- 84% less smog forming gases (NO_x)
- 88% less acid rain gases (SO_2)
- 42% less soot or fine particulate (PM10)

- 65% less brain damaging mercury (Hg) and the potential for
- 90% less global warming gases (CO_2)

The potential for future electric cost increases due to future environmental regulations is less for IGCC because IGCC plants can control all emissions more economically than PC plants.

I prepared these emission calculations based upon:

1. The best available control technology as reported in EPA Final Report, Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies, July 2006;

2. DOE Final Report, Major Environmental Aspects of Gasification-Based Power Generation Technologies, Dec. 2002 and

3. Test results from Eastman's gasification process using activated carbon beds for mercury removal.

Q: The EPA Report that you used for your Comparison of Emissions is Based upon a Standard USPC Plant with Emission Levels Slightly Different than the Emission Levels Proposed for the FGPP Plant. How do the Emission Levels of the Proposed FGPP Plant Compare with an IGCC Plant?

A: Exhibit RCF-9 shows the tons per year (or pounds per year) of emissions for the proposed FGPP plant and an IGCC plant producing the same amount of electricity.

This chart shows that an IGCC plant producing the same amount of electricity as the proposed FGPP plant will dramatically reduce emissions. The use of IGCC plants will produce:

- 84% less smog forming gases (NO_x)

- 79% less acid rain gases (SO_2)
- 56% less soot or fine particulate (PM10)
- 67% less brain damaging mercury (Hg) and the potential for
- 90% less global warming gases (CO_2)

I prepared these emission calculations based upon:

1. The emissions data from the Permit Application for FPL Glades Power Park, Dec. 2006;

2. The best available control technology as reported in EPA Final Report, Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies, July 2006;

3. DOE Final Report, Major Environmental Aspects of Gasification-Based Power Generation Technologies, Dec. 2002 and

4. Test results from Eastman's gasification process using activated carbon beds for mercury removal.

Q. Do Recent IGCC Plants' Permit Levels and Proposed Permit Levels Confirm that these Significantly Lower Levels of Emissions Provided in these Studies can be Produced in Actual Plants?

A. Yes.

Exhibit RCF-10 shows a summary of emissions from recent IGCC permits and proposed permit levels. This table summarizes proposed emission levels from IGCC plants that have recently received or applied for air permits. The majority of IGCC plants proposed in the last 12 months have sought to control sulfur using Selexol, a more effective control strategy than MDEA. These plants include, AEP in Ohio and West Virginia, Northwest Energy, Tondu, Duke, ERORA (Illinois and Kentucky). Only one air permit application filed in the last 12 months, Mesaba (filed June 2006) uses the less effective MDEA. Selexol effectively removes sulfur levels to between 0.0117 to 0.019 lb/MMBtu heat input into the gasifier.

As this table shows, a majority of IGCC plants that have filed applications in the last 12 months include SCRs to control NOx. These include, Northwest Energy, Tondu, ERORA in Illinois and Kentucky, and Duke in Indiana (The Duke plant includes and SCR, but bases reductions on diluent injection only). The NO_x emission rates for SCR controlled IGCC plants is 0.012 - 0.025 lb/MMBtu based upon heat into the gasifier.

These trends toward Selexol and SCR adoption are occurring faster than EPA predicted in its July 2006 report, Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies. The July 2006 EPA report assumed that MDEA and diluent injection would be BACT for the near-term. This report was based upon a "snap shot" of IGCC permits that is out of date. As this table shows, the market has responded with technology faster than the EPA report anticipated.

In deciding which emission rates to compare to the FGPP plant's proposed emission rates, the highest weight should be placed on recently proposed IGCC plants because they represent the most current view of IGCC permit levels. The least weight should be placed on existing IGCC plants and IGCC plants with permits issued prior to 2003 because they do not represent the capabilities of current IGCC technology.

Q. What are the Emission Rates from the Proposed FGPP Plant and How do they Compare with Recent IGCC Permit Applications?

A. Exhibit RCF-11 summarizes the range of recently filed air permits for IGCC plants (filed in the last 12 months) and compares them to the proposed emission levels for the FGPP plant. An IGCC plant would have significantly lower emissions of all pollutants than the proposed FGPP plant.

Exhibit RCF-11 shows that:

An IGCC plant with the Selexol process would emit only 29% to 47% of the sulfur dioxide of the proposed FGPP plant.

An IGCC plant with the SCR process would only emit 24% to 50% of the nitrogen oxides of the proposed FGPP plant.

An IGCC plant would only emit 48% of the particulate mater of the proposed FGPP plant.

An IGCC plant would only emit 16% to 46% of the mercury of the proposed FGPP plant.

An IGCC plant would also be expected to emit about three-quarters less CO and significantly less sulfuric acid mist and VOCs than the proposed FGPP plant.

VI. THE CLEAN AIR ACT AND BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

Q. Should IGCC Technology be Evaluated as Part of the BACT Analysis for a New Power Plant?

A. Yes.

Exhibit RCF-12 shows the definition of BACT that is included in the Clean Air Act. Exhibit RCF-12 also shows why Senator Huddleston proposed the amendment that included the words "innovative fuel combustion techniques for control of each pollutant" to The Clean Air Act's definition of BACT. Senator's Huddleston words from the Congressional Record are:

- "And I believe it is likely that the concept of BACT is intended to include such technologies as low Btu gasification and fluidized bed combustion. But, this intention is not explicitly spelled out, and I am concerned that without clarification, the possibility of misinterpretation would remain.
- It is the purpose of this amendment to leave no doubt that in determining best available control technology, all actions taken by the fuel user are to be taken into account – . . [including] gasification, or liquefaction . . . which specifically reduce emissions."

Senator Huddleston's amendment was accepted as part of the definition of BACT in The Clean Air Act. Therefore IGCC technology should by law be evaluated as part of the BACT analysis for a new power plant.

VII. TAMPA ELECTRIC COMPANY (TECO) AND IGCC

Q. How Long have Commercial Size IGCC Plants been in Operation in the U.S.?

A. Commercial IGCC plants have been in operation for more than 10 years in the U.S.

Exhibit RCF-13 shows the Polk Power Plant near Tampa, FL which is a greenfield site and the Wabash Power Plant in Indiana which is a conversion of an existing plant.

Tampa Electric Company's (TECO) Polk Power Station began operation in 1996. It produces 250 MW (net) of electricity. It uses a Texaco (now GE) oxygen-blown gasification system. Power comes from a GE 107FA combined cycle system. During the summer peak power months, availability is greater than 90 percent when using back-up fuel.

The Wabash River Coal Gasification Repowering Project in Indiana began operation in November 1995. It demonstrated the repowering of an existing coal plant to IGCC. The plant uses an "E-Gas" oxygen-blown gasification system which is sold by ConocoPhillips.

For larger size plants, multiple units are being proposed which will improve system availability and reduce costs by making use of standard, modular designs.

Q. Have the Utilities Involved with these IGCC Plants Announced Plans to Build Other IGCC Plant?

A. Yes.

Tampa Electric Company has announced that they will build an additional 630 MW IGCC plant at the Polk Power Plant for operation in 2013. Tampa Electric started operation of its existing 315 MW(gross)/250MW(net) IGCC plant in October, 1996 and has recently celebrated its 10th year anniversary. It is the lowest cost plant to operate on Tampa Electric's System and has won numerous environmental awards.

Cinergy was the utility partner that was part of the Wabash IGCC plant. Cinergy has now merged with Duke Energy. Duke Energy has announced that they will build a 630 MW IGCC plant to be built at their Edwardsport Generating Station in Edwardsport, Indiana.

There are at least twenty-eight (28) IGCC plants being planned in the United States by utilities and independent power producers.

Q. Why are the Stacks of PC Plants So Much Taller Than

the Stacks of IGCC Plants?

A. A tall stack is required on all PC plants because the emissions are so high that a significant amount of dilution is required before the ground level emissions are within acceptable limits for people to breath. The proposed FGPP plant is designed with a 500 foot stack compared to the 120 foot stack at Tampa Electric's IGCC plant. Exhibit RCF-14 is a picture that demonstrates the significantly lower emissions from IGCC plants by the facts that the IGCC stack is clear and that there is no need for a tall stack. The much taller PC stack also decreases property values in a much larger surrounding area. This IGCC plant was designed about 15 years ago. Since then significant improvements have been made in IGCC emissions control which enable much lower emission levels than what was required for this IGCC plant 15 years ago. Therefore any emissions comparison should be based upon the best available control technologies (BACT) for PC and IGCC plants that are currently being built.

VIII. REFERENCES TO CONTACT FOR PC AND IGCC PLANTS

Q. What Government Officials and Power Plant Managers are the Most Informed about the Advantages and Disadvantages of Using PC and IGCC Technologies for New Power Plants?

A. Exhibit RCF-15 shows references that I recommend to be contacted prior to anyone making a decision on which technology to use for a new power plant. Each of them have agreed to be contacted to provide their advise concerning their decision process in evaluating PC and IGCC plants.

IX. COMMERCIALLY OPERATING AND PLANNED IGCC PLANTS

Q. Please Describe the Types and Number of Commercially Operating Gasification Plants.

A. Exhibit RCF-16 shows the results of the 2004 world survey of operating gasification plants prepared by the Gasification Technologies Council for the Department of Energy.

Gasification dates back to the 18th century, when "town gas" was produced using fairly simple coal-based gasification plants. But what we think of as modern gasification technology dates back to the 1930's when gasification was developed for chemicals and fuels production. Today (2007), there are around 130 gasification plants worldwide that produce fertilizers, fuels, steam, hydrogen and other chemicals, and electricity. Of these 130 plants, fourteen are IGCC plants.

Q. How Many Commercially Operating IGCC Plants Are There?

A. Exhibit RCF-17 from a Department of Energy presentation shows fourteen (14) commercially operating IGCC plants. Together, these plants have a capacity of 3,880 MW(net) and have almost one million hours of operation on syngas.

These plants use a variety of fuels including coal, petroleum coke, biomass, and refinery residues.

Four IGCC plants tend to be the focus of utility interest because they were designed to use coal: 1) Wabash, Indiana, 2) Polk, Florida, 3) Nuon, Netherlands, and 4) Elcogas, Spain. These four commercial IGCC plants have been operating from 10 to 13 years. They have successfully integrated the gasification process with the combined cycle power plant to enable more efficient use of coal while significantly reducing emissions. These plants range in size from 250 to 320 MW per unit.

A second set of plants built after Wabash, Polk, Nuon, and Elcogas are also important in the progression of IGCC. These plants operate at refineries in

Italy. They are: Sarlux 545 MW, Sardinia; ISAB Energy 510 MW, Sicily; Api Energia 280 MW, Falconara; and Eni Power 250 MW, Ferrera. The first two demonstrate that IGCC plants can be built at a scale above 500 MW. Three of the plants were built using non-recourse project financing provided by over 60 banks and other lending institutions. They show that IGCC can be a commercially bankable technology.

Both the Salux and ISAB Energy plants use more than one gasification "train" and operate with more than 90 percent availability without a spare gasifier. 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.

The first commercial-scale demonstration IGCC plant in the United States was Southern California Edison's Cool Water Plant located at Barstow, California. It operated between 1984 and 1989. The plant successfully utilized a variety of coals, both subbituminous and bituminous, and had a feed of about 1,200 tons/day. The project used an oxygen-blown Texaco gasifier with full heat recovery using both radiant and convective syngas coolers.

Q. Can You Describe the Types of IGCC Projects being Developed in the U.S.?

A. Exhibit RCF-18 shows some of the publicly announced IGCC and gasification projects in the U.S.

The range of IGCC projects under development in the United States includes proposals that would be fueled with petroleum coke, bituminous coal, subbituminous coal, and lignite. For example, the Department of Energy announced in August 2006 that it had received tax credit applications under the Energy Policy Act of 2005 from 18 IGCC projects-- 10 using bituminous coal, six using subbituminous coal, and two that would use lignite. The source of this data is from the Department of Energy, Fossil Energy Techline, issued August 14, 2006, Tax Credit Programs Promote Coal-Based Power Generation Technologies.

IGCC technology is commercially available from five major companies: GE, ConocoPhillips, Siemens, Shell and Mitsubishi Heavy Industries (MHI). The gasification industry has undergone many changes in the past few years that have given confidence to industry and lenders that IGCC can obtain sufficient performance warranties to build new IGCC plants. GE, a major company in the power field, has purchased ChevronTexaco's gasification business, and has partnered with Bechtel to offer fully warranted IGCC plants. ConocoPhillips has purchased the E-Gas technology from Global Energy. Siemens has purchased the German gasification technology formerly offered by Future Energy. Shell has partnered with Udhe and Black and Veatch.

Q. **Is there a List of the IGCC Projects that are Presently Under Development in the U.S.?**

A. Yes.

Exhibit RCF-19 is a recent list presented by DOE that shows some of the gasification projects that are being developed in the U.S.

A recent DOE Report lists 28 IGCC projects that are planned in the U.S. by utilities and independent power producers. This Department of Energy Report is Tracking New Coal-Fired Power Plants, by Scott Klara and Eric Shuster, September 29, 2006.

X. SIZE AND AVAILABILITY OF NEW IGCC PLANTS

Q. Is it Possible to Build the Large Size IGCC Plants that are Needed for the FGPP Plant?

A. Yes.

Large size plants are being built using modular designs that improve system reliability, increase efficiencies and provide fuel flexibility.

