EXHIBIT G

ASSESSMENT OF IGCC AS A POTENTIAL ALTERNATIVE CONTROL TECHNOLOGY

EXHIBIT G

G.1 Introduction

Power4Georgians, LLC (P4G) is proposing to construct, own, and operate a pulverized coal (PC)-fired electric power generation facility in Sandersville, Georgia known as Plant Washington. The proposed project consists of one Supercritical Pulverized Coal (SCPC) fired steam generating unit and associated steam turbine generators along with other auxiliary equipment. The generating plant will be rated at approximately 850 MW net output capacity, and will be designed to burn sub-bituminous coal (Powder River Basin, or PRB coal) and up to a 50/50 blend of eastern bituminous coal (Illinois #6) and PRB. Although the facility will be designed for use of PRB and Illinois #6 coals, the facility will also have the capability of utilizing bituminous and sub-bituminous coals with equivalent characteristics of PRB and Illinois #6.

The following equipment is proposed for use at the facility:

- One coal-fired electric utility steam generating unit with a rated heat input of 8,300 million British Thermal Units per hour (MMBtu/hr) using a supercritical cycle design, which will be equipped with low nitrogen oxide (NO_X) burners, overfire air, Selective Catalytic Reduction (SCR), a fabric filter baghouse, and a Wet Flue Gas Desulfurization (WFGD) System. In addition, emission controls will include sorbent injection systems for the control of sulfuric acid (H_2SO_4) mist (SAM) and mercury (Hg) emissions.

- A steam turbine and associated generator

- Facilities for receiving, handling, storing, blending, and processing two types of coal—Sub-bituminous and Bituminous. The preliminary design coal basis for Plant Washington is based on use of PRB and Illinois #6 coals, with a nominal consumption rate of approximately 417 tons per hour (ton/hr) of blended coal at a 50/50 blend or at a rate of approximately 488 ton/hr when burning only PRB coal, but the facility will be designed to handle any similar sub-bituminous and bituminous coals.

- Facilities for receiving, handling, and storing anhydrous ammonia, which is a raw material for the SCR system

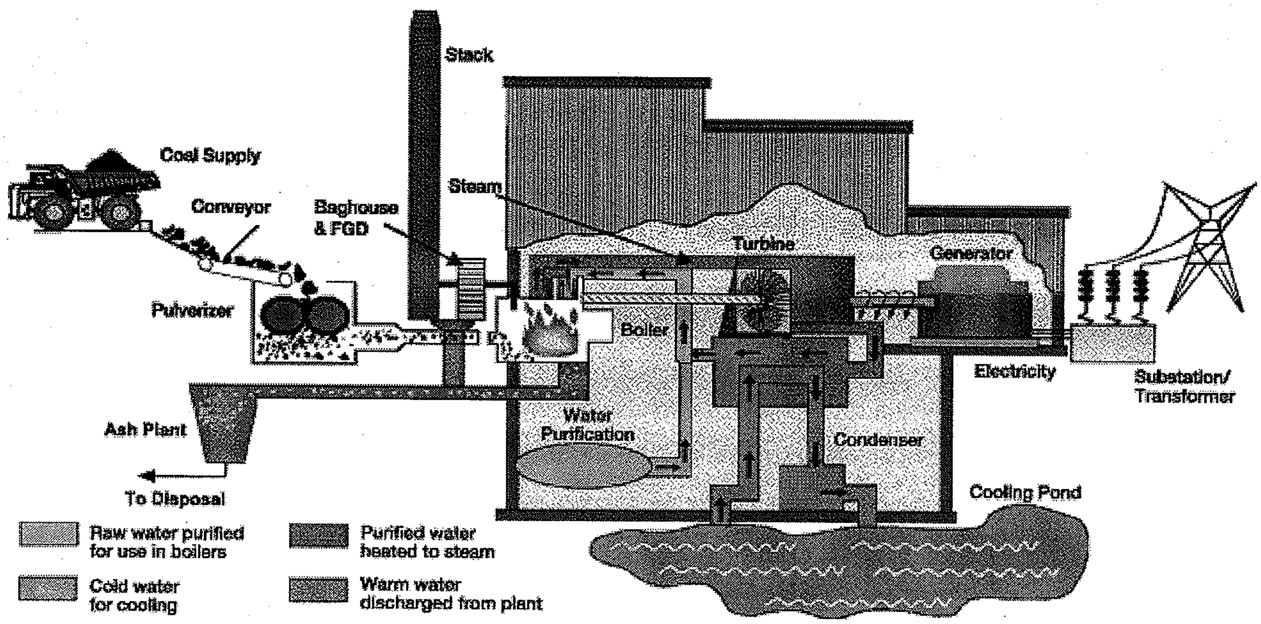
- Facilities for receiving, handling, storing, and processing limestone, which is a raw material for the WFGD system

- Facilities for receiving, handling, storing, and delivering mercury removal adsorbent (sorbent) and sulfur trioxide (SO_3) removal sorbent (to control SAM emissions)
- A SMHF for handling and storing process byproducts for potential reuse
- An emergency diesel-fired generator
- A diesel engine driven fire pump
- A 240 MMBtu/hr fuel oil fired auxiliary boiler

A Prevention of Significant Deterioration (PSD) permit application was submitted to the Georgia EPD in January 2008. A draft permit for the facility was recently received in August 2009. In response to both public comment and EPA comments regarding consideration of Integrated Gasification Combined Cycle (IGCC) this addendum to the permit application is being added to assess IGCC technology as a potentially available control technology in terms of an alternative means of producing power from coal while possibly producing lower emissions.

