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Before the Public Service Commission of the State of Mississippi

MPSC Docket No. 2017-AD-112

Testimony of

Critical Technologies Consulting, LLC

On Behalf of

Mississippi Public Utilities Staff

Prepared by

Critical Technologies Consulting, LLC
2369 Dogwood Trace Blvd
Lexington, KY 40514

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SUMMARY, SCOPE OF TESTIMONY

Q: Please state your name and business address.

A: My name is Donald Grace. My business address is 2369 Dogwood Trace Blvd. Lexington, KY 40514.

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

A: I am an independent consultant and subcontractor of Cost Plus Consulting, LLC ("CPC"). CPC has been subcontracted by Critical Technologies Consulting, LLC ("CTC") for its expertise regarding technical, cost, and schedule issues associated with the Kemper County integrated gasification combined cycle ("IGCC") project ("Kemper Project"). Members of CPC have prior experience working on the Kemper Project as consultants to Burns and Roe Enterprises, Inc. ("BREI").

Q: Is CTC the same firm that has previously testified on behalf of the Mississippi Public Utilities Staff ("MPUS" or "Staff") as Independent **Monitor ("IM") for the Kemper Project?**

A: No. BREI was initially contracted as the IM for the Kemper Project in March 2011, representing the MPUS. In July 2014, BREI was acquired by POWER Engineers, Inc. and became POWER Burns and Roe. The executive management of POWER Engineers, Inc. concluded that continuation of BREI's IM engagement with the Staff was not compatible with the company's long-term strategic objectives. Consequently, in May 2015, POWER Burns and Roe withdrew from its role as the Kemper Project IM. To maintain the historical knowledge acquired of the Kemper Project since March 2011, several key POWER Burns and Roe personnel who had worked on the project since the inception of the BREI engagement were, as employees of CTC, contracted to serve as the Staff's new IM in May 2015.

CTC was created in 2008 and is a technical consulting firm experienced in project consulting services in the power arena, including IGCC, coal, nuclear, gas, and renewables. Typical activities include overall project management, as well as pre-construction studies such as labor analysis, cost studies and analysis, economic impact analysis, development of construction plans and procedures, nuclear plant outage coordination, project layout and conceptual design review, and constructability evaluation. CTC's post-construction activities include claims mitigation, analysis to determine prudency of performance, and acquisition due- diligence studies.

Q: Has CPC provided prior services to both CTC and BREI?

A: Yes. CPC is currently a subcontractor to CTC and is a technical consulting firm experienced in the design and construction of all types of projects including power, process, and industrial. It specializes in project cost development from conceptual or detailed information, including costs associated with first-of-a-kind ("FOAK") technology. CPC also specializes in providing expert witness testimony regarding claims, cost demands, and independent estimates and analysis of costs associated with such claims.

CPC has previously subcontracted its services to BREI and performed a detailed cost review that is contained in the Independent Monitor's Project Schedule and Cost Audit dated August 15, 2012 ("IM Report"), which was filed in Docket No. 2013-UN-189 contemporaneously with the April 15, 2014, Direct Testimony of Albert M. Ferrer ("Ferrer Direct"). CPC's personnel have worked with BREI employees on numerous projects including those involving FOAK technologies utilized in the IGCC, coal, and oil and gas arenas of the power industry.

Q: Has previous testimony been offered by BREI or POWER Burns and Roe in any docket relating to the Kemper Project?

A: Yes. The Ferrer Direct, noted above, was filed in April 2014, and the Surrebuttal Testimony of POWER Burns and Roe, by consultant Greg Zoll, was filed on July 21, 2014 ("Zoll Surrebuttal"), in Docket No. 2013-UN-189 - MPC's petition for a finding of prudence regarding the Kemper Project. Much of the IM testimony filed in that docket relates to the present evaluation of MPC's rate filing and the prudence review of costs associated with that filing. CTC has adopted all previous testimony offered by these two entities and, as needed, has referenced that testimony and its associated documents/reports in this testimony.

Q: Have you previously testified before the Mississippi Public Service Commission ("MPSC" or "Commission")?

A: Yes. In Docket 2015-UN-80 related to the In-Service of the Combined Cycle Plant.

Q: Have you previously testified before any other regulatory body?

A: Yes. I have testified numerous times before the Nuclear Regulatory Commission ("NRC"). This occurred while I was serving as the utility-elected chairman of the Boiling Water Reactor Owners Group ("BWROG"). The BWROG was formed by nuclear power generating plant owners to address safety issues common to multiple types of boiling water reactor plants, to develop solutions to these issues, and to obtain NRC approval of the proposed solutions.

Q: Please describe your educational background and professional experience.

A: I graduated Cum Laude with a BS Degree in Marine Engineering from the U.S. Naval Academy in 1966. I then completed U.S. Navy Nuclear Power School (equivalent to a commercial senior reactor operating license), and several other U.S. Navy schools, served as a nuclear-trained and qualified submarine officer, and was honorably discharged in 1971. I was then awarded a fellowship to attend Harvard Graduate School of Business and graduated with a Master of Business Administration in 1973.

With respect to my professional experience, following graduation from the U.S. Naval Academy, I served as a nuclear-trained and qualified submarine officer. Following graduation from Harvard, I worked for an electric utility, General Public Utilities ("GPU"), for 17 years. During my first year of employment I became certified as a professional engineer in the field of power generation, and after GPU I worked for the architect/engineering firm, BREI, for another 17 years. For the past 13 years, I have worked primarily as an independent consultant in the power industry.