The Nuon Utility in the Netherlands, Belgium and Germany has been successfully operating an IGCC plant on coal and biomass for the past 12 years at about 253 MW. Nuon recently announced that they are building a 1200 MW plant which will consist of four 300 MW units. This design shown in Exhibit RCF-20 requires no additional scale-up from the design of their existing plant and makes use of readily available combined-cycle plants that have been used with natural gas. This modular design provides additional system reliability, increased efficiencies, fuel flexibility and any possible size.

The standard IGCC unit is now 300 MW. Most manufacturers are supplying 600 MW plants which consist of two 300 MW units. This is due to the fact that the gasifiers have been sized to produce the amount of synthesis gas needed for the 300 MW combined-cycle plants that are already in-service using natural gas. 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 scale-up required. Any large size plant can be built by using additional 300 MW units. Three manufacturers have 300 MW IGCC units that have been operating successfully for the last 10 to 13 years. GE states that "IGCC technology can satisfy output requirements from 10 MW to more than 1500 MW, and can be applied in almost any new or repowering project where solid and heavy fuels are available." The source of this quote is from: www.gepower.com/prod_serv/products/gas_turbines_cc/en/igcc/index)

Q. Have Recent Coal Gasification Plants and IGCC Plants Demonstrated Reliabilities Above 90% Required by the Utility Industry?

A. Yes.

Now GE offers to take on responsibility for everything "From Coal off the Coal Pile to Electrons on the Grid" by Ed Lowe, GE General Manager of Gasification from Time Magazine, Inside Business, November, 2006.

Exhibit RCF-21 is a chart by GE which shows that their 4 new coal gasification plants that have been operating in China for the past 3 years have been operating at greater than 90 % reliability.

An additional advantage of an IGCC plant is that it can operate on various fuels. If the gasifier is out-of service for maintanence the power plant can still operate on natural gas or diesel fuel. This is not possible with a PC plant which is usually designed for one type of coal. Older IGCC plants built in the early 1990s such as Polk and Wabash that operate without a spare gasifier have demonstrated availabilities above 85%.

A recent Gas Turbine World article reported on the capacity factors of the more recently built IGCC plants in Italy that utilize refinery waste such as asphalt as a fuel. As the report notes, the availability of these plants are between 90% and 94%. The source of this data is from Refinery IGCC plants are exceeding 90% capacity factor after 3 years, by Harry Jaeger, Gas Turbine World, January-February 2006.

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. The economic comparisons conducted for Tampa Electric's IGCC plant indicate that it is more cost effective to operate on natural gas or diesel fuel than to build a spare gasifier to increase plant availability. Tampa Electric's IGCC plant has demonstrated reliability to produce electricity of 95% with their dual fuel capability. This is greater than PC plants that do not have dual fuel capability. The source of this data is from Tampa Electric's Presentation of Operating Results, by Mark Hornick, Plant Manager, presented during plant tours.

Therefore IGCC plants are being built without a spare gasifier. They will be able to operate above 90% availability by using their back-up fuel of either natural gas or diesel.

Reliability and availability are measures of the time a plant is capable of producing electricity. Reliability takes into account the amount of time when a plant is not capable of producing electricity because of unplanned outages. Availability takes into account the time when a plant is not capable of producing electricity because of planned and unplanned outages.

XI. THE GREAT PLAINS SYNFUELS PLANT

Q. Are There Any Commercially Operating Gasification Plants That Are Capturing CO_2?

A. Yes.

Exhibit RCF-22 shows the Great Plains Synfuels Plant in Beulah, North Dakota which is a good example of a commercial gasification plant. It began operating in 1984 and today produces more than 54 billion cubic feet of

Synthetic Natural Gas (SNG) from 6 million tons of coal per year. If the SNG from this one plant were used in combined-cycle power plants there would be enough fuel for more than 1,000MW of generating capacity.

Adjacent to the Great Plains Synfuels Plant is the Antelope Valley Station which consists of two 440 MW lignite coal power plants that also started operation on lignite in the early 1980s.

Both plants are owned by the Basin Electric Power Cooperative. Al Lukes, Senior Vice President and COO of the Dakota Gasification Company, presented a paper at the 2005 Gasification Technologies Conference entitled Experience with Gasifying Low Rank Coals which showed the significantly lower emissions from the coal gasification plant than the coal-fired power plant. I recently asked Al Lukes which technology he would select today for a power plant, and he said "definitely the gasification technology".

Q. Has the Great Plains Synfuels Plant been Able to Commercially Demonstrate that the CO_2 from this Coal Gasification Plant can be Economically Captured and Sequestered?

A. Yes.

Carbon dioxide capture, transportation and sequestration has been operating commercially since 2000 at the Great Plains Synfuels Plant. In 2000, the Great Plains Synfuels Plant added a CO_2 recovery process to capture the CO_2. It transports the CO_2 by pipeline 205 miles, as shown in Exhibit RCF-23, to the Weyburn oil fields where it is used for enhanced oil recovery (EOR). In this way, the CO_2 does not become a global warming emission source but is sold as a useful byproduct to recover additional oil from depleted oil fields and the CO_2 is sequestered underground. This CO_2 recovery process is expected to help extract 130 million extra barrels of oil from this oil field. This demonstrates the ability to efficiently capture and sequester the $CO2$ from the gasification process.

XII. ENVIRONMENTAL IMPACT COMPARISONS OF PC AND IGCC PLANTS

Q: What Mercury Control Technology is Used With IGCC Plants that Can Remove So Much More Mercury Than What can be Removed from the Proposed FGPP Plant?

A: The efficient mercury removal process that will be used for IGCC plants has been commercially operating for more than 21 years.

The plant shown in Exhibit RCF-24 uses activated carbon beds for removing more than 94% of the mercury from the synthesis gas of this coal gasification plant. Mercury testing has indicated non-detectable mercury levels in the synthesis gas. However it is not economically possible to use this efficient mercury removal process for conventional Pulverized Coal (PC) plants due to the much larger quantities of stack gas in a PC plant. The stack gas (also called flue gas) from proposed PC plants will be 160 times the volume of the synthesis gas that will be treated in an IGCC plant. It is not economically feasible to treat this much larger volume of stack gas using this much more efficient process. Therefore FPL has proposed the much less expensive and much less efficient technology of activated carbon injection (ACI) that has not underdone long term testing at the commercial scale that should be required for these plants. Therefore a recent Electric Power Research Institute (EPRI) Journal article titled <u>Mercury Control for Coal-Fired Power Plants</u>, Summer 2005, page 19 states:

"No technology designed specifically to control mercury in coal plants is in use anywhere in the world, or has even undergone long term testing."

What this means is that the proposed technology of activated carbon injection (ACI) that FPL has proposed has not underdone long term testing at the commercial scale that should be required for these plants. Therefore there is a significant risk that the proposed mercury control system for the FGPP plant will not meet their proposed emission levels for mercury.

Q. Are there Less Solid Wastes Produced from IGCC Plants?

A. Yes.

Exhibit RCF-25 shows the significantly less solid waste that is produced by IGCC plants. Instead of large quantities of scrubber sludge to dispose from the proposed FGPP plant an IGCC plant produces useful sulfur byproduct. Leachable ash and scrubber sludge from the PC plants can cause ground water contamination. Instead of a leachable fly ash to dispose of IGCC produces a non-leachable slag that can be used in asphalt. The higher temperatures for gasification than combustion has a benefit because coal ash has a softening temperature of about 2250 F. Therefore, the coal ash goes through a molten state when gasified then cools to become an inert, vitrified slag that can be sold as a byproduct or disposed of as a non-leachable material.

Q. Do IGCC Plants Use Less Water than the Proposed PC Plant?

A. Yes.

Exhibit RCF-26 shows that IGCC plants use 30% to 40% less water than a PC plant.

The 30 to 40 % less water usage for an IGCC plant is due mostly to the fact that a combined cycle power plant is being used which requires less cooling tower water. A combined cycle power plant consists of both a gas turbine and a steam turbine for power generation. The gas turbine portion of the power generation cycle does not require the large quantities of water for cooling that are needed for the steam turbine cycle. Since a PC plant generates all of its electricity from the steam turbine cycle it requires larger amounts of water.

Combined cycle plants are more energy efficient but require a clean fuel such as natural gas, diesel, or synthesis gas. The older, less efficient technology uses only a steam turbine, which must be used for PC plants due to the contaminants in the combustion products.

XIII. THE BENEFITS OF FUEL FLEXIBILIY FOR POWER PLANTS

Q: What are the Benefits of a Power Plant being Able to Use Different Fuels?

A: The 1200 MW IGCC Plant to be built by the Nuon Utility in The Netherlands is a good example of a multi-fuel power plant. This plant is shown in Exhibit RCF-20. It will have the capability of using coal, petcoke, biomass and natural gas. This plant will be able to respond to changing fuel prices and availability of these alternative fuels. The coal, petcoke and biomass can all be gasified to produce syngas for the combined-cycle power plants. The biomass capability enables IGCC plants to use various renewable energy sources that will reduce the emissions of CO_2. Biomass is available in Florida as a byproduct of the sugarcane and pulp industries and then renewable energy crops can be developed as a new industry in Florida. 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.

feasibility studies, financial analyses, R&D projects, marketing analyses and commercialization of these new fuel technologies.

April 1977 - July 1981

Florida Power & Light Company, Miami, Florida
Senior Project Coordinator – Research and Development
Managed FPL's coal conversion program and fuels R&D program. Developed R&D projects with emphasis on alternative fuels and processes for electric power generation. Assessed the technical and economic feasibility of coal gasification, advanced coal cleaning technologies, coal-oil mixture technologies, coal-water slurry technologies, coal liquefaction processes, fluidized combustion processes and advanced pollution control methods. Established company R&D projects in uranium recovery, coal cleaning, coal-oil mixtures, coal-water slurries and combustion modifications.

September 1975 - March 1977

Center for Energy Policy, Inc., Boston, Massachusetts
Program Manager

Organized multi-disciplinary studies on the technical and economic feasibility of power plant conversions from oil to coal, the pricing policies for fuels and electricity and future methods for energy conservation in space heating. Directed engineering study for the conversion of New England Electric's Brayton Point Plant from oil to coal.

May 1972 - September 1975

Walden Research Division of ABCOR, Inc. Cambridge, Mass.
Senior Engineer

Industrial consultant for air pollution control, energy conservation, and industrial hygiene. Engaged in process modifications to reduce energy consumption. Responsible for engineering evaluations of air pollution control systems.

September 1970 - June 1972

Massachusetts Institute of Technology, Cambridge, Mass.
Graduate Student, Teaching Assistant, Researcher

Researcher – NSF grant to evaluate future energy sources and their environmental impact. Researcher for book entitled "New Energy Technology," by Hottel and Howard, MIT Press.

Graduate Student – Master's thesis: "Technical and Economic Evaluation of Coal Gasification Processes."

Teaching Assistant – "Principles of Combustion and Air Pollution" and "Seminar in Air Pollution."

June 1969 - February 1970

Southern California Edison Company, Los Angeles, California
Chemical Engineer
Engaged in power plant combustion air pollution control. Investigated two-stage combustion to reduce nitrogen oxides emission.

Professional Organizations

Electric Power Research Institute - EPRI
Gas Research Institute - GRI
Association of Energy Engineers - AEE
Cogeneration Institute - CI
American Institute of Chemical Engineers – AIChE
American Gas Cooling Center – AGCC

RICHARD C. FURMAN
CONSULTING ENGINEER

Address: 10404 S.W. 128 Terrace, Miami, Florida 33176
Date of Birth: January 7, 1947
Height: 6'0" **Weight:** 170 lbs.
Marital Status: Married: 2 children
Phone #: (305) 232-4074 office; (305)439-5604 cell.
E-mail: RcFurman2@aol.com

Education:

Massachusetts Institute of Technology, MS CHE 1972.
Worcester Polytechnic Institute, BS CHE 1969.

Experience:

February 2003 to Present

Retired – Volunteer at Camp Sunshine to help children with cancer and volunteer for the Clean Air Task Force (CATF), the Natural Resources Defense Council (NRDC), Environmental Defense, Sierra Club and Public Citizen to advise utilities, government agencies and the public about the environmental benefits, economic potential and energy security of using coal gasification technologies to produce electricity, fuels and chemicals .
Provided expert testimony and information on new energy technologies to Florida's Public Service Commission and Texas Senate Committee on Natural Resources.

September 1989 - February 2003

Consulting Engineer – New Energy Technologies

Consulting engineer to various utility companies, equipment manufacturers, government agencies and environmental organizations on the development and application of new energy technologies.
Consultant in the areas of coal gasification, integrated gasification combined-cycle (IGCC) power plants, alternative fuels, cogeneration and natural gas cooling technologies.
Identify potential applications for these new technologies with electric and gas utilities. Introduce these new technologies to company executives, government officials and potential users. Assist engineers with designs and applications for these new technologies. Create marketing programs with manufacturers for increased use of these technologies.
Direct technical feasibility studies and financial analyses for site specific applications. Assist equipment manufacturers, the Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), and the American Gas Cooling Center (AGCC) with development and demonstration of these new technologies.
Provided expert testimony and information on new energy technologies to Brazil's Center for Gas Technology and Trinidad's National Gas Company.