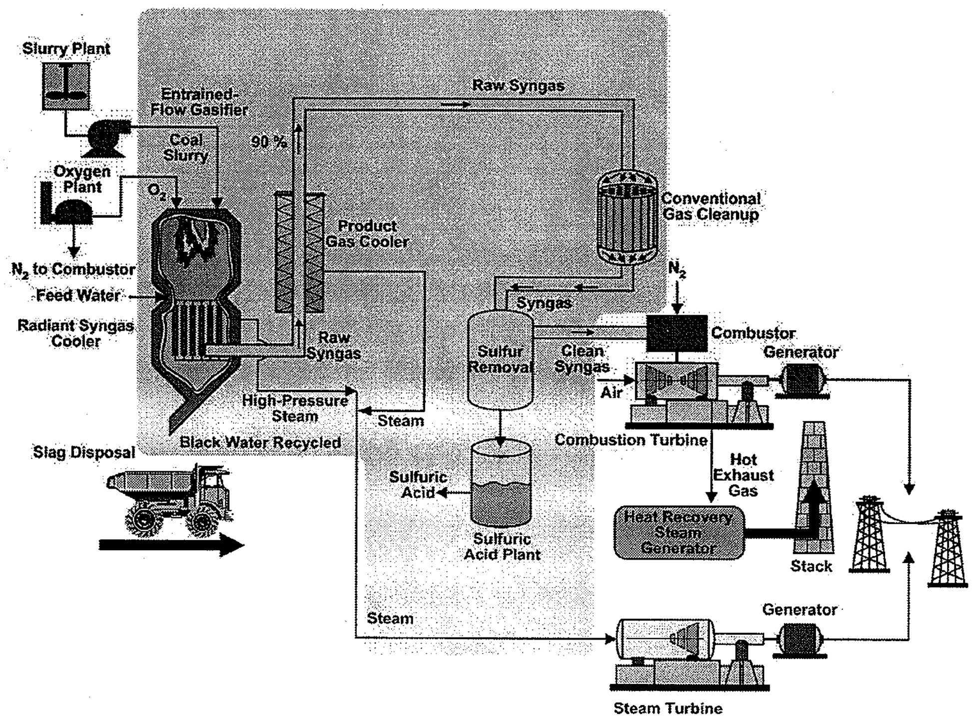
P4G does not agree that Georgia law requires P4G to evaluate IGCC as an alternative pollution control technology for the SCPC facility it proposes to build. In fact, in a recent decision from the Georgia Court of Appeals, *Longleaf Energy Associates, LLC v. Friends of the Chattahoochee*, the Court squarely rejected the argument that IGCC must be included in the pollution control technology review for a pulverized coal-fired power plant. Plant Washington is the same type of pulverized coal-fired power plant that was at issue in the *Longleaf* decision. IGCC is a fundamentally different type of electrical generating unit, with chemical and physical processes that cannot be "applied" to an SCPC facility without rebuilding the facility from the ground up. For this reason, P4G believes that, as the Georgia Court of Appeals has already found, that IGCC would constitute a "redefinition of the source" it has proposed to construct and operate. Moreover, P4G considers IGCC to be unreliable and unproven on a commercial scale. Installing such a process would pose serious financial risks and even obtaining funding for such an unproven technology would be difficult if not impossible. A comparison between the two processes is illustrated by the following Figure G-1 and Figure G-2.

Figure G-1: Example Coal Fired Boiler Process Diagram



Source: http://asmslibrary.editme.com/JSPcoal *Article on Burning Fossil Fuels*

Figure G-2: Example IGCC Process Flow Diagram



Source: <u>http://www.netl.doe.gov/technologies/coalpower/cctc/summaries/tampa/tampaedemo.html</u> *- Fact Sheet on Tampa Electric Polk Power Station*

Since IGCC is not an add-on control technology, it therefore cannot be evaluated as a cost addition to the overall base cost of Plant Washington, as would be done with air pollution control devices as part of a BACT evaluation. Therefore, the analysis must instead conduct an economic evaluation by utilizing the total cost of a comparable hypothetical IGCC project. The analysis will then compare total emissions from the two plants based on referenced permit limits, and assess the incremental cost to achieve the emissions reduction.

Since the power generation capacity by even the recently proposed IGCC plants does not reach the level of power generation proposed from Plant Washington, costing data for an IGCC plant will have to be adjusted to account for the difference in net power generation between the two fundamentally different types of electrical generating facilities. Plant Washington is planned as an 850 MW net output facility. The IGCC plant evaluated as part of this project, based on a review of IGCC plants that have been recently permitted and are currently under construction, is the 630 MW net output Edwardsport IGCC

Project. This plant design is complete and the construction schedule calls for startup in 2012. Therefore, because of the lower power rating for this evaluation, emissions and costs of the Edwardsport IGCC project were increased by 1.35 times the reported values (850 MW ÷ 630 MW).

This evaluation is divided into three sections. Section G.2 provides an overview of the IGCC technology, including an assessment of both performance data for operational IGCC facilities as well as future proposed and permitted IGCC facilities. Section G.3 includes the comparative emissions and incremental cost analysis evaluations for a hypothetical IGCC plant of equal size in comparison to Plant Washington. Section G.4 provides the conclusions of the assessment.

G.2 IGCC Technology Overview

IGCC is an integration of gasification technology that produces a gaseous fuel (syngas) used in a combined cycle power plant. In an IGCC facility, the gasification plant produces syngas that is cleaned and fired in a combustion turbine that turns a generator, producing power. In the gasification step, coal is oxidized in a reactor in the presence of water in an oxygen starved atmosphere to produce a "syngas" of hydrogen and CO. Once this gas is clean by removing sulfur components, it is direct-fired in a combustion turbine. Then the hot gases from the turbine exhaust are sent to a heat recovery steam generator where steam is created to produce power from a steam-driven turbine. IGCC is therefore theoretically more efficient than a typical steam plant in producing power. The coal-fired IGCC process is still an emerging technology with only five commercial-scale coal-fired IGCC power generation facilities currently operating worldwide.