With respect to the nature of my professional experience, it can be generally summarized in terms of these three major subject areas:

> ***Directing Operations*** - I have over 47 years of hands-on technical, managerial, and executive experience in all phases of the power plant cycle (design, licensing, construction, start-up and testing, commissioning, operations, and decommissioning). I directed operations of a nuclear power plant while serving aboard a submarine in the U.S. Navy, and worked primarily on operating plants while working for GPU. Through my employment with BREI, I performed economic and technical analyses of projects, facilities and processes, including work with the government of Thailand (in particular Thailand's nationalized electric utility) to assess various electrical generation alternatives, such as Thailand's ability to develop nuclear power as an energy source and its plans for accomplishing that task.

> ***Developing New Facilities*** - In my 17 years with BREI, I worked on the design and construction of new power generation facilities in positions of increasing

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responsibility, including Project Engineering Manager, Project Manager, Executive Consultant, and eventually President of Uranium Disposition Services (UDS), LLC, a company formed jointly by BREI and two other firms. Nearly all these experiences involved FOAK technology projects, including new nuclear power plants and FOAK chemical process projects.

Directing Major Projects, Independent Reviews - During my time of employment, BREI was contracted by the U.S. Department of Energy ("DOE") to assemble project review teams, which I then directed to provide independent project management reviews of multi-billion-dollar DOE projects. Nearly all the projects involved FOAK technology, and the reviews were full scope reviews (evaluating the DOE contractor's ability to achieve technical objectives within the forecasted costs and schedules). Also, as an independent consultant, I was contracted by the DOE to work as the technical lead of DOE teams that reviewed and certified DOE contractors' earned value management systems. Reviews were conducted according to the 32 criteria of ANSI (American National Standards Institute) Standard 748.[1]

Q: On whose behalf are you testifying?

A: I am testifying on behalf of the Staff.

Q: What is the purpose of your testimony?

A: Since the initiation of this engagement by BREI in 2011, the primary task has been to review and evaluate the major decisions and actions of the Kemper Project team that have taken place during the engineering/design, procurement and construction ("EPC") and

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[1] The purpose of this standard is to establish criteria for implementing an earned value management system which can be relied upon to produce valid project cost and schedule information. Many organizations (including the DOE) audit their contractors against this standard, and require them to be certified as compliant with this standard.

operational phases of the entire project, including the combined cycle power plant ("CC") and all its ancillary systems and portions of systems required to support the operation of the CC, as described in this testimony. This testimony continues that work. Further with regard to this particular testimony:

1. I will provide cost estimates for a CC. The primary estimate is a "yardstick estimate" for what a 730 MW net (winter time rating), Conventional Natural Gas Fired Combined Cycle Plant should have cost, if built at a competitive cost and at an optimal location within the MPC service area, with a Commercial Operations Date ("COD") of July/ August 2014. It is derived by combining two independent estimates that each produced similar results for the costs of such a comparable CC: (i) a detailed, "bottoms-up estimate", and (ii) a "top down" estimate, based on U.S. Energy Information Administration ("EIA") data. Secondarily, I also provide an independent bottoms-up estimate for the actual "as built" CC at Kemper. For comparability, all these estimates deal strictly with the Engineering/Procurement/Construction costs ("EPC") plus the Owners' Costs and do not include Allowance for Funds used During Construction ("AFUDC"). I will compare the MPC proposed asset value for the Kemper CC (likewise limited to EPC plus Owners' Costs) to the CTC derived "yardstick estimate"; show that MPC's value is nearly 50% higher; and identify the main factors which have contributed to that large difference. This discussion will (a) identify what are now (since the Gasifier portion of the project has been terminated) some of the "non-valued features" which have been designed into the CC in order to enable it to operate on both Syngas and Natural Gas, (b) explain how the integration planning and construction of the CC with the planning and construction of Kemper's Gasifier Island contributed to cost growth, and (c) provide CTC's observations regarding how ineffective (and Imprudent) the initial planning of the project, combined with the inadequate implementation of Management Controls further contributed to the cost growth.

2. I will review the Kemper CC's current status, readiness to continue operations, and rated capacity. This discussion includes comparison of past statements regarding the Kemper CC's Net MW Rating to the unit's documented performance.

3. I will address the actual and forecasted "maintenance capital" expenditures following the previously-declared August 9, 2014 In-Service date.

Q: Is there a reason to focus on a "yardstick estimate" rather than the actual costs for building the "as-built" CC at Kemper?

A: The Direct Testimony of Staff witness Dr. Craig Roach explains, with references to the Order on Remand and other Commission orders, why it is appropriate to focus on what a comparable CC would have cost, if built at a competitive cost and at an optimal location within the MPC service area. My testimony's focus on the yardstick estimate quantifies that concept. For completeness, however, my testimony will also provide an independent estimate for the actual "as built" Kemper CC. I will also identify the key differences that have increased the actual "as built" costs far above the yardstick estimate.

Q: Please describe the means by which you developed a yardstick estimate for the Kemper CC.