August 1981 - August 1989

Consulting Engineer – New Fuel Technologies

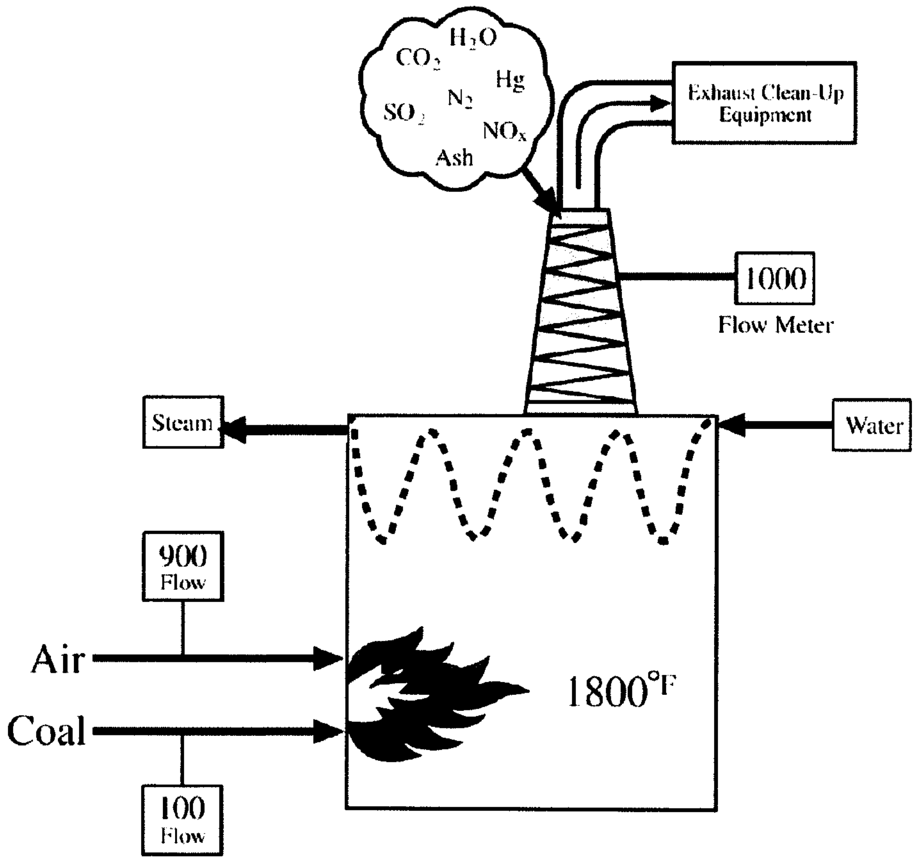
Consultant to various companies on the technical feasibility and business development for new fuel technologies. Major areas of consulting consist of the development and use of alternative new fuels and the conversion of power plants to these new fuels. Director and project manager for various development programs,

COMBUSTION VERSUS GASIFICATION

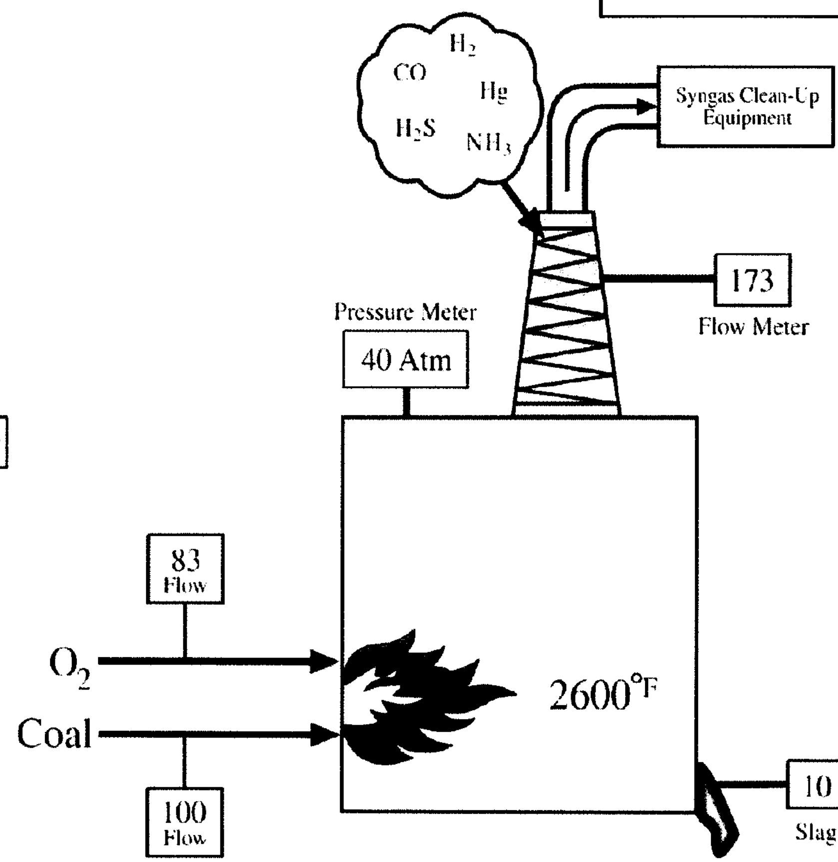
Volume of Exhaust Gas Clean-Up **Volume of Syngas Clean-Up**

Docket No. 070098-EI
Combustion vs. Gasification
Exhibit RCF-2, Page 1 of 1

160 X **X**



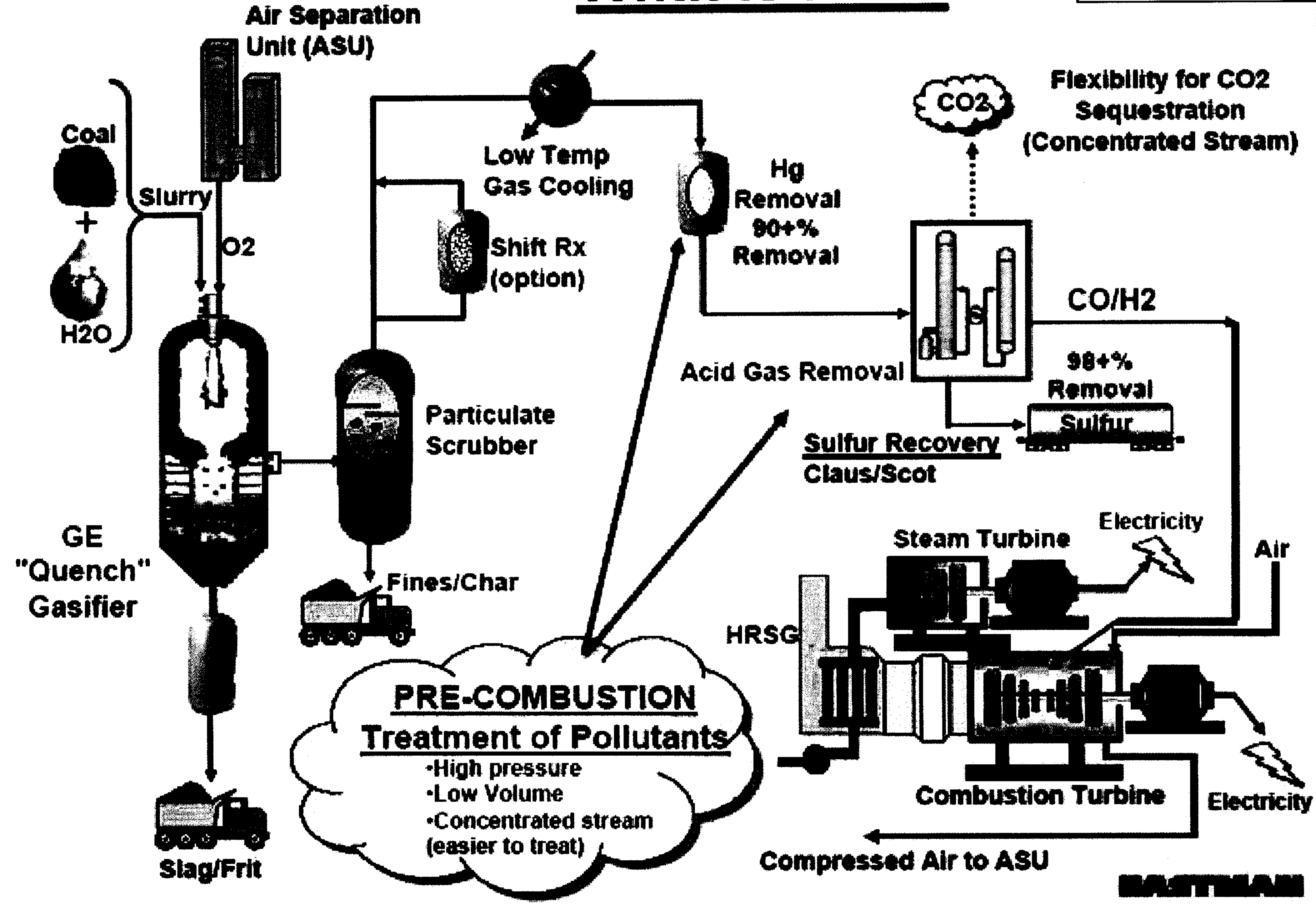
Coal Boiler



High Pressure Coal Gasifier
with Oxygen

- (Source: EPRI Presentation – "Gasification Combined Cycles 101" by Dr. Jeffrey Phillips, pages 9 and 12, presented at the Workshop on Gasification Technologies, Tampa, FL 3/2/06)

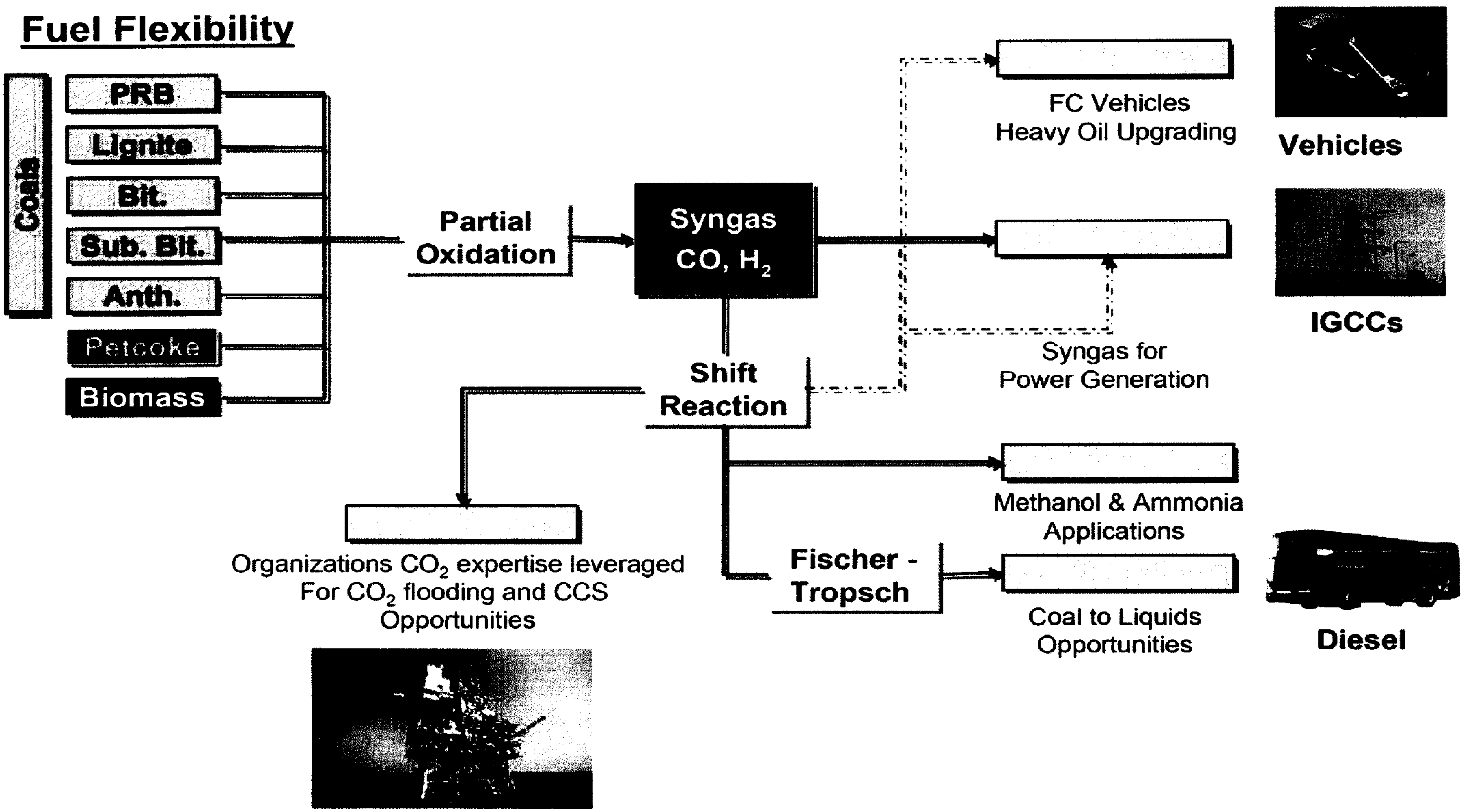
What is IGCC?



Source: Eastman Gasification Overview, March 22, 2005, page 15, by Eastman Gasification Services Company.