G.2.1 IGCC Operating Experience with Performance

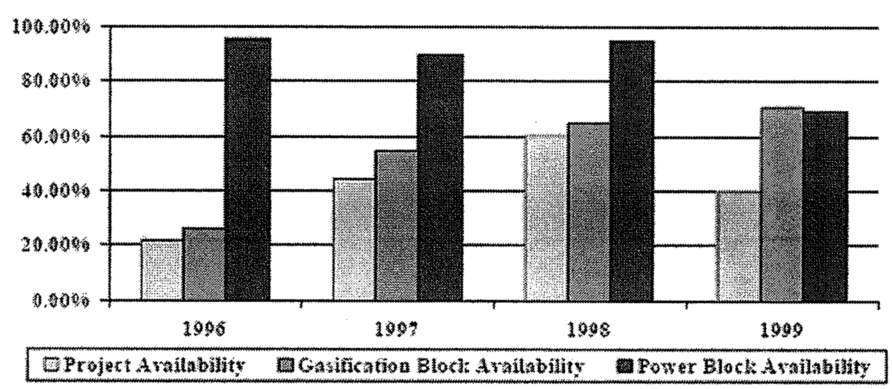
There are five commercial-scale, coal-fired IGCC plants currently operating worldwide with long-term experience using an entrained flow gasification technology: two in the United States, two in Europe, and one in Japan (CCP Nakoso). The coal-fired IGCC plants currently operating in the U.S. include the Wabash River Coal Gasification Repowering Project (Wabash River IGCC) and the Polk Power Station Unit Number 1 (Polk IGCC). Both of these domestic IGCC power generation facilities were provided funding by the DOE. The only other IGCC facilities in operation with long-term experience are the Nuon site in the Netherlands, the Elogas site in Spain, and the CCP Nakoso site in Japan. The CCP Nakoso IGCC demonstration project uses coal as a primary fuel source and has been operational for the last several years.

Other gasification facilities do exist. Indeed, other gasification projects have been developed around the world for power generation, creation of synthetic fuels, chemicals manufacturing, etc, including sites in the United States such as the Valero Refinery in Delaware. Additionally, two DOE-funded IGCC demonstration plants, the Southern California Edison Coal Gasification Plant and the Dow Chemical Louisiana Gasification Technology project, formerly operated in the United States, but are no longer in service. These other gasification facilities, however, were not investigated as part of this analysis because they lack the published data regarding operational history, emissions, availability, etc. that is necessary to conduct a meaningful analysis. For this reason, P4G's IGCC evaluation focused only on the five operational facilities mentioned above.

The Wabash River IGCC began operation in 1995 and uses an E-Gas two-stage pressurized, oxygen-blown, entrained-flow gasifier with full heat recovery that is integrated with the power block. The Wabash River IGCC was designed to use bituminous (Illinois Basin) coal as a primary fuel source with the use of pet coke. The Polk IGCC began operation in 1996 and uses a GE (formerly Texaco) pressurized, oxygen-blown, entrained-flow gasifier with full heat recovery using both radiant and convective syngas coolers. The project was designed to use a variety of bituminous coals, pet coke, and biomass. Both of these sites now preferentially burn pet coke as a fuel source because of its higher heating value compared to coal which promotes more reliable operation.

Numerous publications have reported on the performance problems and low on-stream availability of the gasification systems at the Wabash River and Polk Power Station sites. What is important to note when reviewing such information is that the combustion turbines at the Polk Power Station and Wabash River Sites are both permitted for use of backup fuels (i.e. natural gas, fuel oil). Therefore, overall plant online availability is not necessarily reflective of gasifier/IGCC system availability because when the gasifier is down, the combustion turbines can be operated on natural gas or fuel oil. The following Figure G-3 was taken from the *Wabash River Coal Gasification Repowering Project – Final Technical Report (August 2000).*

Figure G-3: Availability Data for the Wabash River Coal Gasification Repowering Project



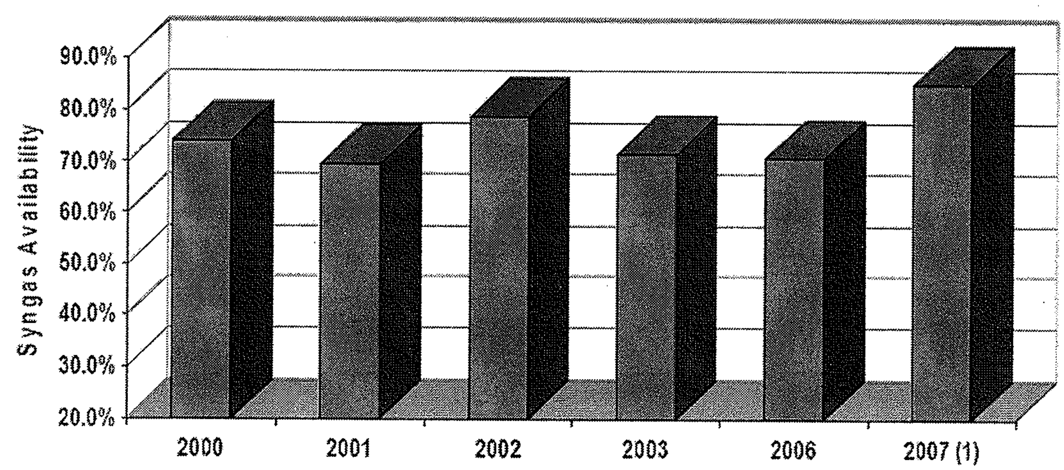
Source: Wabash River Coal Gasification Repowering Project – Final Technical Report (August 2000)

This report indicates that the availability of the gasification block, the primary component of the IGCC process, had less than an 70% availability during the trial study period. This was also discussed in a technical presentation by Elaine Everett of the Gasification & Fuels Division of the DOE titled

Gasification and IGCC: Status and Readiness (2/28/07), which indicated the Wabash River site was achieving a gasifier availability of 77%. An additional presentation given by ConocoPhillips titled *Wabash River Coal Gasification Repowering Project (June 12, 2007)* included additional availability data for the gasifier systems through 2007 as shown in Figure G-4.

The data provided in this figure is Adjusted Gasifier Availability, discounting times when the gasifier was operational but the remainder of the plant was not.