A: This estimate combines two distinct estimating approaches, each of which produced a similar result. <u>The first means can be described as a top-down benchmarking approach, based on EIA data for CC costs per installed kw of net capacity.</u> The end result of this approach is a total cost (inclusive of the EPC costs, plus the Owners' Costs); and, within the context of this testimony, it provides a "yard stick" measure of cost. This estimate excludes AFUDC and related Regulatory Assets, which are outside the scope of this testimony.

The second means is a detailed bottoms-up estimate independently developed by CTC/CPC. It is based on a typical owner/ EPC Contractor arrangement, the actual prices for the Kemper CC major equipment, labor rates (including premium rates to attract the necessary levels of qualified craftspeople), and bulk material quantities (as provided by the MPC developed computer model of the facility), etc. For more details on the basis of this detailed bottoms-up estimate, see Exhibit A.

Q: Please describe each of these methods and their results in greater detail, starting with the EIA-based, top-down benchmarking approach.

A: EIA periodically issues a report titled "Capital Cost Estimates for Utility Scale Electricity Generating Plants". The most recent of these reports provides this data in "overnight" 2016 dollars, and the prior report provides this data in "overnight" 2012 dollars.[2] Greater detail on the EIA approach is within the report itself, but in general it can be summarized as follows:

- Among the many different types of Power Plants, for Natural Gas Combined Cycle Plants it considers two types; i.e., "Conventional Combined Cycle Plant", and an "Advanced Combined Cycle Plant". Given the heat rates of the two types and the heat rate for Kemper, it is the former that is most comparable to Kemper.

- EIA addresses EPC Contractor Costs, and assumes Owners' Costs to be 20% of the EPC Contractor Costs.

- Costs are based primarily on recently completed construction experiences and are based on an assumed "generic site", which is optimally located based on factors such as (a) distance to required infrastructure (e.g., water and gas), (b) distance to

[2] "Overnight" dollars or costs represent the cost to build the plant "overnight", and, therefore, the costs do not take into account either escalation/inflation or de-escalation/deflation as they apply to the timeframe over which the money is spent.

the transmission grid, and (c) other potential factors (e.g., distance to major existing, and/ or forecasted loads). Because it assumes a CC plant will be optimally located, the EIA approach does not include allowances for getting infrastructure such as a transmission line, water, or gas to the site, but does deal with the tie-ins of these items to the facility.

- EIA provides a table of "Regional Factors" by which the cost/kw should be adjusted to reflect the fact that the costs of inputs to plant construction vary by location. For Kemper, this factor (to represent construction in the Southeast rather than at the "generic site") is 0.93.

- As noted previously, EIA's estimate does not include either AFUDC or related Regulatory Assets.

In following this EIA approach, CTC took the EIA Cost/kw for a Conventional CC in both the EIA 2012 overnight dollar costs/kw, and the EIA 2016 overnight dollar costs/kw, averaged them, applied the 0.93 Regional Factor, and then multiplied by the assumed 730 MW net CC rating. This calculation yields a EIA-based top-down cost estimate of $643.26M. The basis of the 730 MW net nominal rating, and the derivation of the EIA Based top-down cost estimate are shown below in Tables 1 and 2, respectively.

TABLE 1

KEMPER NET MW RATINGS (WHEN OPERATING ON NATURAL GAS) (Data Source: MPC Response to Data Request No. MPUS(CTC) 1-3, Dated 8/21/2015)		
Season	Temperature (°F)	Net MW Rating
Summer	95	696.4
Fall/ Spring	65	**730.0**
Winter	40	**730.0**

TABLE 2

EIA BASED TOP-DOWN COST ESTIMATE (for July/ Aug 2014 COD)			
Cost Category	2012 $'/kw	2016 $/kw	Average $/kw
EPC	$764	$815	$789.5
Owners' Cost[3]	$153	$163	$158.0
Total $/kw	$917	$978	**$947.5**
		x Regional Factor	**x 0.93 = 881.175**
		x 730,000 KW	**x 730,000 kw= $ 643.26 M[4]**

Note that as "overnight" cost estimates, these estimates do not account for changes in dollar purchasing power over the construction period. Although that straightforward approach is somewhat simplistic, it does not significantly impact the results, given the low-inflation conditions in the relevant time frame.

Q: Please describe the basis for and results of the detailed bottoms-up estimate.

A: As mentioned previously, this is a very detailed estimate based on a typical client/EPC contract approach, actual prices of major equipment, bulk quantities as derived from the MPC developed plant model, local labor prices, etc. Exhibit A to this testimony describes these estimate bases in more detail. This bottoms-up estimate starts by quantifying the costs of EPC. Owners' Cost is then added, following the EIA approach of estimating the "Owners' Cost" at 20% of the EPC costs. This results in a total bottoms-up cost estimate for EPC and Owners' Cost for a comparable, but optimally sited and competitively costed CC. That estimate is $ 664.8 M.

The resultant $664.8 million bottoms-up estimate represents the same scope and therefore can be used as another data point to validate the results of, and consistency with, the EIA approach. Combining the similar results of the bottoms-up and EIA approach produces a

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[3] EIA calculates Owners' Costs at 20% of EPC Costs

[4] As noted previously, this EIA based top-down cost estimate does not include AFUDC, and does not include related Regulatory Assets. Also, this simply represents the EPC and Owners' Costs for a competitively priced 730 MW conventional CC and does not consider issues such as DOE off-setting funds, tax credits, or any other similar issues.

yardstick estimate for what a comparable CC should have cost MPC, and can be used as a basis of comparison with the Kemper CC's actual costs as claimed by MPC.