Docket No. 070098-EI
Shell Clean Coal Technology
Exhibit RCF-4, Page 1 of 1

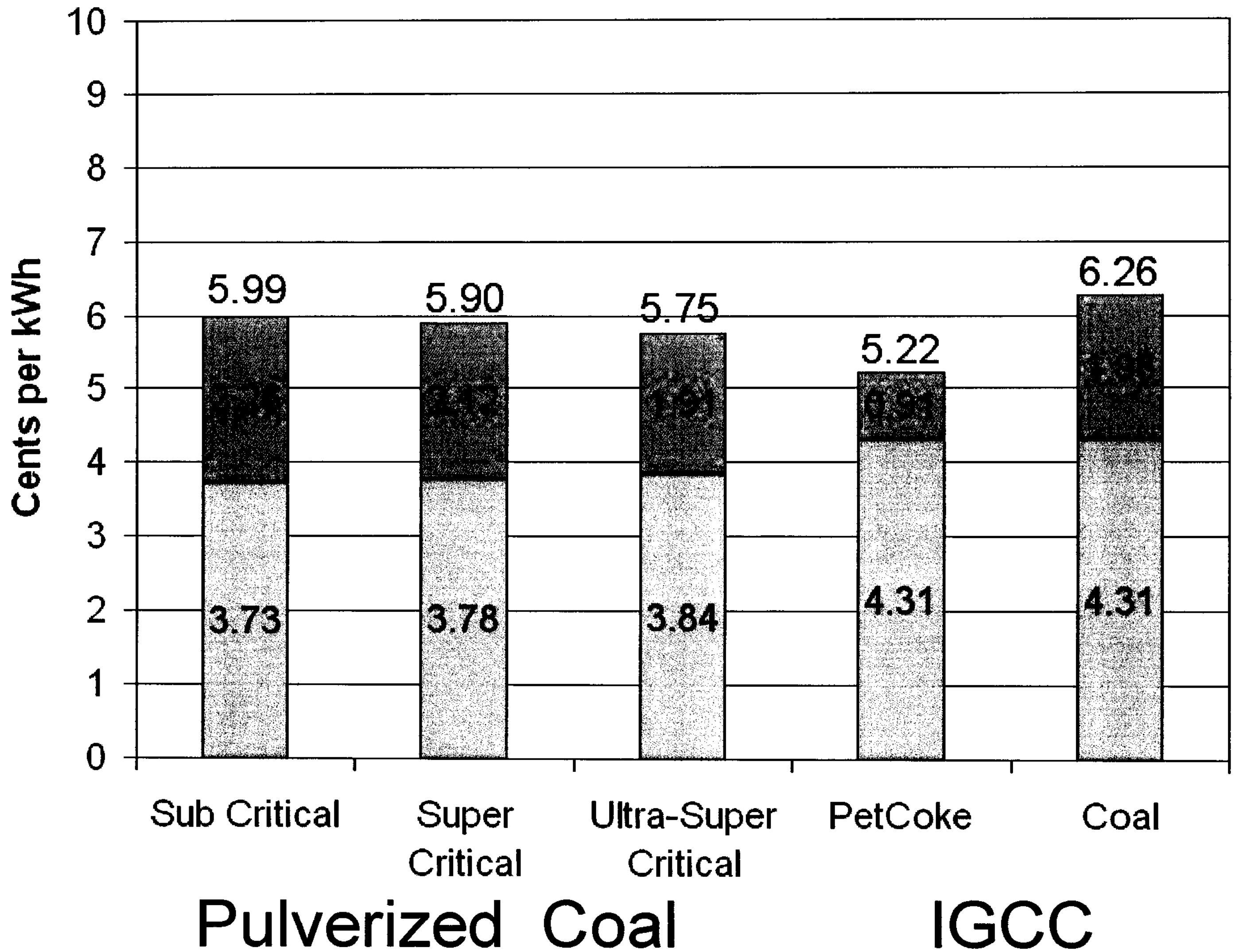
Shell has the enabling clean coal technologies…



- Source: <u>Shell Coal Gasification in North America</u> by **Milton Hernandez,** Shell U.S. Gas & Power, Presented at GTC, Oct. 2, 2006

Cost of Electricity Comparison Chart for Florida

Docket No.
070098-EI
Cost of
Electricity
Comparison (FL)
Exhibit RCF-5,
Page 1 of 1



■ Fuel Costs

■ Non-Fuel Costs

Coal Cost	$2.38/MMBtu	PC capacity factor	85%
PetCoke Cost	$1.11/MMBtu	IGCC capacity factor	80%

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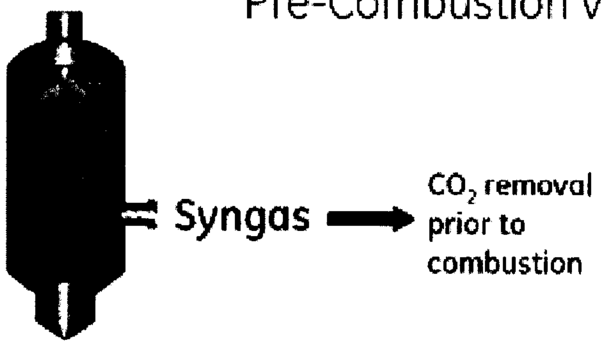
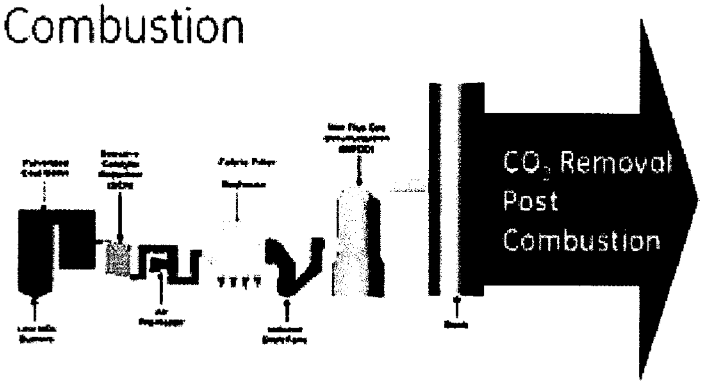
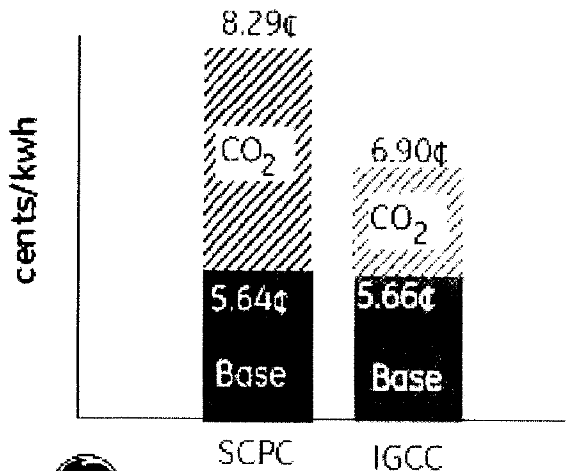
IGCC – CO_2 Capture

Pre-Combustion vs. Post Combustion





IGCC offers CO_2 capture advantages over SCPC

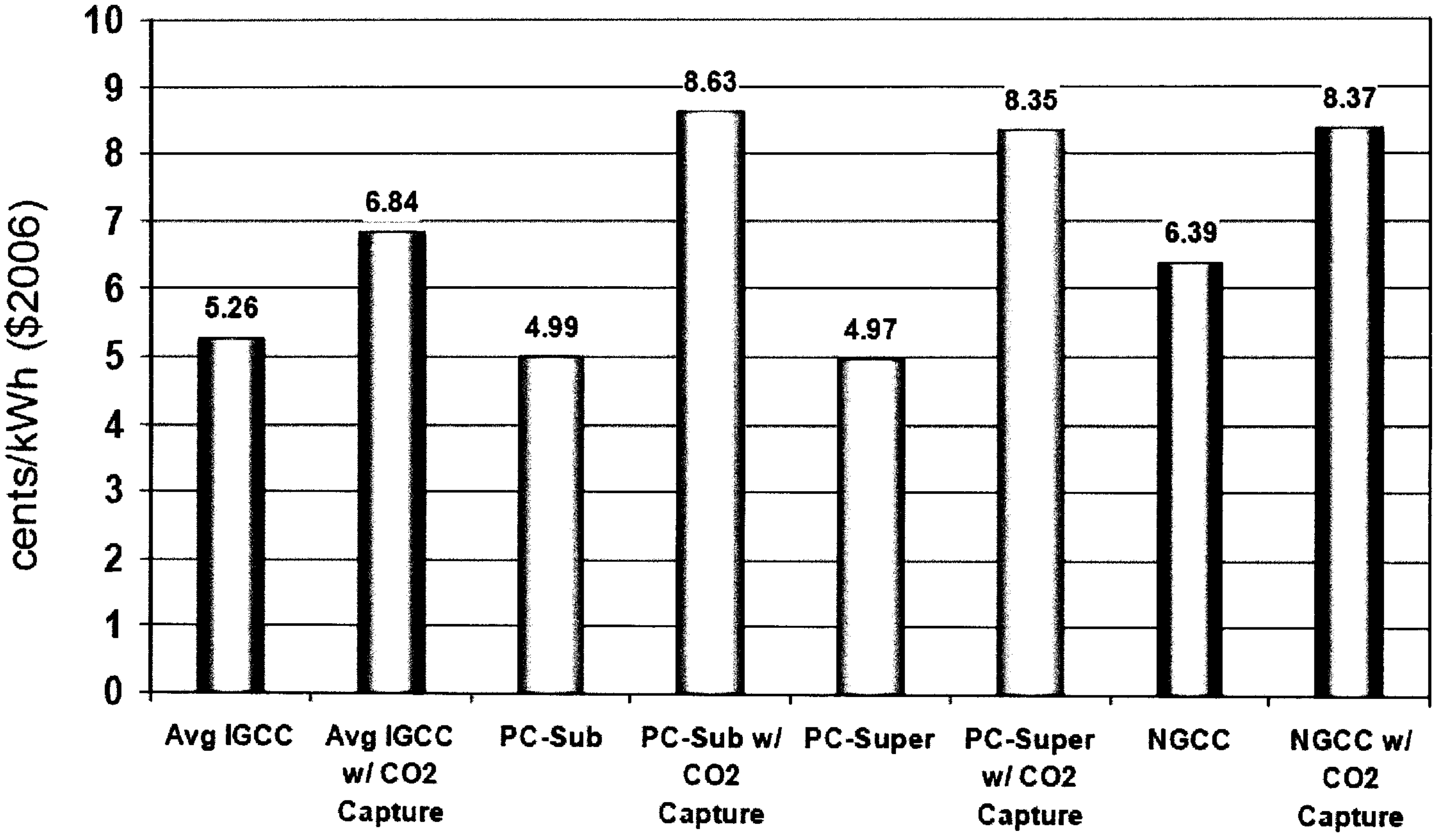


	IGCC	SCPC
kW penalty	-5%	-28%
Capital Cost	+30%	+73%
COE Increase	+25%	+66%

Source: GE Energy, Integrated Gasification Combined Cycle Panel Discussion, by Robert Rigdon – Director of IGCC Commercialization, presented at Power-Gen International, December 8, 2005, page 10.

Docket No. 070098-EI
Cost of Electricity Comparison
Exhibit RCF-7, Page 1 of 1

Cost of Electricity Comparison



January 2006 Dollars, 85% Capacity Factor, 13.8% Levelization Factor, Coal cost \$1.34/10^6Btu. Gas cost \$7.46/10^6Btu