Figure G-4: Additional Availability Data for the Wabash River Coal Gasification Repowering Project

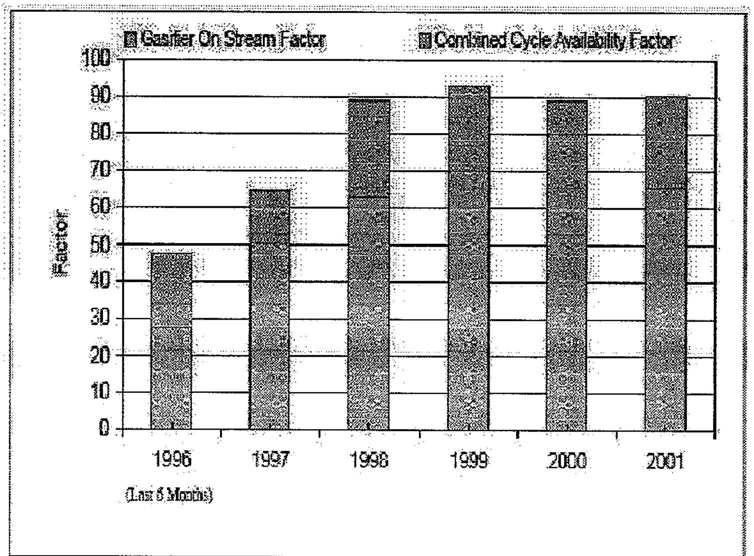


Source: Presentation given by ConocoPhillips titled Wabash River Coal Gasification Repowering Project (June 12, 2007)

Although operating availability has improved over the life of the facility, the facility has not achieved the levels of operational availability required for a base load power facility such as Plant Washington. Data was not provided for the years 2004 or 2005 due to a repowering project at the site in 2004, and an ownership change which occurred that interrupted plant operations. Data shown in Figure G-4 demonstrates a gasifier availability for the Wabash River site generally ranging from 70% to 80%.

The same operational experience with availability has been seen encountered at the Polk Power IGCC facility. The following Figure G-5 is Figure ES-2 of the *Tampa Electric Polk Power Station Integrated Gasification Combined Cycle Project – Final Technical Report (August 2002)*.

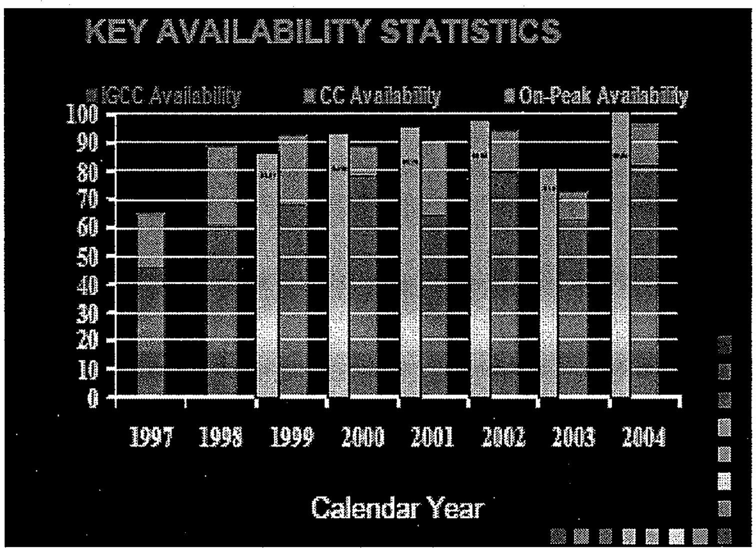
Figure G-5: Availability Data for the Tampa Electric Polk Power Station IGCC Project



Source: Figure ES-2 of the Tampa Electric Polk Power Station Integrated Gasification Combined Cycle Project – Final Technical Report (August 2002).

Data for the Polk Power Station is consistent with the low availability values of the IGCC process seen at the Wabash River site ranging from 25% to 80% on stream factor with most recent years ranging from 70% to 80%. A presentation by Steve Jenkins, former Deputy Project Manager of the Polk Power Station IGCC Project titled *Real World Experience with IGCC – Lessons Learned in Design, Permitting, Operations and Maintenance (August 17, 2005)* included data on the availability of the IGCC systems through 2005. This data is presented in Figure G-6.

Figure G-6: Additional Availability Data for the Tampa Electric Polk Power Station IGCC Project



Source: A presentation by Steve Jenkins, former Deputy Project Manager of the Polk Power Station IGCC Project titled Real World Experience with IGCC – Lessons Learned in Design, Permitting, Operations and Maintenance (August 17, 2005)

As with the Wabash River site, availability of the IGCC systems at the Polk facility improved over time. However, the levels of availability demonstrated for the site are not representative of those values that would be required for a base load power generation facility such as Plant Washington. Data shown in Figure G-5 and Figure G-6 demonstrates an average gasifier/IGCC availability for the Wabash River site of less than 80% over the life of the project with a maximum of just over 80% reported. Pulverized coal-fired power plants are expected to have a minimum on stream factor (reliability) of over 90%, a target generally achievable within the few years of operation of the unit. Consistent performance of 90% availability has not yet been seen from the operational IGCC facilities reviewed, and the first years of operation have especially shown poor performance availability, as would be expected with a developing technology.

The same experience with availability has been seen with the Nuon IGCC site in the Netherlands, and the Elogas IGCC site in Spain. Based on data as provided in the Santee Cooper Pee Dee Technology Alternatives Analysis (April 2007), the peak reliability of the Nuon site in the Netherlands was 78%, and the peak reliability of the Elogas site in Spain was 60%. Limited reliability data for the CCP Nakoso demonstration project is available. A presentation given at the 2009 Gasification Technologies Council conference titled *Second Year Operation Results CCP's Nakoso 250-MW Air-Blown IGCC Demonstration Plant*, indicated an approximately 70% on-stream factor for the IGCC gasification systems from January thru September 2009. Therefore, relying on an IGCC plant for electrical generation would require a back-up operation.

Important considerations regarding IGCC feasibility include the size of the facility, the fuel used, and the availability of the unit. An IGCC project has not yet been successfully demonstrated at the size of Plant Washington (850 MW net). The five IGCC demonstration projects referenced in this evaluation have all been 300 MW or smaller in size. Therefore, operational difficulties could be experienced with a larger scale IGCC facility that are, at this time, unknown. A presentation given by Dennis Zupan of Duke Energy, titled *Edwardsport IGCC – Moving Forward (October 2009)* alluded to such potential difficulties, as it was indicated in the engineering design phase of the project that "the Edwardsport IGCC site design was truly the first of its kind, and not simply a direct scaling of the Polk Power Station IGCC Project." As mentioned earlier in this analysis, the Edwardsport IGCC facility is a 630 MW net facility.