Q: In summary, based on the two-independent means by which you calculated the competitive cost of a 730 MW net Conventional Combined Cycle Power Plant, with a Commercial Operations Date of July/August 2014, what would you say that cost should be?

A: For the EPC Costs plus Owners Costs, CTC has determined that the cost should be in the range of roughly $643 M to $665 million. The average of these two estimates, $654 million, is a good yardstick estimate for what such a CC should have cost MPC. Of course, that is an estimate, but if the precise cost is different, the difference should be relatively small, say 5% to 10%. To be clear, this estimate does not include AFUDC, related Regulatory Assets, DOE Credits or other external funding sources, tax credits, prior write-downs of the assets, or any other such accounting entries. In summary, it represents the estimated cost of actually building such a CC, and does not include off-setting accounting entries such as DOE funds, tax credits, etc.

Q. Please explain your "as built" Kemper CC estimate.

A. This estimate is the same as the detailed bottoms-up estimate I described earlier, except that this estimate includes what I term "non-value added" items related to the fact that Kemper was sited and designed to operate mainly on syngas. The siting-related items in this category include the costs for a water line and gas line, to the site. The design-related items in this category are features that were included in the current CC to make it capable of operating on syngas, adding cost, but which serve no useful function when operating only on natural gas. To provide a complete and precise estimate of these features' added cost would require a much more detailed technical and cost analysis, and is beyond the scope of this testimony. However, CTC has done a very "rough order of magnitude estimate" ("ROM") of some of these added costs. For details regarding some (but not necessarily all) of the factors that need to be considered please refer to Exhibit B. The addition of the items discussed results in an "as built" Kemper CC estimate of $776.6 million.

Q **Please summarize your testimony thus far.**

A I have presented three cost estimates and have combined the first two of those estimates into a yardstick estimate. I first presented two different means for providing a competitive EPC Cost plus Owners Costs for a 730 MW Net CC for a commercial operations date of July/August 2014. These results are $ 643 million (utilizing the top-down, EIA benchmarking approach) and $ 665 million (utilizing the detailed, bottoms up estimating approach). These similar results validate the reasonableness of a yardstick estimate set at their approximate average, $ 654 million. The third estimate is an independent estimate for the actual "as built" CC at Kemper, including the identified "non-value added" costs (which totals $ 776.6 million).

Q: **I understand your position that MPC's cost recovery should be based on the yardstick cost for an equivalently capable CC. Setting that aside, have you reviewed what MPC is seeking in terms of cost recovery for the Kemper "as-built" plant, and do you have any comments in that regard?**

A: Yes.

Q: **Please provide a summary of the costs that MPC proposes to recover.**

A: MPC's latest valuation (summarizing forecasted costs through December 31, 2017) is provided in Table 3.

Table 3

"As-Built" CC at Kemper; MPC's Forecast Booked Total Cost; on 12/31/2017 ($1,066.60; for total of EPC, Owners Cost, and AFUDC)		
Item	**$ M's**	**Remarks**
EPC	**$804.91**	
Major Equipment	$356.53	
Engineering	$96.60	
Construction	$350.45	
Scope Additions	$1.33	
Owners' Costs	**$131.23**	
Land	$18.83	
Fuel Facility; Gas Lateral	$10.88	
Pre-Commercial Operations	$75.03	
Corp Development	$10.98	
Start Up Fuel/Energy/By-Product	$5.28	
Ad Valorem	$10.23	
Contingency/Risk	$0.00	
EPC + Owners' Cost	**$936.14**	
AFUDC	**$115.25**	
Total of EPC+OWNERS COST+AFUDC	**$1051.39**	
Maintenance Capital/Retirements	**$ 14.70**	This includes $21.55 in maintenance capital since the Kemper CC went in-service and $(6.94) in retirements.
Total included in MPC's August 21, 2017 filing.	**$1,066.09**	Total included in MPC's August 21, 2017 filing.

The proper "apples to apples" comparison of MPC's proposed costs to the CTC "yardstick" and "as built" estimates, is EPC + Owners Cost amount of $936.14M included in the chart above.

Q: You previously referenced non-value-added location and design features that added costs. Did other factors contribute to the difference between the costs being claimed by MPC and your yardstick estimate?

A: Yes. For example, Southern Company/ MPC decided to not hire a third-party EPC Contractor. Such an arrangement would have entailed well-defined contractual Terms & Conditions, which typically include technical and schedule warranties, and associated remedies if not met. In general, this approach provides for a much more disciplined and accountable means of executing what is basically another commercially available product (often referred to as an "nth-of-a-kind" project[5]). This decision was due in part to the complications expected in attempting to plan and execute the syngas aspects of the Kemper Project, which made it a high risk First of a Kind ("FOAK") project. It led to Southern Company Services being assigned the responsibility to function as the over-all Project Management organization for the integrated planning and execution of the entire project, encompassing both the Gasifier Island and the CC. Consequently, Southern Company Services ("SCS") functioned as the EPC Contractor, without the contractual risk mitigation that typically applies to a commercially available "nth-of-a-kind" project. Due to complexities, uncertainties, and schedule delays experienced with many of the FOAK Gasifier Island systems, the Gasifier Island work constituted the critical path to plant completion. Consequently, workers were often pulled off the CC and assigned to the Gasifier Island. All these issues were a complicating factor which undoubtedly accounts for another portion of the cost difference.