NETL

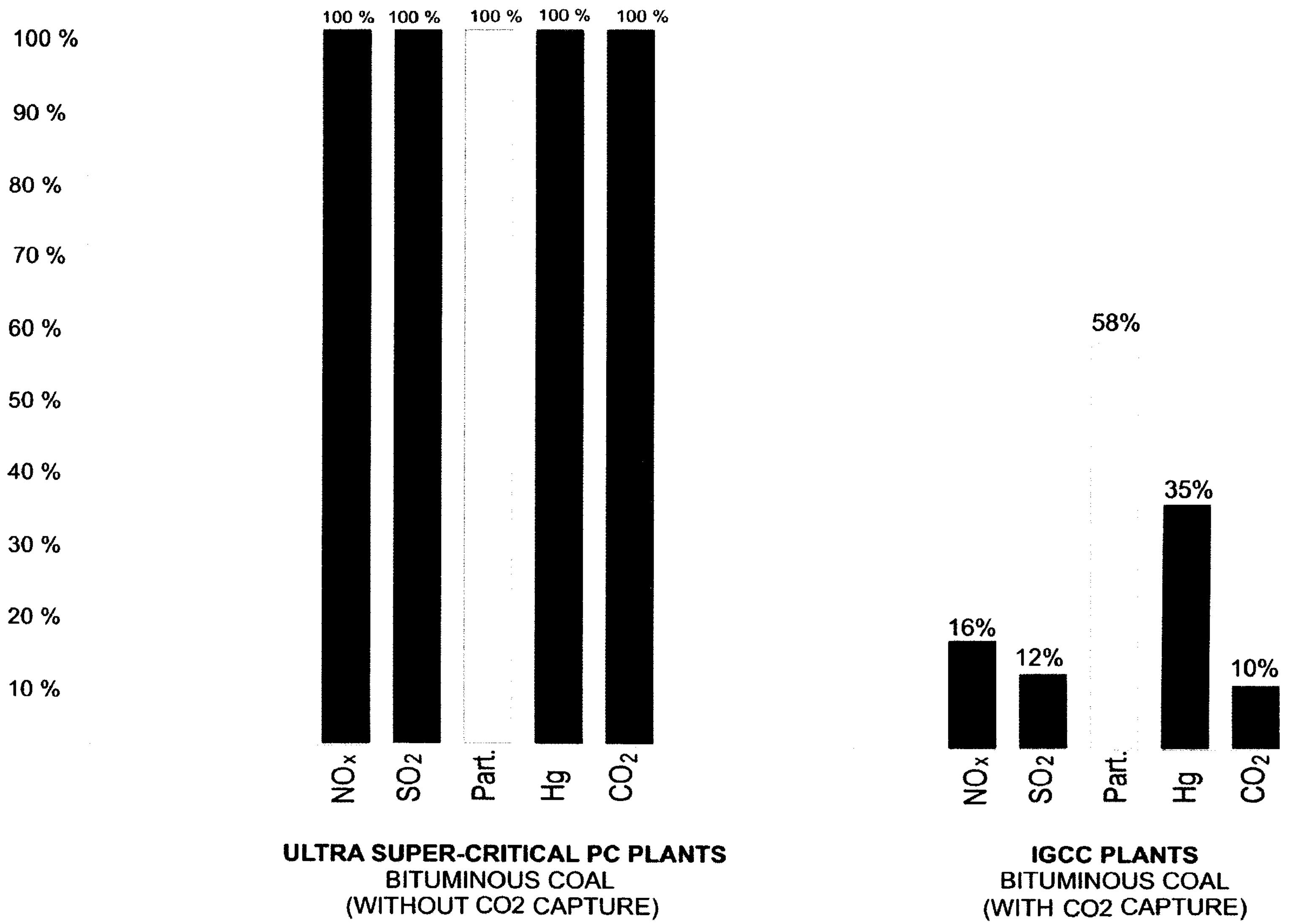
Note: Preliminary results as of September 2006. Final report release Date: January 2007

NETL Meeting with Wyoming Officials / GJStiegel / June 15, 06

Source: Department of Energy/NETL Presentation, Overview of Coal Gasification Technologies, by Gary Stiegel, presented at NSTAR Meeting, Pittsburgh, PA, Oct. 27,2006.

Docket No. 070098-EI
Relative Emissions from Proposed Plants
Exhibit RCF-8, Page 1 of 1

RELATIVE EMISSIONS FROM PROPOSED COAL POWER PLANTS



rcfurman2@aol.com 11/2006

TOTAL EMISSIONS FROM FPL GLADES POWER PARK (FGPP)
AND
AN IGCC PLANT OF THE SAME SIZE (1960 MW)

Docket No. 070098-EI
Total Emissions from FGPP
and IGCC Equivalent
Exhibit RCF-9, Page 1 of 1

	NOX (Tons per Year)	SO2 (Tons per Year)	Particulates (Tons per Year)	Mercury (Pounds per Year)	Carbon Dioxide (Tons per Year)
PC	3,811	3,048	991	180	12,774,000
IGCC	601	631	438	60	1,277,400
% REDUCTION	84%	79%	56%	67%	90%

less smog forming gases / acid rain gases / fine particulate / brain damage / global warming gases

SUMMARY OF RECENT IGCC PERMITS AND PROPOSED PERMIT LEVELS

Docket No. 070098-EI
Summary of IGCC Permits
Exhibit RCF-10, Page 1 of 1

	Approved Permit					Application Filed, Draft Permit Not Issued Yet						
Pollutant	Global Energ Lima, Oh, 59 MW	Kentucky Pionee Energy, KY	Wisconsin Electric Elm R 600 MW	ERORA Cash Cre KY, 630 MW	Southern Illinoi Clean Energy Complex, IL, 64 MW & 110 MMS methane	ERORA, Taylorville, IL MW	Nueces, T 600 MW	Energy Northwest WA, 600 MW	AEP, OH, 629 MW	AEP, WV, 629 MW	Mesaba One (606 MW), Mesaba Two (606), MN,Total 1,2 MW	Duke, Edwardsp t, IN, 630 MW
	(in lb/MMB	(in lb/MMBtu)	(in lb/MMBtu)	(in lb/MMBtu)	(in lb/MMBtu)	(in lb/MMBtu)	(lb/MMBtu	(lb/MMBtu	(lb/MMBtu	(lb/MMBtu	(lb/MMBtu)	(lb/MMBtu
SO_2	0.021	0.032 -3 hr ave	0.03 -24 hr ave	0.0117 -3 hr ave	0.033 -30 day ave	0.0117 -3 hr ave	0.019	0.016 -3 hr ave	0.017	0.017	0.025	Repower, n from BACT
NOx	0.097	0.0735 -3 hr ave	0.07 (15 ppmdv) -30 day ave	0.0246-24 hr ave	0.059 -30 day ave	0.0246 -24 hr ave	0.019	0.012 -3 hr ave	0.057	0.057	0.057	Repower, n from BACT
Mercury			.56 x 10-6	.197 x10-6 (1)	.547 X10-6	.19 x 10-6 (1)	1.825 x10-6	1.1 x10-5			90% removal, .026 tons Phas I and II total	.008 tons/y
PM	0.01	.0.011	0.011 (backhalf)				0.015	0.001			0.009	18.1 lbs/hr
PM10			0.011 (backhalf)	0.0063 -3 hr ave (filterable)	0.00924 (filterable)	0.0063 -3 hr ave (filterable)	0.014		.006 (filterable)	.006 (filterable)		
VOC	0.0082	0.0044	0.0017 -24 hr ave (LAER) (3)	0.006 -24 hr ave	0.0029	0.006 -24 hr ave	0.004	0.003	0.001	0.001	0.0032	1.4 ppmvw
Sulfuric Acid Mist			0.0005 -3 hr ave	0.0026 -3 hr ave	0.0042 -30 day ave	0.0026 -3hr ave	0.0001		98 tons/yr	98 tons/yr		
Fluorides (2)												
CO	0.137	0.032 -3 hr ave	.030 -24 hr ave	0.036 -24 hr ave	0.04 -30 day ave	0.036 -24 hr ave	0.04	0.036	0.031	0.031	0.0345	15 ppmvd
Lead			0.0000257									
Sulfur Control Techn	MDEA	MDEA	MDEA	Selexol	MDEA	Selexol	Selexol	Selexol	Selexol	Selexol	MDEA	Selexol
Nox Control Technology	Diluent Injection	Diluent Injection	Diluent Injection	Diluent/SCR	Diluent Injection	Diluent/SCR	Diluent/SCR	Diluent/SCR	Diluent Injection	Diluent Injection	Diluent Injection	Diluent/SCR

(1) Application estimates this emission limit but does not proposed an emission limit
(2) No limit established. Fluorides from IGCC plants are below PSD significance
(3) Polk IGCC also has this emission rate effective July 2003 as set by BACT.

Source: Declaration of John Thompson, Director of the Clean Air Transition Project for the Clean Air Task Force, submitted to EPA for the Desert Rock air permit, dated November 10, 2006, page 13.

EMISSIONS FROM FPL GLADES POWER PARK VERSUS RECENT IGCC PERMIT APPLICATIONS

	FGPP	IGCC			
	Proposed Emission Rates	Sulfur control using MDEA	Sulfur control using Selexol	Nitrogen control using diluent injection	Nitrogen control using both diluent injection and SCR
	(lb/MMBtu)	(lb/MMBtu)	(lb/MMBtu)	(lb/MMBtu)	(lb/MMBtu)
SO2	0.04	0.025 - 0.033 (62% - 82%)	0.0117 - 0.019 (29% - 47%)		
NOx	0.05			0.057 - 0.07 (114% - 140%)	0.012 - 0.025 (24% - 50%)
PM	0.013	0.0063 (48%)			
CO	0.15	0.03 - 0.04 (20% - 27%)			
Hg	0.0000012	0.00000019 - 0.00000056 (16% - 46%)			

Sources: 1. IGCC Data from Declaration of John Thompson, Director of the Clean Air Transition Project for the Clean Air Task Force, submitted to EPA for the Desert Rock air permit, dated November 10, 2006, page 15.
2. Air Permit Application for FPL Glades Power Park, by Golder Associates, December 2006.

The Clean Air Act specifies that Gasification must be Evaluated to Determine the Best Available Control Technology (BACT)

- The Clean Air Act defines BACT as follows:
- The term "best available control technology" means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation... emitted or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through the application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each pollutant.
- Indeed, the Act itself is clear – BACT emission limitations must consider "application of production processes and available methods, systems, and techniques, *including . . . innovative fuel combustion techniques* for control of each pollutant." (42 U.S.C. § 7479(3)).

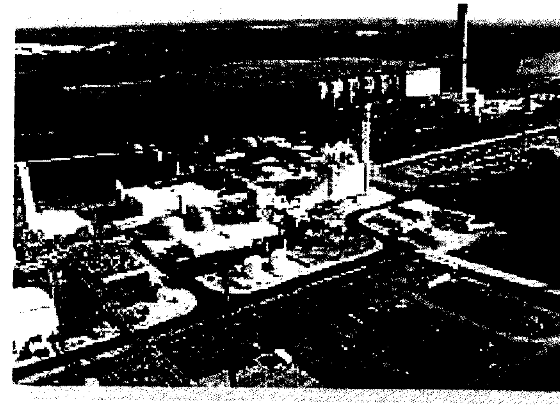
- Next the analysis of Congressional Intent:
- The legislative history of the CAA makes this point just as clearly. Consider the following statements from Senator Huddleston of Kentucky who proposed the amendment to add the words, "or innovative combustion techniques" to the definition of BACT:
- The definition in the committee bill . . . indicates a consideration for various control strategies by including the phrase "through application of production processes and available methods, systems, and techniques, including fuel cleaning or treatment." And I believe it is likely that the concept of BACT is intended to include such technologies as low Btu gasification and fluidized bed combustion. But, this intention is not explicitly spelled out, and I am concerned that without clarification, the possibility of misinterpretation would remain.
- It is the purpose of this amendment to leave no doubt that in determining best available control technology, all actions taken by the fuel user are to be taken into account – . . . [including] gasification, or liquefaction . . . which specifically reduce emissions.
- [CITE: 123 Cong. Rec. S9434-35 (June 10, 1977) (debate on P.L. 95-95) (emphasis added).]

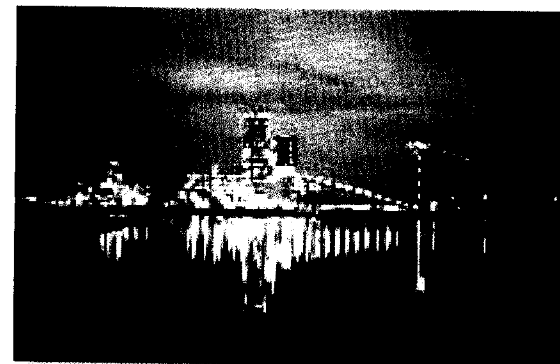
IGCC Technology in Early Commercialization

U.S. Coal-Fueled Plants

Docket No. 070098-EI
IGGC Technology – US Plants
Exhibit RCF-13, Page 1 of 1

- **Wabash River**
  - 1996 Powerplant of the Year Award*
  - Achieved 77% availability **
- **Tampa Electric**
  - 1997 Powerplant of the Year Award*
  - First dispatch power generator
  - Achieved 90% availability **





Nation's first commercial scale IGCC plants, each achieving
> 97% sulfur removal
90% NO_x reduction