IGCC technology has not yet been commercially demonstrated as technically feasible with utilization of PRB coal on a long-term basis. The IGCC system performance is affected by the composition of the fuel. The existing operational IGCC demonstration projects have used bituminous coals, a mixture of bituminous coals and petcoke, or petcoke alone. Operational data from the Wabash River and Polk IGCC facilities indicates preferential use of petcoke as fuel. There is no current operational experience with an IGCC unit operating fully on PRB coal on a long-term basis. Of concern with use of PRB coal are the high moisture content and low BTU content, which could cause technical issues within the gasification process. The only proposed IGCC project found to indicate the intended use of PRB coal was the Mesaba IGCC project.

IGCC has also not yet been demonstrated at the availability levels of existing pulverized coal-fired electrical generating units. Although the recently proposed IGCC facilities indicate that higher availability will be achieved through use of spare gasifiers, availabilities as high as those achieved in practice by existing pulverized coal-fired boiler units have not yet been demonstrated.

For this reason alone, IGCC technology should not be considered a technically feasible technology for base load power generation of the type that P4G proposes to build. Plant Washington will be a base load power generation unit, and consistent availability is a fundamental requirement for the successful operation of the facility. Therefore, IGCC technology should not be considered a potential alternative "control technology" for Plant Washington.

G.2.2 Process Emissions

In theory, emissions from an IGCC plant should be less than direct firing of coal because a gas is being burned instead of a solid fuel. However, the syngas created in the gasification process requires cleaning before combustion and this cleaning process produces emissions. Therefore, the emissions performance of an IGCC facility is dependent on the technologies used for cleaning of the syngas fuel, combustion controls used in the combustion turbine, and any post-combustion control technologies used (e.g., SCR for NOx emissions control).

Sulfur Dioxide (SO_2) Emissions

The gasification process involves conversion of a coal slurry and oxygen at high temperature and pressure into a carbon monoxide and hydrogen-rich fuel. Gaseous pollutant byproducts (e.g. H_2S) are removed in a pre-combustion Acid Gas Removal (AGR) system, which provides the SO_2 emissions control for an IGCC facility. There are currently two physical absorption solvents, Selexol™ and Rectisol™, and one chemical absorption solvent, MDEA, available for use in the AGR systems. MDEA (methyldiethanolamine) is a chemical absorption solvent which can reportedly achieve 98% to 99% sulfur removal and is the least costly solvent to utilize. Selexol™ (primarily dimethyl ethers of polyethylene glycol, DEPE) is a physical absorption solvent that can reportedly achieve up to 99.9% sulfur removal and has a higher cost of use than MDEA. Rectisol™ (methanol) is a physical absorption solvent that is the most costly to use, but can reportedly achieve a sulfur removal of 99.98%.

In existing units, the AGR process involves the use of a thermal oxidizer and flare in order to reduce facility emissions of acid gases. Therefore, sulfur from the process is not necessarily recovered but is combusted and exhausted in tail gas. The acid gas destruction also creates emissions of NOx and other criteria pollutants. The Wabash River IGCC and Polk IGCC both use the MDEA-based chemical for syngas cleanup and SO_2 emissions control. The currently proposed IGCC facilities have proposed the use of the referenced physical absorption solvents, Selexol™ and Rectisol™, in favor of MDEA due to the low operational performance of the MDEA systems.

To date, the demonstrated SO_2 emission levels from IGCC units discussed in this analysis have ranged from 0.03 to 0.20 lb/MMBtu from main stack syngas combustion emissions, not including tail gas incineration emissions or other facility emissions.

Nitrogen Oxides (NOx) Emissions

A combustion control technique involving injection of a diluent (i.e. nitrogen or steam) into the combustion chamber, which reduces flame temperature thereby reducing thermal NOx, is the predominant method of NOx control for IGCC facilities firing syngas fuel. The Wabash River and Polk IGCC projects used diluent injection for NOx emissions control.

If acid gases are removed to a sufficient degree from the syngas, then use of Selective Catalytic Reduction (SCR) for control of NOx emissions with IGCC could be feasible. SCR utilizes ammonia (NH_3) as a reagent, with a degree of "ammonia slip" occurring through the system. Because of this, concerns have been raised that this ammonia slip will react with remaining sulfur compounds within the syngas forming ammonium sulfate and ammonium bisulfate, which could cause fouling of the Heat Recovery Steam Generator (HSRG) of the combined cycle portion of the IGCC process. Such fouling could cause an increase in forced outages of the system, or lead to the requirement to operate the SCR system at a reduced capacity. Therefore, it is unknown whether SCR technology can be used.

To date, the demonstrated NOx emission levels from IGCC units discussed in this analysis have ranged from 0.02 to 0.10 lb/MMBtu from main stack syngas combustion emissions, not including tail gas incineration emissions or other facility emissions.

Particulate Matter (PM) Emissions

Emissions of particulate matter from an IGCC plant are controlled by barrier filters or wet scrubbers used to clean the syngas prior to combustion in the combustion turbine. Effective removal of particulate matter from the syngas is required to protect the components of the combustion turbine. The Wabash River and Polk IGCC facilities utilize pre-combustion scrubbing for particulate matter control.

To date, the demonstrated PM emission levels from IGCC units discussed in this analysis have ranged from 0.007 to 0.012 lb/MMBtu from main stack syngas combustion emissions, not including tail gas incineration emissions or other facility emissions. .

Carbon Monoxide (CO) Emissions

Carbon monoxide emissions result from incomplete combustion. Control methods for CO emissions for an IGCC process are the same as those for a traditional coal-fired boiler: good combustion controls to minimize the formation of CO. Both the Wabash River and Polk IGCC facilities utilize good combustion controls to control CO emissions.

To date, the demonstrated CO emission levels from IGCC units discussed in this analysis have ranged from 0.004 to 0.056 lb/MMBtu from main stack syngas combustion emissions, not including tail gas incineration emissions or other facility emissions. .

Volatile Organic Compound (VOC) Emissions

As with CO emissions, VOC emissions also result from incomplete combustion, and are also controlled by good combustion controls. The Wabash River and Polk IGCC facilities utilize good combustion controls for the control of VOC emissions.

To date, the demonstrated SO_2 emission levels from IGCC units discussed in this analysis have ranged from 1 x 10^{-5} to 0.002 lb/MMBtu from main stack syngas combustion emissions, not including tail gas incineration emissions or other facility emissions.