Q: Did additional factors contribute to that difference?

A: Yes, there definitely are additional factors that contributed to the increased cost for the gasifier and the CC. One such fact was with the decision to start project construction with so little engineering having been completed, in an effort to obtain DOE funding and tax credits. In the

[5] Within this context, "nth of a kind project" (e.g., a CC project) means that the CC is not the first of a particular design, but rather is one in a long line of previously built, and well-functioning, CC's.

long run, this decision proved to cost much more than it could have saved. Beyond these poor initial planning decisions, other major contributing factors were inefficiencies encountered due to the inadequacy of the management controls implemented on the project. Although these controls (which include Risk Analysis, Project Controls/Earned Value Management Systems, Quality Assurance, and others) were in theory adequately defined via the project procedures, their proper implementation was severely lacking. This deficiency led to numerous problems, such as premature turnovers of incomplete construction efforts (in apparent response to management pressures to "show progress"), extensive re-work, not knowing the actual progress made and associated ineffective planning, systems that simply could not be made to achieve design rated conditions, etc. These problems were further compounded by the stretch-out of the schedule and the associated increases in overhead charges. Although many of the problems manifested themselves primarily in the Gasifier Island portion of the project, they also impacted the CC portion of the project, and therefore increased the costs for which MPC is now seeking recovery.

Q: At this point it appears that we have entered the topical area of prudence. Do you agree, and if so could you please continue to describe these additional factors in greater detail?

A: Yes, I agree with this observation. In reviewing these issues, I plan to first address CTC's prior review comments, which serve to highlight some of the points already made (not necessarily in detail, but at least provide highlights of these past reviews). Following that, I will discuss in greater detail the additional factors noted above.

PRUDENCE REVIEW OF ISSUES ASSOCIATED WITH THE KEMPER PROJECT

Q: **Earlier in the project your organization provided detailed comments associated with the EPC and startup phases of the Kemper Project's CC. Could you please highlight some of those prior review comments within this testimony?**

A: I have reviewed the previous testimony and reports filed by BREI and POWER Burns and Roe,[6] which have been adopted by CTC, and I concur that the analyses, descriptions, and conclusions expressed in those documents accurately characterize the nature of the difficulties and challenges experienced by the Kemper Project team during the planning, EPC, and start-up phases of the entire project (including the CC portion). The prior testimony and reports filed in Docket No. 2013-UN-189 and Docket No. 2015-UN-80 provide greater detail, but a summary of the EPC phase of the CC portion of the project is provided below.

The Kemper CC was designed, procured, and constructed as an integral part of the overall IGCC project. That overall project included (in addition to the CC, and among other things) a transport integrated gasification ("TRIG™") process, systems to provide the necessary clean-up of the gasification processes, approximately 87 miles of transmission lines, approximately 32 miles of treated effluent pipeline, approximately 61 miles of CO2 pipeline, and sulfuric acid and ammonia byproduct systems.

Like the other major areas of the plant, the CC experienced many of the same difficulties during the design phase of the project, such as the failure of the pile testing,[7] resulting in a re-design of the piling required for the entire site. This re-design caused a ripple effect of delays, beginning with the late delivery of completed design documents, materials, components, and equipment to the field construction personnel, which resulted in delays to

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[6] Docket No. 2013-UN-189, Ferrer Direct and IM Report filed April 15, 2014, and Zoll Surrebuttal filed July 21, 2014.
[7] Zoll Surrebuttal, pp. 20-21.

the construction activities and, in many cases, a re-sequencing of component and equipment installations.

The overall effect of these CC re-designs was an increase of inefficiencies in the performance of the CC construction activities.

CTC maintains that a major issue impacting the Kemper Project was the minimal design upon which the original estimate and schedule were based. As explained herein, this was in part due to the premature start of the field portion of the project and compressed schedule, all to achieve tax credits and DOE funding. This deficiency led to multiple project issues as evidenced by the increased commodity quantities, causing a major growth in the required amount of linear feet of piping, associated hangers, steel, etc.; the additional time needed for installation by craft labor and delays resulting from insufficient capacity within certain vendors and suppliers for piping and hangers,[8] all resulting in scheduling delays and work inefficiencies.[9]

Specifically, major difficulties were encountered during the design, fabrication and installation of the piping for the CC as well as the other areas of the plant. In many cases, the CC was not in the Kemper Project's scheduled "critical path" and thereby received less attention from senior project management. Modifications were made to the contracting strategies within the CC. Such modifications were primarily for commodity installations which resulted in a shift to the "labor broker" method of contracting, which allowed SCS supervision personnel to oversee and assign the daily tasks of the craftsmen supplied through subcontractors.

[8] IM Report, p. 52, §8.4 and p. 55, §8.5; Zoll Surrebuttal, p. 16.
[9] IM Report, pp. 66-69, §10.1; Zoll Surrebuttal, p. 56; Ferrer Direct, p. 23.

Q: Getting back to the specific problem areas that you previously summarized, could you discuss construction quality issues as it relates to the CC?

A: Quality issues added to the challenges and difficulties encountered during the project's EPC activities and contributed to the CC's costs.