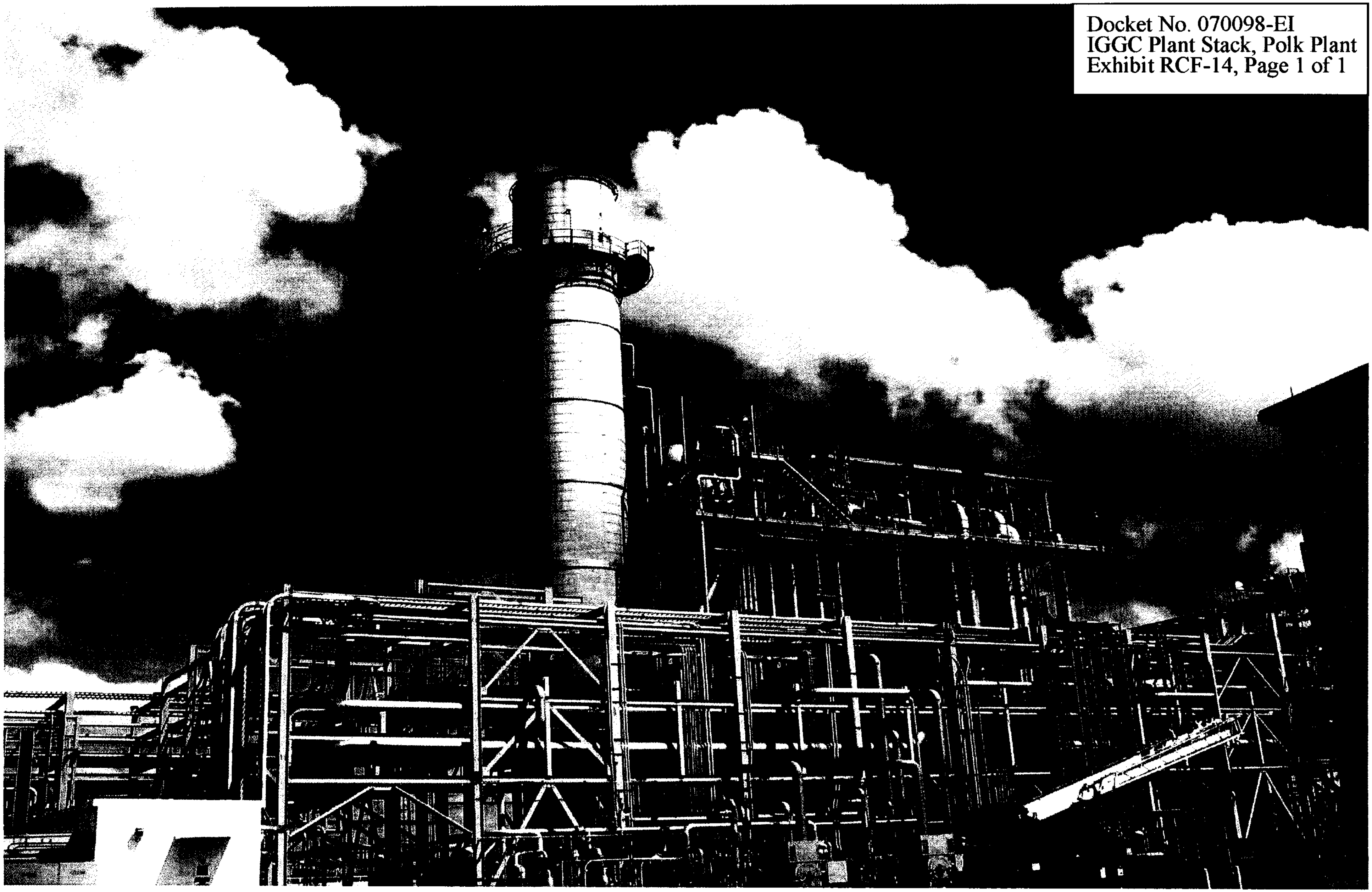
NETL

*Power Magazine

** Gasification Power Block

Source: Department of Energy/NETL Presentation, <u>Overview of Coal Gasification Technologies,</u> by Gary Stiegel, presented at NSTAR Meeting, Pittsburgh, PA, Oct. 27,2006.

Docket No. 070098-EI
IGGC Plant Stack, Polk Plant
Exhibit RCF-14, Page 1 of 1



IGCC PLANT STACK AT POLK POWER PLANT
TAMPA ELECTRIC COMPANY

References to Contact

Pulverized Coal vs. IGCC Plants

City of Gainesville

Pegeen Hanrahan
Mayor

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Telephone: (352) 334-5015
Facsimile: (352) 334-2036
mayor@ci.gainesville.fl.us

City Hall
200 E. University Avenue
Gainesville, FL 32602-0490

City of Gainesville hired ICF Consultants directly. ICF evaluation selected IGCC as best choice. Gainesville issued RFI for partners in IGCC plant.

TAMPA ELECTRIC

[illegible]
GENERAL MANAGER
POLK POWER STATION
PHILLIPS POWER STATION

OFFICE 863-425-5988
CELL 813-376-6643
FAX 863-428-5927
MJHORNICK@TECOENERGY.COM

Tampa Electric has operated an IGCC plant for over 10 years. Tampa Electric has announced an additional 630MW IGCC plant to be operating in 2013. The plant manager can answer any questions. Tours of the plant are available.

LAURA MILLER
MAYOR

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Laura.Miller@dallascityhall.com

The Mayor of Dallas has toured the Tampa Electric IGCC plant and is knowledgeable about power plants and pollution control equipment. She has formed a coalition of 22 mayors in Texas to encourage the use of IGCC plants.

ST. LUCIE COUNTY FLORIDA

Chris Craft
County Commissioner
District 5

ST. LUCIE COUNTY

2300 Virginia Avenue
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e-mail: Chris_Craft@co.st-lucie.fl.us

The St. Lucie County Commission voted 6 to 0 against a 1700MW PC plant proposed by FPL. Commissioner Chris Craft traveled to the Taylor County Commission hearing to advise them on St. Lucie's experience.

World Gasification Survey: Summary Operating Plant Statistics 2004

117 Operating Plants

385 Gasifiers

Capacity~**45,000** MWth

Feeds

Coal **49%**, Pet. Resid. **36%**

Products

Chemicals **37%**, F-T **36%**, Power **19%**

Growth Forecast **5% annual**

Gasification Technologies Council

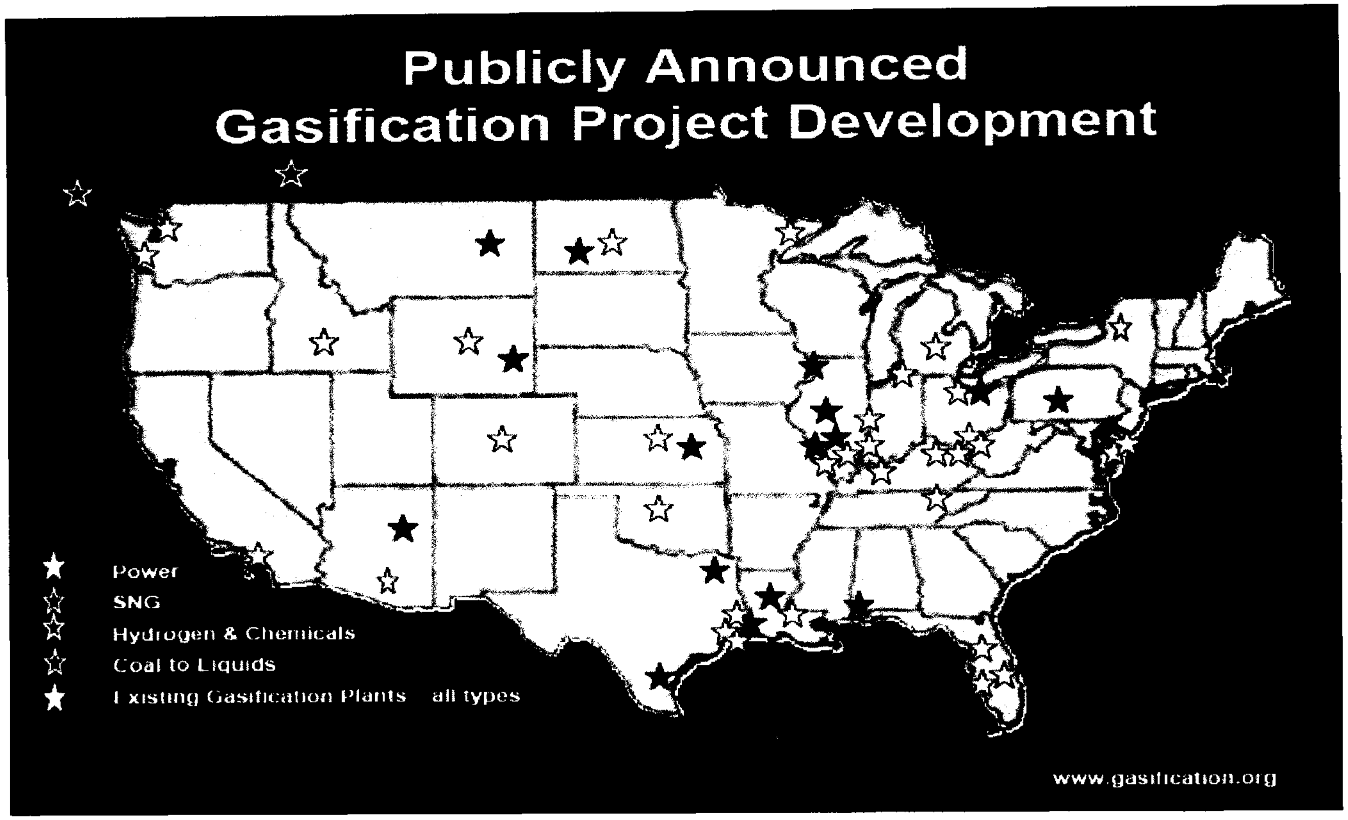
Operating IGCC Projects

Project – Location	COD	Megawatts	Feedstock - Products
Nuon (Demkolec) – Netherlands	1994	250	Coal - Power / Coal
Wabash (Global/Cinergy) – USA	1995	260	Coal/Petroleum Coke – Repowering
Tampa Electric Company – USA	1996	250	Coal/Pet. Coke – Power
Frontier Oil, Kansas – USA	1996	45	Coke – Cogeneration
SUV – Czech Republic	1996	350	Coal – Cogeneration
Schwarze Pumpe – Germany	1996	40	Lignite - Power & Methanol
Shell Pernis – Netherlands	1997	120	Visbreaker Tar - Cogen & Hydrogen
Puertollano – Spain	1998	320	Coal/Coke – Power
ISAB: ERG/Mission – Italy	2000	510	Asphalt – Power
Sarlux: Saras/Enron – Italy	2001	545	Visbreaker Tar - Power, Steam, H2
Exxon Chemical – Singapore	2001	160	Ethylene Tar – Cogeneration
API Energia – Italy	2001	280	Visbreaker Tar - Power & Steam
Valero Refining – Delaware, USA	2002	160	Coke – Repowering
Nippon Refining – Japan	2003	340	Asphalt - Power
EniPower – Italy (in start-up)	2006	250	Asphalt - Power

NETL

Total IGCC Megawatts – 3,880 MW
Total Experience, Operating Hours on Syngas = Almost 1,000,000 hours

Source: Department of Energy/NETL Presentation, Overview of Coal Gasification Technologies, by Gary Stiegel, presented at NSTAR Meeting, Pittsburgh, PA, Oct. 27,2006.



Docket No. 070098-EI
Publicly Announced Gasification Project Development
Exhibit RCF-18,
Page 1 of 1

Source: Phil Amick, "Experience with Gasification of Low-Rank Coals," presented at Workshop on Gasification Technologies, Bismark North Dakota, June 28, 2006.

- In the United States, there are 40 to 50 IGCC and gasification projects that are under development. Examples include the following IGCC projects:
- **Two 629 MWe IGCC plants** to be built by the nation's largest utility, American Electric Power Company (AEP), in Ohio and West Virginia scheduled to be operational in 2010;
- **600 MWe IGCC plant** proposed by the nation's fourth largest utility, Cinergy (now part of Duke), near Edwardsport, Indiana;
- **550 MW IGCC plant** planned by Mississippi Power Company in Kemper County, MS
- **630 MW IGCC** plant proposed by Tondu Corp. in Corpus Cristi, Texas
- **630 MW IGCC plant** planned by Tampa Electric Company in Polk County, FL to operate in 2013
- **630 MW IGCC plant** proposed by Energy Northwest in Washington
- **366 MW IGCC plant** proposed by Summit in Oregon,
- **Three repowering projects** to take old PC plants and convert them to IGCC by NRG in CT, DE, and NY. **Each would be 630 MW**
- **500 MW IGCC plant** to be built by BP in Carson, CA with CO2 capture for enhanced oil recovery
- **Two 630 MW IGCC plants** proposed by the ERORA Group (one in Illinois and one in Kentucky) and
- **Two 606 MWe IGCC units** in Hoyt Lake Minnesota by Excelsior Energy

Source: John Thompson, Desert Rock testimony, page 7, November 6, 2006 and DOE press release Nov. 30, 2006 -

US Gasification Development

Coast to Coast, and North to South

- American Electric Power OH, WV
- Agrium/Blue Sky AK
- Baard Generation OH
- BP/Edison Mission CA
- Cash Creek Generation KY
- Clean Coal Power IL
- DKRW WY
- Duke/Cinergy IN
- Energy Northwest WA
- Erora Group IL
- Excelsior Energy MN
- First Energy/Consol OH
- Leucadia National LA
- Madison Power IL
- Mountain Energy ID
- NRG Energy DL
- Orlando Util/Southern FL
- Otter Creek MT
- Power Holdings IL
- Rentech MS
- Royster Clark/Rentech IL
- Southeast Idaho ID
- Steelhead Energy IL
- Synfuel OK
- WMPI PA
- Xcel Energy CO

NETL **Most large projects are for power, but also substitute natural gas and liquid fuels.**