Sulfuric Acid Mist (H_2SO_4) Emissions

Sulfuric Acid Mist (SAM) emissions from the IGCC process are controlled in the same way as SO_2 emissions, through the pre-combustion AGR system. The Wabash River and Polk IGCC facilities both use the MDEA based chemical for syngas cleanup and control of SAM emissions.

Provided below is a table of the lowest long-term emission rates demonstrated in practice by the Wabash River and Polk IGCC facilities, compared to the draft permit emission limits for Plant Washington.

Table G- 1: IGCC Existing Facility Achieved Emission Rates and Plant Washington Draft Permit Limits

Pollutant	Polk Unit 1	Wabash River	Plant Washington
	lb/MMBtu	lb/MMBtu	lb/MMBtu
SO_2[1]	0.15 – 0.18	0.033 – 0.207	0.052 – Annual 0.069 – 30 day 0.08 – 24-hr 959 lb/hr – 3-hr
NOx[1]	0.06 – 0.09	0.07 – 0.10	0.05 – 30-day
PM_{10}[2]	0.007	0.011 – 0.012	0.018 (Total) 0.012 (Filterable)
H_2SO_4[2]	Not Available	Not Available	0.004
VOC[2]	1×10^{-5}	0.002	0.0034
CO[2]	0.004	0.033 – 0.056	0.1 – 30-day 0.3 – 1-hr

[1] Values listed for SO_2 and NOx are annual average value ranges from 2002 to 2008, based on CEMS data as reported to the EPA Clean Air Markets Program.
[2] Values listed for PM_{10}, VOC, and CO based on stack testing data as discussed in the *Tampa Electric Polk Power Station Integrated Gasification Combined Cycle Project – Final Technical Report (August 2002)*, and the *Wabash River Coal Gasification Repowering Project – Final Technical Report (August 2000)*.

Prepared by/Date: JDF 1/12/10
Checked by/Date: KDH 1/12/10

As can be seen in Table G-1, the demonstrated emission rates from existing IGCC facilities are no better than the draft permit limits for Plant Washington, with the possible exception of CO and VOC emissions. It should also be noted that Table G-1 compares the actual operational data of the existing facilities, compared to the draft permit limits for Plant Washington. Therefore, the actual emissions from Plant Washington during source operation would be expected to be less than the permitted emission limits. In addition, factoring in the lower reliability of the unit even more emissions should be added to the IGCC process. During the down times of the gasifier systems a backup fuel is utilized (e.g., natural gas or fuel oil) or a duplicate gasifier is maintained.

Also, the above listed emissions do not include additional emissions from other plant operations, such as the flaring activity or tail gas incineration from the Acid Gas Removal (AGR) process, which involves use of a flare and incinerator device to burn off gases. Based on data provided in the *Wabash River Coal Gasification Repowering Project – Final Technical Report (August 2000)*, tail gas incinerator emissions can exceed 150 tons/yr of SO_2. Therefore, when evaluating emissions from IGCC processes, and comparing those emissions to Plant Washington, emissions of the secondary IGCC plant processes (i.e. tail gas incineration) must be included.

It is also important to consider the permitted and proposed emission rates for recently permitted and proposed IGCC facilities. Table G-2 lists the permitted and proposed emission rates for six IGCC facilities that are not yet constructed.

Table G- 2: Permitted and Proposed IGCC Facility Emission Limits (lb/MMBtu)

Pollutant[1]	Taylorville Energy Center[2]	Cash Creek Generating Station[3]	Edwardsport IGCC[4]	Mountaineer IGCC[5]	TECO Polk Unit 6[6]	Mesaba IGCC[7]	Plant Washington
SO_2	0.016	0.0158	0.014 – 0.019	0.017	0.017	0.026	0.052 – Annual 97.5% Removal
NOx	0.034	0.033	0.08 – 0.115	0.057	0.032	0.057	0.05 – 30-day
CO	0.049	0.0485	0.046	0.031	0.032	0.035	0.1 – 30-day
Total PM_{10}	0.022	0.0217	0.019	---	0.019	---	0.018
Filterable PM_{10}	0.009	0.0085	---	0.006	0.0091	0.009	0.012
VOC	0.0015	0.0015	0.002	0.001	0.0012	0.003	0.0034
H_2SO_4	0.0035	0.0035	0.0015	0.0038	0.004	0.001	0.004

[1] All emission limits represented in lb/MMBtu.
[2] Based on Taylorville Energy Center Permit No. 021060ACB (June 2007)
[3] Based on Cash Creek Generation LLC Permit No. V-07-017 (January 2008)
[4] Based on Edwardsport IGCC Permit No. 083-23531-00003 (March 2008). Values given for SO_2 and NOx are a range of values. This is due to the fact that there are facility Plant Wide IGCC limits of 358.5 tpy SO_2 and 2121.5 tpy NOx. The upper bound of the range is based on the annual facility SO2 and NOx emission limits. The lower bound of the range is based on potential emissions listed for the combustion turbine units in Appendix A of the Technical Support document of the permit.
[5] Based on permit application for the Mountaineer IGCC project, Appendix II
[6] Based on application data for Polk Unit 6 (September 2007)
[7] Based on application data for the Mesaba IGCC facility (June 2006)

Prepared by/Date: JDF 1/12/10
Checked by/Date: KDH 1/12/10

As shown in Table G-2, the proposed and permitted emission limits for the listed IGCC facilities are not significantly different from the proposed emission limits by Plant Washington. With use of PRB coal, and the minimum removal efficiency of 97.5%, Plant Washington would expect SO_2 emission rates in the range of 0.02 lb/MMBtu, with the referenced IGCC permitted limits in the range of 0.014 to 0.026 lb/MMBtu (not including tail gas incineration). Some IGCC sites have proposed or permitted limits for NOx emissions higher than the draft permit limit for Plant Washington (0.05 lb/MMBtu), with values ranging from 0.032 to 0.08 lb/MMBtu.

Also, of the 4 sites reviewed which had proposed or permitted total PM_{10} limits those values were higher than those proposed for Plant Washington (0.018 lb/MMBtu total PM_{10}), ranging from 0.019 to 0.022 lb/MMBtu. Proposed and permitted Sulfuric Acid Mist (H_2SO_4) emission limits for the sites reviewed ranged from 0.001 to 0.004 lb/MMBtu, compared to the draft permit limit for Plant Washington of 0.004 lb/MMBtu. As was seen from the operational emissions data from the Wabash River and Polk Power

Station IGCC operating facilities, the primary emissions reductions benefit from use of IGCC technology (when compared to Plant Washington) would be from CO and VOC emissions.