For example, welding performance within the project's CC portion was poor month after month. Following industry-accepted standards, the Kemper project team considered weld rejections above 3% to be unacceptable. Each monthly "EPC Status Production Meeting Reports" contained a chart showing weld rejections by area, as well as an overall average for the project. The following example, covering December 2012 to March 2013, provides a representative sampling:

Table A-25-1 Combined Cycle Weld Rejections

Timeframe	CC	Average of all areas
December 2012 Production Meeting	5.4%	2.4%
January 2013 Production Meeting	6.0%	2.4%
February 2013 Production Meeting	5.5%	2.5%
March 2013 Production Meeting	5.4%	2.5%

CTC is of the opinion the excessive weld rejections within the CC, which in this period more than doubled the weld rejection average for the overall project, are a direct result of the Gasifier and Gas Clean Up areas having a higher priority. This prioritization resulted in welders and other workers continually being reassigned to the higher priority areas, thus causing inefficiencies and added time and cost to the CC.

Another example is the failure of numerous hydrostatic pipe tests due to excessive leakage as a result of improper installation methods such as missing hanger hardware, torque values differing between contractors and incorrect gaskets used in pipe joints. Consequently, a large staff needed to be hired to review required Quality Assurance ("QA") records. In many cases the records were so incomplete they required re-testing be performed in order to provide proper documentation. During re-testing, if the tests failed, this would require performing re-work (which, in some cases, could require turning a system back from the Startup Group to the Construction Group).

Implementation of an effective quality assurance/control management program was lacking throughout the project, resulting in the need for multiple components to be reworked and/or completed by the start-up group instead of the construction group. Thus, quality issues also led to the Kemper project team placing the burden of "completing" typical construction activities, which were either installed incorrectly or were not completed, with the Start Up Group after it received installations for testing.

This tendency is evidenced in numerous IM meeting handouts. Representative direct quotes, reflecting the build-up of these problems, can be seen from the August 2015 IM meeting in which the Risk section of the meeting handout, Page 10 under Startup, it states:

> "Construction/Supplier Quality Lessons learned on initial train.
> Seeing rework issues materialize."

On Page 12 of the August 2015 IM meeting handout by MPC, under the section "Fluidization Lines Pressure Testing" it states:

> "Needed after current valve and tubing rework/repair"

Page 13 of the August 2015 IM meeting handout, under "Kemper Schedule" and subsection "Primary Risk/Drivers to Syngas", it states:

> "Rework from Fabrication and Construction Quality"

Again, on Page 21 of the August 2015 IM meeting handout under "Startup: Risk List", one of the risks is called "Construction/Supplier Quality" and under the column called "Why an Issue", it states:

> "Seeing rework issues materialize. Experience to date has shown issues could continue."

The pervasive quality issues, which had been building and manifested themselves as these quotes from the August 2015 IM Meeting handout, are just representative examples, and contributed to the wide difference between the Kemper CC costs being sought by MPC and the yardstick competitive estimate cost for a comparable CC unit.

Q: Did the project experience inadequate prototype testing of critical Gasifier Island related systems?

A: Yes. The "Lignite Preparation" portion of the "Lignite Preparation and Feed System" is a very clear example of inadequate prototype testing and associated poor quality risk assessments. Since this system provided the fuel supply for the facility, it was clear that if it did not achieve its required feed rates, the Kemper IGCC would be unable to achieve its rated operations. The prototype testing led SCS to a conclusion of essentially "no risk" and to proceeding with, and having built, a "full scale facility" for which the problems still have no defined solutions. Even with its built-in redundancy of requiring only two of three trains per gasifier, the system was unable to consistently achieve the required lignite feed rate for any sustained period of time. For a graphic display of the issues encountered, please refer to Exhibit "C", titled "Lignite Preparation Problem Areas".[10]
In addition to providing an indication of design issues, Exhibit C also serves to focus attention on the previously discussed inadequate construction quality

Q: The Lignite Preparation and Feed System is not part of the Kemper CC. Is the inadequate testing of that system relevant to this proceeding?

A. Yes. The consequences of that inadequate testing were not limited to the costs of the Lignite Preparation and Feed System. For example, they led to work being reprioritized

[10] NOTE: Except for the additional text provided outside the margins of that graphic, this graphic was prepared by MPC.

away from the CC in order to support the critical path Gasifier Island work, and diverted management's attention from the CC. Further, these problems led to CC schedule delays (discussed later in this testimony) which (due to schedule stretch-out and increased carrying costs) increased the CC costs that MPC is seeking to recover.

Q: Although Project Controls have been discussed in prior BREI and CTC testimonies and reports, would you like to add any additional comments about the Earned Value Management System ("EVMS") system?

A: Yes, and I will offer three further observations in this subject area, as follows:

1. The industry standard by which organizations are reviewed and their EVMS is certified is American National Standards Institute ("ANSI") Standard 748 (this is a requirement for all US Department of Energy and US Department of Defense FOAK contracts, but to CTC's knowledge was not a requirement for the Kemper IGCC Project). Among the 32 criteria against which an organization's EVMS is reviewed is to minimize the use of Level-of-Effort tasks in determining progress versus plan (especially when "discrete measures" can be used). As an example, instead of having discrete tasks (e.g., plan on x linear feet of pipe, and measure the actual linear feet installed vs planned), when using Level-of-Effort one simply measures actual hours expended versus planned hours, which then provides no measure of specific task performance. At Kemper, situations existed where 100% completion was pegged to a certain number of hours charged, and when the hours exceeded that number, the credited complete number greatly exceeded 100%, thus distorting the actual status of that task which also contributed to an inflated measure of over-all project completion.