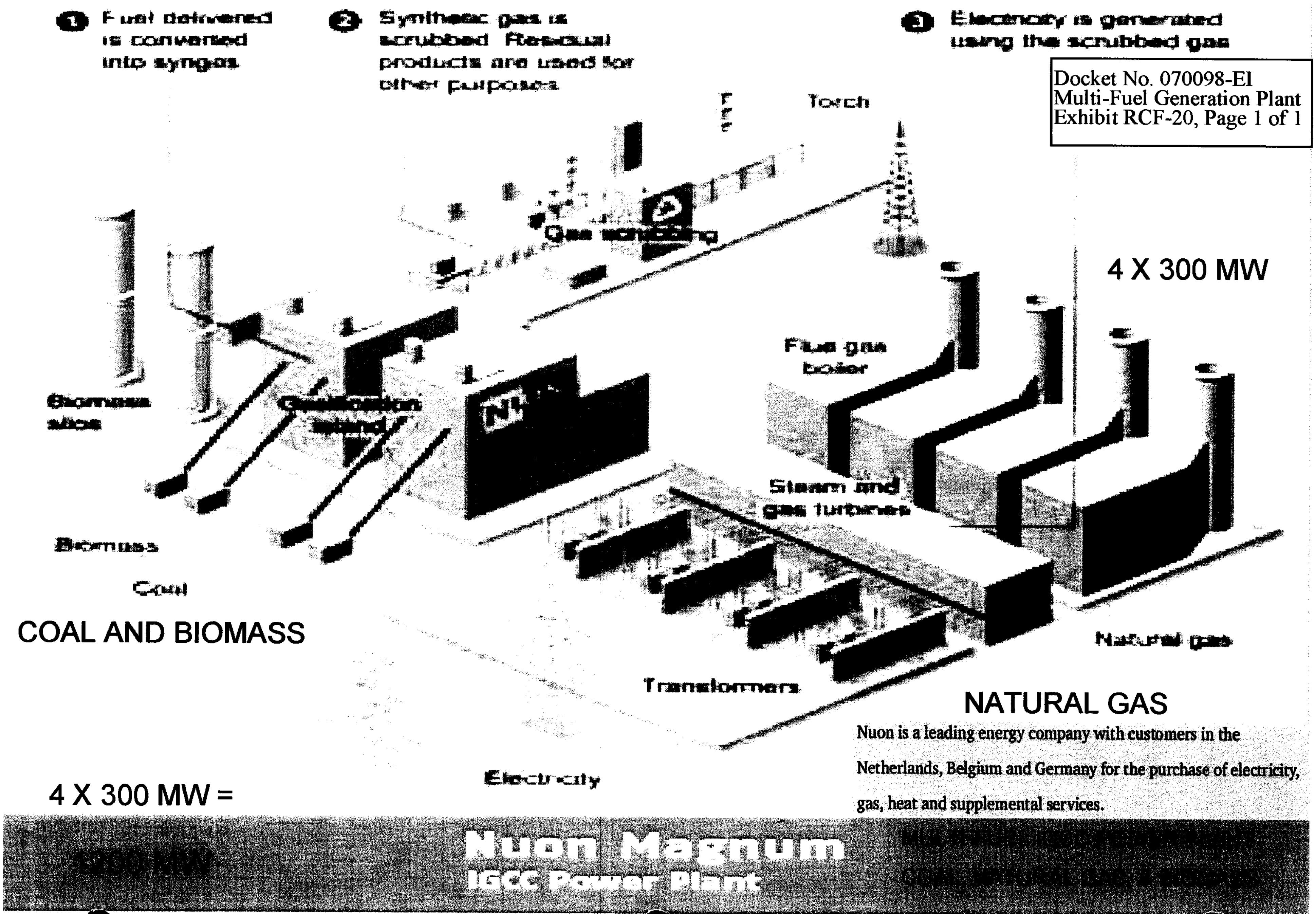
NETL Meeting with Wyoming Officials / GJStiegel / June 15, 06

Courtesy of Burns and Roe

Source: Department of Energy/NETL Presentation, Overview of Coal Gasification Technologies, by Gary Stiegel, presented at NSTAR Meeting, Pittsburgh, PA, Oct. 27,2006.

MULTI-FUEL GENERATION PLANT

Docket No. 070098-EI
Multi-Fuel Generation Plant
Exhibit RCF-20, Page 1 of 1



Nuon is a leading energy company with customers in the Netherlands, Belgium and Germany for the purchase of electricity, gas, heat and supplemental services.

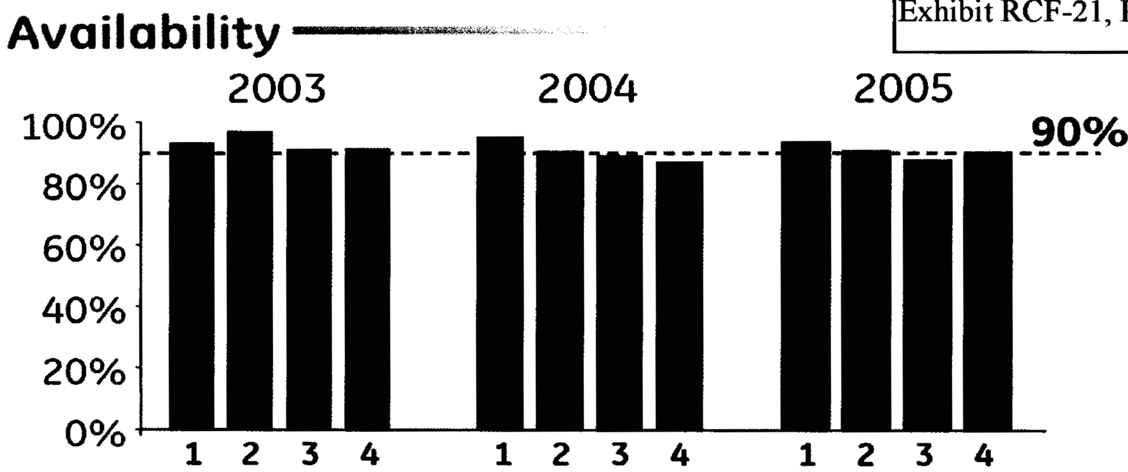
Availability & Reliability – Solids Gasification in China

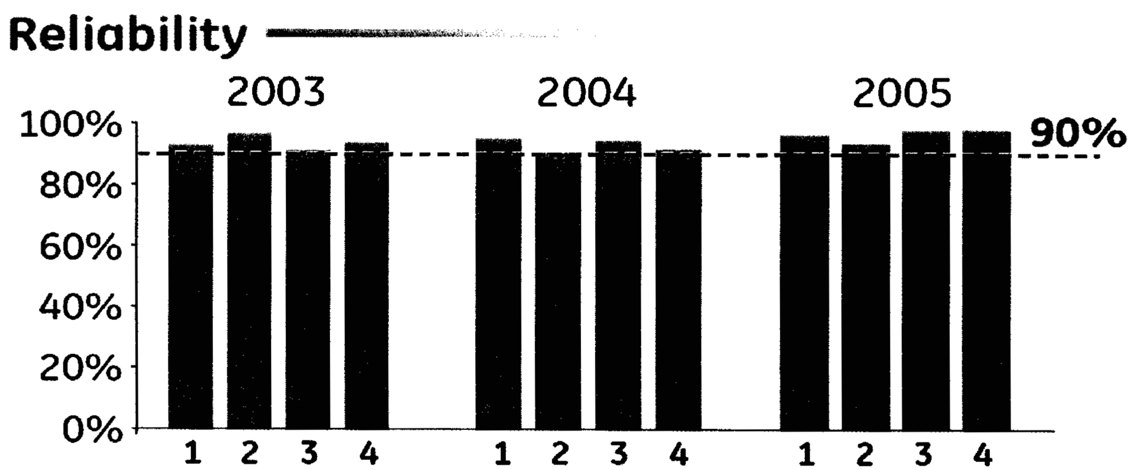
Docket No. 070098-EI
Availability and Reliability
Exhibit RCF-21, Page 1 of 1

GE Technology in China Four Coal Plants

Availability = (1-(unplanned outage +planned outage) /8760)*100%

Reliability = (1-(unplanned outage) /8760)*100%





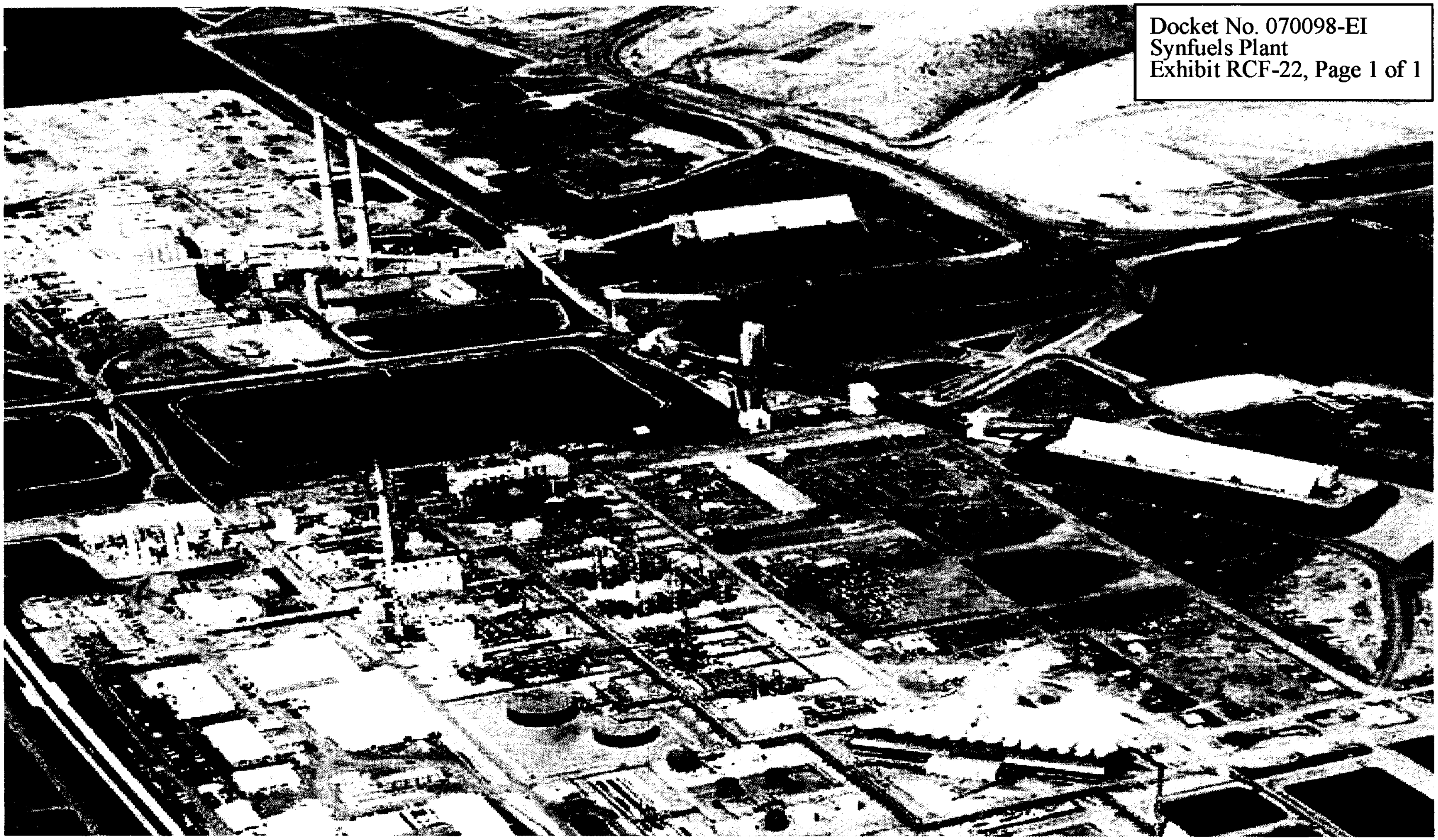
imagination at work

- **Source:** Commercial Experience of GE's Gasification Technology in China **by Qianlin Zhuang, GE Energy, Presented at GTC, Oct 3, 2006**