An alternative way of evaluating emissions would be an evaluation on a lb/MW-hr basis, which could provide more favorable results due to the increased efficiency of the combustion turbines and IGCC process when compared to a coal fired boiler producing steam to generate electricity. However, there are important factors that should be considered when comparing emissions from IGCC to pulverized coal fired boilers on a lb/MW-hr basis.

Internal power demands, or the amount of power required to operate power plant equipment, are an important consideration if evaluating IGCC emissions on a lb/MW-hr basis. Internal plant power demand for an IGCC facility is more significant than from a pulverized coal-fired boiler facility due to the ancillary equipment and processes involved in the IGCC process. For example, the Taylorville Energy Center is a 770 MW gross, 630 MW net power facility with 140 MW of internal plant power consumption, while Plant Washington is a 930 MW gross and 850 MW net power facility with 80 MW of internal plant power consumption. This equates to approximately 18% internal power demand for the Taylorville facility and approximately 9% internal power demand for the Plant Washington facility. Therefore, comparing facility emissions on a lb/MW-hr basis between IGCC and pulverized coal-fired boiler facilities using gross power generation is not an effective basis of comparison. If comparing net power production to facility equipment heat input, this equates to approximately 0.106 MW/MMBtu for the Taylorville facility and approximately 0.102 MW/MMBtu for Plant Washington.

Although the IGCC process is potentially more efficient at power generation than Plant Washington, an important consideration are the additional emission processes involved with the IGCC process that are not part of a pulverized coal-fired boiler process. Gaseous emissions, such as those of SO_2 and NOx at Plant Washington, resultfrom combustion emissions of the main boiler and auxiliary boiler. However, gaseous emissions from a site such as the Taylorville IGCC project will arise from the primary combustion turbine/IGCC process and the auxiliary boiler, as well as from the sulfur recovery unit processes. The emissions of SO_2 from the combustion turbines at the Taylorville site are limited to a total of approximately 95.3 lb/hr. However, emissions of SO_2 from the sulfur recovery unit are permitted at 20.82 lb/hr. Adding these SO_2 emissions to the combustion turbines at the Taylorville site would increase SO_2 emissions by approximately 20%. Therefore, when comparing emissions between IGCC and pulverized coal-fired boiler processes, plant-wide facility emissions should be taken into consideration. The following Table G-3 is summary of the permitted emission rates for the sulfur recovery units at the indicated sites. As can be seen in Table G-3, emissions of other pollutants (not just SO_2) are also affected by these operations.

Table G-3: Permitted and Proposed IGCC Sulfur Recovery Emission Limits (ton/yr)

Pollutant[1]	Taylorville Energy Center[2]	Edwardsport IGCC[3]	Mesaba IGCC[4]
SO_2	91.2	87.01	56.6
NOx	71.9	1.65	78.8
CO	41.5	1.39	588
Total PM_{10}	2.8	0.13	5.2
VOC	2.8	0.09	3.4

[1] All emission values represented in ton/yr.
[2] Based on Taylorville Energy Center Permit No. 021060ACB (June 2007) Data for Sulfur Recovery Unit
[3] Based on Edwardsport IGCC Permit No. 083-23531-00003 (March 2008). Values given are for emissions from the sulfur recovery unit thermal oxidizer.
[4] Based on application data for the Mesaba IGCC facility (June 2006) for the tank vent boiler and flare.

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Other Non-Air Related

Environmental impacts from the use of IGCC technology are another important consideration. The primary environmental impact considerations are solid by-products, water use and water impacts, and air quality impacts. The solid byproducts produced by Plant Washington will include bottom ash, fly ash, and gypsum that will be stored at an onsite solid materials handling facility. These by-products may be re-used: ash (concrete); gypsum (wall-board). The solid by-products produced by an IGCC facility include gasifier slag and either solid sulfur or sulfuric acid produced at an on-site sulfuric acid plant, none of which is re-usable. Also IGCC facilities typically have a larger area footprint than a pulverized coal-fired boiler utility site.

The water use for Plant Washington is projected to be higher than that of an IGCC facility. IGCC facilities may have a higher air quality impact even though emission rates are in some cases lower, due to the lower stack heights and plume dispersion for combustion turbine and heat recovery steam generator emission stacks when compared to the main stack for Plant Washington. Despite these differences, neither technology is more beneficial than the other when considering all of the environmental impact considerations.

G.3 Comparative Emissions and Incremental Cost Analysis

An economic evaluation and comparative cost analysis of IGCC technology to Plant Washington is difficult due to the variability in published costs for IGCC technology and the lack of actual plant development experience for the next generation of IGCC plants proposed. However, the Edwardsport IGCC project in Indiana has commenced construction, and startup is anticipated sometime in 2012. Since this facility is the newest "next generation" IGCC facility in the United States for which there is available design engineering data, P4G has chosen this facility as its point of comparison in the following analysis.

The approved capital expenses for the 630 MW Edwardsport IGCC project are $2.35 billion, as referenced in a presentation given by Dennis Zupan of Duke Energy, titled *Edwardsport IGCC – Moving Forward (October 2009).* Therefore, capital cost values used in the analysis for an IGCC facility were based on the published value for the Edwardsport IGCC project. The capital cost for Plant Washington was also based on published values for the project. Operations and maintenance cost values for Plant Washington and the Edwardsport IGCC project were based on published values from the document *Cost and Performance Baseline for Fossil Energy Plants* (*DOE 2007*), specifically Exhibit 3-31 (IGCC Data) and Exhibit 4-35 (Supercritical Pulverized Coal).