2. In turn, construction was reported at 98% complete from late 2014 to late 2016. However, there were more than 1,000 craft laborers on site, and into June 2017 (when Southern Company/ MPC decided to suspend the Gasifier Island/ Syngas

portion of the project) it still was not completed.

3. As further evidence of the problems with the EVMS, the project controls staff was – per management direction - often replaced.

In short, the Kemper Project's EVMS deficiencies left the project team with no effective method of tracking the project's progress and productivity. The project team, in turn, was unable to accurately report and understand where it truly was, and it could not make necessary and realistic adjustments in order to meet milestones and ultimately achieve the planned schedule completion dates.

Q: MPC has always maintained that all decisions relative to the EPC of the project were prudent. Do you agree with their assessment?

A: No. The decision to start the field construction activities in parallel with the start of detailed design was an imprudent decision. CTC understands the motivation to achieve certain schedule milestone dates in order to take full advantage of available tax credits and DOE funding. However, pennywise may be pound foolish. In this instance, Southern Company executive management should have known the risks and acted more appropriately to protect against them. The risk associated with completing this FOAK project while working to a compressed and unrealistic schedule should have been a key concern to the executive/management core of Southern Company since in large part it did not "set the stage" in a manner which could have provided the Project team the opportunity for success in executing the EPC of the plant.

The risks associated with these decisions to prematurely start the project and to work to an overly compressed schedule should have been recognized but were apparently dismissed. Consider, as SCS should have, the schedule for the Southern Company IGCC project originally planned for the Stanton Energy Center near Orlando, Florida. That project was jointly owned by Southern Company and Orlando Utility Commission and was to be a

285MW IGCC facility, less than half the size of Kemper. The IGCC portion of the project was terminated two months after starting construction in Orlando in November of 2007, citing uncertainty about potential state regulations on greenhouse gas emissions. (See Exhibit D for the referenced Power Point Presentation titled "Orlando Gasification Project Demonstration of a 285MW Coal-Based Transport Gasifier," dated November 1, 2006). In that presentation, the schedule (time line) clearly shows the "preliminary" and "detailed" designs starting a minimum of 1 1/2 years prior to the start of field construction, allowing the design to mature and develop prior to commencement of field construction activities, thus avoiding the majority of work-a-rounds and late equipment deliveries (and late delivery of completed engineering) experienced by the Kemper project. The decision to change this planning and execution philosophy for the Kemper project seems to have been motivated by a willingness to take on massive risk, in a misguided chase after much smaller tax credits and DOE funding.

Q: Was the CC completed in accordance with its originally estimated schedule?

A: No. The CC area at Kemper was completed later than the original baseline schedule for that area, which in turn was lengthened (as compared to the typical schedule for a standalone CC) by the fact that that the CC was planned in an integrated fashion with the project's Gasifier Island portion. Although there may be disagreement with Southern Company/ MPC (due largely to the lack of detail and the resultant ambiguity in various milestones), CTC believes that the completion of the CC slipped by roughly 7 months.

Q: Was the CC completed in accordance with its originally estimated cost?

A. No. Based on Southern Company/MPC's prior representations, the CC portion of the $2.4 billion original IGCC project estimate was $660.36 million. MPC is now seeking recovery based on a much higher asserted cost, $936.14 million before the addition of AFUDC and maintenance capital.

Q: Is the Kemper CC comparable to the other combined cycles owned and operated by Southern Company?

A: No. The Kemper Project CC is unique when compared to the other fifteen combined cycle projects designed and constructed by SCS, in that it was constructed as an integral part of the Kemper Project IGCC plant, which had exponentially more issues and challenges than any of the combined cycle units previously constructed by SCS.

In my opinion, MPC's project management/project controls actions and decision-making processes were overly focused on financial/accounting considerations such as tax benefits and DOE funding. This misplaced focus on the financial and accounting considerations then adversely impacted the ability to effectively manage the project on a day-to-day basis. For example, it contributed to inaccurate progress monitoring, such as accepting premature turnovers to "report completion." It also contributed to poor decisions early in the EPC portion of the planning efforts, such as (i) the decision to begin the detailed design concurrent with the construction field activities and (ii) management's inability to implement and effectively use procedurally required project control scheduling tools to their fullest capabilities.[11]

Q: What is the Kemper Project CC's current status and available capacity record?

A: The Kemper CC is currently available for economic dispatch operation using natural gas only. Normal operation is two-on-one (two gas turbines and one steam turbine).
Leading up to the planned September 2017 outage, the CC's 2017 year-to-date Equivalent Forced Outage Rate ("EFOR") was 1.22%. This EFOR represents the flip side of "availability" (i.e., time in a period that the CC could generate some net level of electricity should it be called upon to do so, divided by the time in the period, expressed as a percentage).

[11] See Exhibit B, IM Report, pp. 42-43, § 8.2.

A planned outage began on September 29, 2017, was scheduled to be completed by October 18, 2017, and was completed roughly 1-1/2 days behind schedule. The main purpose for this outage was to (i) remove, repair and replace valves in the Steam Turbine, (ii) remove, repair and replace valves in the Condenser, (iii) inspect and clean tube bundles in the Condenser, (v) perform internal and external inspections and maintenance of Gas Turbines, (v) perform external and internal inspections, cleaning and maintenance of the Heat Recovery Steam Generators ("HRSGs") and (vi) drain, clean and perform structural inspection of the CC Cooling Tower.