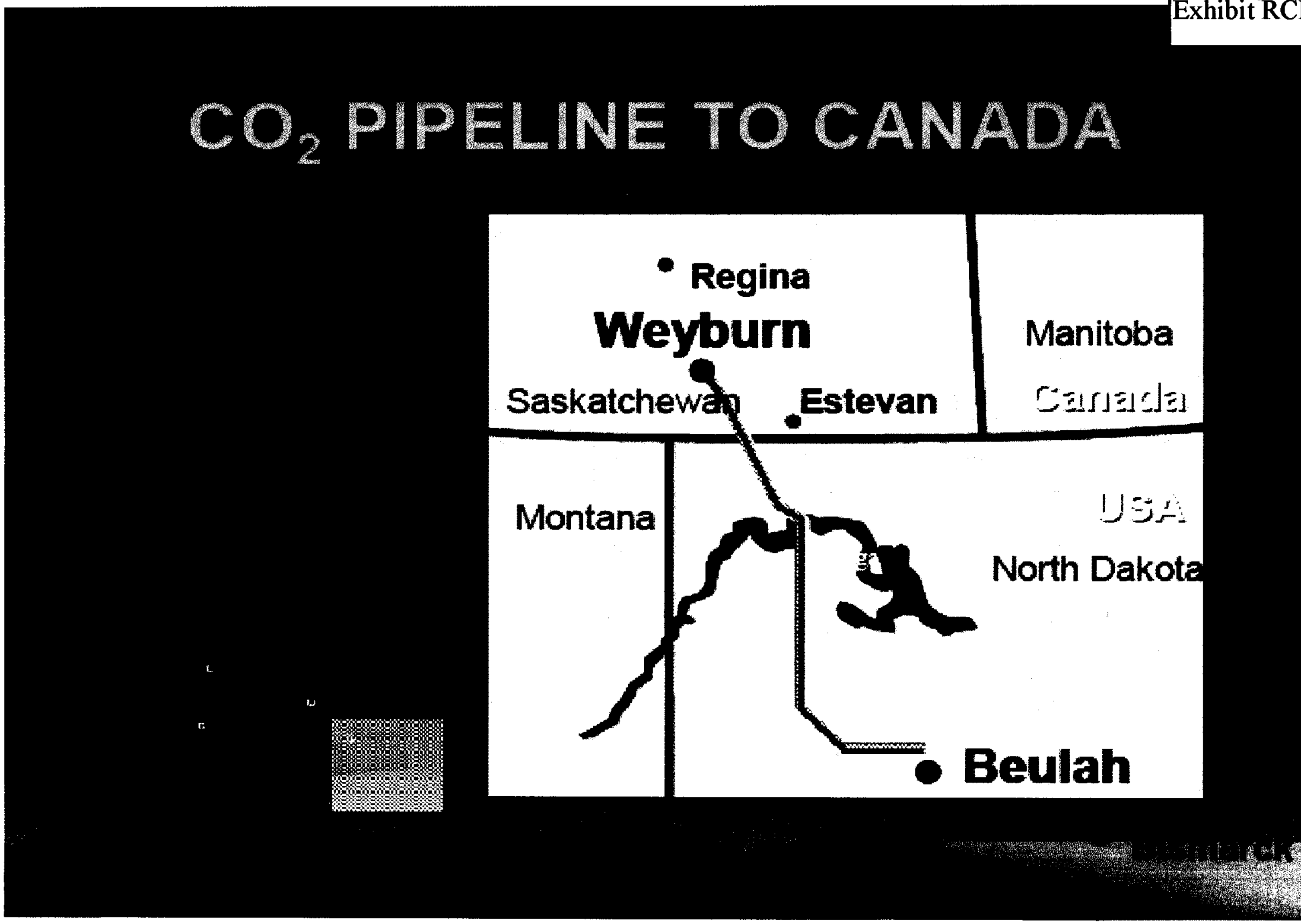
THE GREAT PLAINS SYNFUELS PLANT

The Gasification Plant shown in the foreground began Operating in 1984 in North Dakota & uses 6 million tons per year of Lignite Coal to Produce 54 Billion cubic feet of Synthetic Natural Gas (SNG) and 4 million tons per year of Carbon Dioxide used for EOR. The Antelope Valley Power Plant shown in the background uses 5 million tons of Lignite Coal for the two 440 MW Units.

Docket No. 070098-EI
Synfuels Plant
Exhibit RCF-22, Page 1 of 1

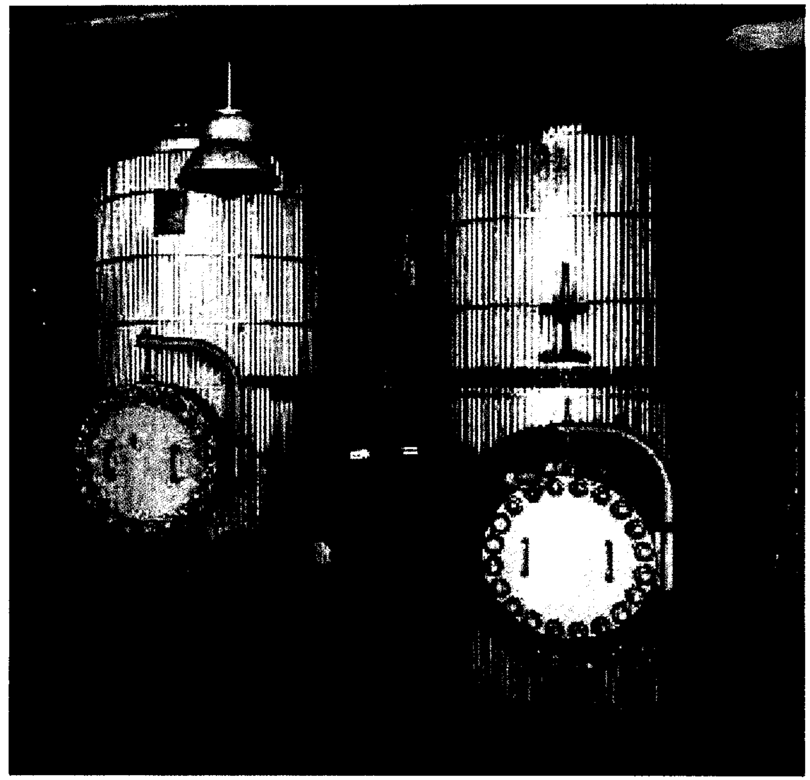


(Source: "The New Synfuels Energy Pioneers" by Stan Stelter, Introduction by Former President Jimmy Carter, published by Dakota Gasification Co.- 2001, A subsidiary of Basin Electric Power Cooperative, page 48)



(Source: Experience Gasifying ND Lignite by Al Lukes, Dakota Gasification Company, The Great Plains Synfuels Plant presented at the Montana Energy Future Symposium)

EASTMAN GASIFICATION SERVICES COMPANY



Vapor-Phase Mercury Removal

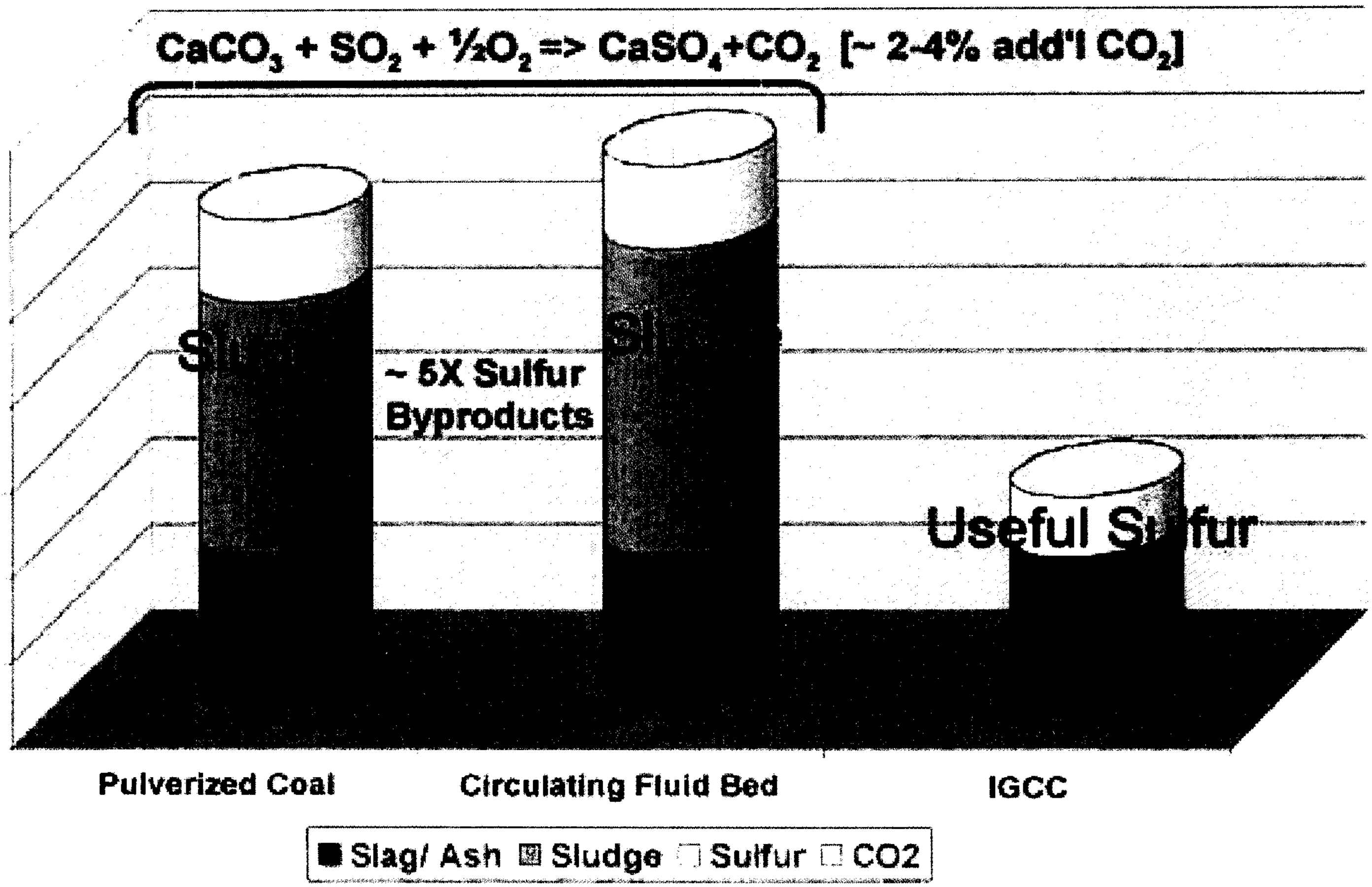
>94% Removal

Demonstrated for 21 years at Eastman !

The cost of volatile mercury removal by IGCC is estimated to be < $0.25/MWh, almost an order of magnitude lower than for PC technologies using activated carbon, according to a 2002 DOE report by Parsons (DOE Report, "The Cost of Mercury Removal in an IGCC Plant", September, 2002).

EASTMAN

IGCC: Lowest Collateral Wastes



No Add'l CO_2 Associated with Sulfur Removal for IGCC

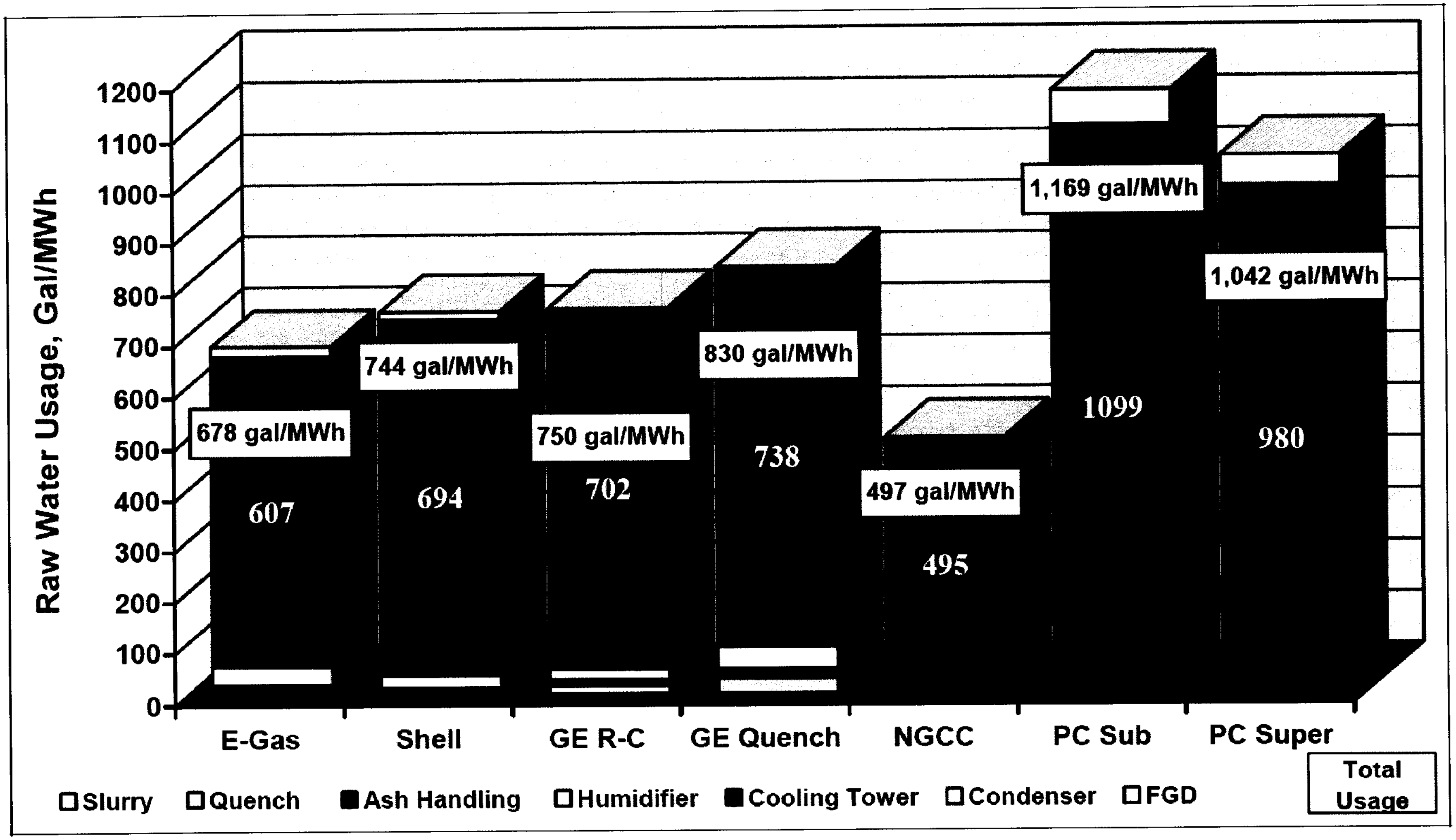
Slide provided by G.E. Power Systems

EASTMAN

Docket No. 070098-EI
30-40% Less Water Usage with IGCC
Exhibit RCF-26, Page 1 of 1

30% to 40% Less Water Usage With IGCC

Comparison of Raw Water Usage for Various Fossil Plants, gallons per MWh



Source: Power Plant Water Usage and Loss Study, DOE/NETL Report, August 2005, by Gary Stiegel, et al.

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing was served on this 7th day of March, 2007, via US Mail on:

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