Emissions data for Plant Washington were based on the draft permit emission limits established for Plant Washington at 850 MW/hr. IGCC facility emissions were based on the lowest proposed or permitted emission limits found from a review of permitted and proposed IGCC facilities (Section 2). The following Table G-4 is a summary of the estimated capital and annualized costs for Plant Washington and the Edwardsport IGCC project. The following Table G-5 provides the emission rates used in the analysis, while the following Table G-5 and Table G-6 show the estimated Plant Washington and IGCC annual emissions and incremental emissions reductions for IGCC versus Plant Washington. Table G-7 provides the estimated incremental cost effectiveness ($/ton) determined for the pollutants of interest. The values for annual emissions in Table G-4 are based on a permitted emissions (plant-wide) for both sites, and scaling the IGCC site data from 630 MW to 850 MW.

Table G-4: Plant Washington and Edwardsport IGCC Annualized Costs Estimation (in thousands)[1]

Topic	Plant Washington	Edwardsport IGCC	
Plant Net Output Capacity	850 MW	630 MW	Scaled to 850 MW
Total Plant Capital Cost[2]	$2,100,000	$2,350,000	$3,170,635
Annualized Capital Recovery Cost[3]	$246,750	$276,125	$372,550
Annual Operation and Maintenance Cost Estimates[4]	$53,568	$51,595	$69,612
Fuel Cost[5]	$109,062	$78249	$105,574
Total Annual Operating Cost[6]	$409,380	$405,969	$547,736
Incremental Annual Total Cost[7]	---	---	**$138,356**

[1] All cost values provided in table are ($ x 1000)
[2] Based on published values.
[3] Based on a Capital Recovery Factor of 0.1175 for both projects.
[4] Annual operation and maintenance cost estimates based on data provided in DOE 2007 Report: Performance Baseline for Fossil Energy Plants Exhibit 3-31 and Exhibit 4-35.
[5] Fuel cost based on delivered fuel estimate for PRB coal of $1.50/MMBtu and heat capacity of facility combustion units.
[6] Total Annual Operating Cost is the sum of annualized capital recovery cost, annual operation and maintenance cost estimates, and estimated annual fuel cost.
7 Incremental Annual Operating Cost is the difference of Scaled IGCC Operational Cost minus Plant Washington Annual Operating Cost ($537,502 - $398,464).

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Table G-5: Plant Washington and IGCC Facility Emissions

Pollutant	Plant Washington (ton/yr)	IGCC Facility (ton/yr) at 630 MW[1]	IGCC Facility (ton/yr) at 850 MW
Sulfur Dioxide (SO_2)	1,896	465.3	627.8
Nitrogen Oxides (NOx)	1,836	2416.49	3,260.3
Carbon Monoxide (CO)	3,642	1284.04	1,732.4
Particulate Matter (PM_{10})	678	446.82	602.8
Volatile Organic Compounds (VOC)	110	87.6	118.2
Sulfuric Acid Mist (H_2SO_4)	145.4	38.9	52.4

[1] Plant Wide IGCC emission totals for Edwardsport IGCC facility taken from Page 2 of 11 of Appendix C of Permit No. T 083-7243-00003.
[2] IGCC Facility emissions scaled up from 630 MW facility to 850 MW facility.

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Table G-6: Incremental Emissions Reduction for IGCC Versus Plant Washington[1]

Pollutant	Emissions Reduction (ton/yr)
Sulfur Dioxide (SO_2)	1,268.2
Nitrogen Oxides (NOx)	-1,424.3
Carbon Monoxide (CO)	1,909.6
Particulate Matter (PM) – Filterable	75.2
Volatile Organic Compounds (VOC)	-8.19
Sulfuric Acid Mist (H_2SO_4)	93

[1] Emissions Reduction is Plant Washington emissions (ton/yr – Table G-5) minus IGCC facility emissions at 850 MW (ton/yr – Table G-5).

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Table G-7: Incremental Cost Effectiveness of IGCC Technology Compared to Plant Washington[1]

Pollutant	Incremental Cost Effectiveness ($/ton)[1]
Sulfur Dioxide (SO_2)	109,095
Nitrogen Oxides (NOx)	(97,136)[2]
Carbon Monoxide (CO)	72,454
Particulate Matter (PM) - Filterable	1,841,117
Volatile Organic Compounds (VOCs)	(16,892,247)[2]
Sulfuric Acid Mist (H_2SO_4)	1,487,670

[1] Incremental cost effectiveness is incremental annual operating cost for IGCC divided by IGCC emissions reduction ($138,356,000/1268.2 ton = $109,095/ton).

[2] Those values indicated in brackets are negative values, where the plant wide IGCC emission totals are greater than the total plant wide emissions for Plant Washington.

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Based on an assessment of pollutant control incremental cost effectiveness, IGCC technology would not be a cost effective solution of control of pollutants when evaluated compared to Plant Washington.

G.4 Conclusion

While IGCC is an available technology for power generation, it should not be considered a technically feasible option for base load power generation for Plant Washington since it has not been demonstrated at the availability level required for operation of a base load coal fired power plant. IGCC should also be eliminated from consideration for Plant Washington since demonstrated emission levels from existing IGCC facilities are no better than those proposed or achieved by pulverized coal-fired utility boilers, and those low emission levels listed for the newly permitted or proposed IGCC facilities have not yet been demonstrated in practice. IGCC should also not be considered for Plant Washington due to the fact that the estimated incremental cost effectiveness for control of pollutants when compared to Plant Washington is significantly greater than $10,000 per ton. In sum, when evaluating feasibility and environmental, energy, and economic considerations, IGCC technology should not be considered for Plant Washington.

In summary:

- IGCC would be a "redefinition of the source" and is a facility Power4Georgians does not intend to build nor could get funding if they did.
- IGCC has not been demonstrated to be a commercially viable process for base load power generation.
- The IGCC process is a complex process which will impact the reliability of the power plant.
- Emission controls of some pollutants on the IGCC process are as yet untested and fully evaluated (SCR – NOx control).
- In all demonstration plants evaluated plant availability has not averaged greater than 80% for the first 5 years of operation of the plant, with the first years of operation of the plant typically showing low availability.
- In a comparative cost analysis, adopting IGCC technology for control of emissions would result in cost effectiveness values of greater than $100,000/ton; and for some pollutants has greater emissions.
- No IGCC plants the size of Plant Washington have yet become operational. Based on reported experiences with the design engineering of the Edwardsport IGCC project, additional engineering and design difficulties could be encountered when "scaling up" the size of any future IGCC facilities to the size of Plant Washington.