The next planned outage for the CC is scheduled for October 2018. It is planned to consist of hot gas inspections, and conversion of the Gas Turbines to Ultra Low NO_x ("ULN") and F6 HGP components (ULN/F6 HGP conversion) (to improve heat rate and NOX control).

Notwithstanding the Kemper CC's availability record, CTC has had continuing questions regarding its current actual net generation capability. This is important especially as it relates to the "competitive cost estimate" in that 730 MWs has been used as the major assumption in the yardstick cost estimate I discussed earlier.

To further illustrate the above, the reported net rating for the CC operating on natural gas, as supplied by MPC, has changed over time. In support of the August 9, 2014 In-Service date, it was reported in fall of 2015 to be 730 MW net (fall/winter/spring) and 696 MW (summer). More recently, it has been reported at 746 MW (winter) and 680 MW (summer). Operationally, the Kemper CC has been reported to be operating at 681 MW Gross when at full load (i.e., two gas turbines at max load, duct firing and steam turbine). Accounting for the CC parasitic/ house-load of 19.4 MW, this then yields a Net MW Output of roughly 661.6 M. To CTC's knowledge, the Kemper CC has not consistently performed at a net output in excess of 661.6 MW. Although data requests have been submitted to clarify why, from the answers received CTC still does not understand what the root causes are for the net MW Output being so limited.

Q: Moving from the Kemper CC's MW value to MWh, please discuss the plant's energy production.

The Kemper CC's on-going cost competitiveness in terms of "economic dispatch" presents an important issue. An important measure of this cost competitiveness is the "heat rate" (i.e., a measure of how much fuel must be consumed to produce a kW-Hr of electricity). The Kemper CC has been reported as less efficient (i.e., a higher number) than it would have been had the plant been designed to operate strictly on Natural Gas. The proposed 2018 Low NO_x conversion should remedy this issue.

Also, MPC's calculating and reporting of the plant's "Capacity Factor" still uses 555 MW as its rated capacity, which appears to be an averaged net MW hold-over from when it was intended to operate on syngas. The use of the 555 MW figure tends to inflate the capacity factor measure.[12] It should be noted that even when using a 696 MW net rating (i.e., the summer rating), the resultant capacity factor is still greater than the EIA published average for conventional combined cycle plants, which is 56%. However, that capacity factor reflects the Kemper CC's heat rate relative to other, generally older resources in the Southern Company dispatch stack, and does not mean that the Kemper CC is efficient relative to other CCs of similar vintage.

Q: Does the current operations staff have adequate numbers of qualified personnel, training, operating procedures, and experience to successfully operate and maintain the CC?

A: Yes. The CC was placed in service on August 9, 2014, and MPC has shown that it has adequately trained and experienced personnel to (a) operate the facility, (b) maintain the facility, and (c) with adequate support from specialty contractors when required such as in making further modifications to the Combustion Turbines, manage capital modifications to improve the facility. My prior testimony in Docket No. 2015-UN-80 stated that MPC

[12] Capacity Factor, as opposed to Availability Factor, measures the amount of energy provided to the grid (measured in MW-Hrs) over a period of time, divided by the amount of energy the generating plant could have delivered had it operated at its rated capacity for this same period of time, expressed in percent.

had adequate procedures in place for the operation of the CC, and my conclusion remains valid.

Q: Are you aware of additional capital costs that have been or are expected to be booked to the Kemper CC, but which are attributable to its relationship to the Gasifier Island?

A: Yes. Above and beyond the capital costs that I discussed above, MPC has identified, and has included in its 2018 test year for recovery, an additional $25 million of "Maintenance Capital." The $25 million represents amounts spent for maintenance capital after the Kemper CC went in-service and also includes amounts to be spent through the end of 2018. I believe that this work planned includes efforts to isolate the CC from the Gasifier Island. Other work planned includes the Low NO_x conversion to achieve an improved heat rate that is more in line with the efficient CC that MPC could have constructed absent the complications of the IGCC. The Low NOx conversion costs appear reasonable to be recovered from ratepayers since the conversion will also reduce the long-term maintenance costs of the Kemper CC.

Q: Are there any final issues not already addressed that you would like to address?

A: Yes, and the issue relates to determining costs for what the CC portion of the IGCC Project acquired land should be. CTC would like to address and challenge the reported cost of $18.83M for the CC portion of the land.

Q: Do we know the total value of all land and the total acreage for the Kemper Project?

A: Yes. The total land cost, as reported by MPC, is $29.36M

The total acres for the overall project, based upon Greenleaf data request GCS 2-16, is 2,968.0 acres, which translates to $ 9,892.00 per acre.

Q: What is the value and acreage of the land MPC is requesting for the CC portion at Kemper?

A. MPC is requesting $ 18.83M for CC portion of Kemper. Using the $ 9,892.00 per acre calculated above, MPC is requesting the equivalent of 1,903.6 acres.to be included in rate base.

Q: As a matter of understanding, did CTC determine how much land a typical Combined Cycle requires?

A: Yes. A study in March 2012[13], by the Natural Gas Supply Association, ("NGSA") shows a 0.3 acres / per 1,000 household, is needed.

Additionally, an October 2016 study performed for the U.S. Energy Information Administration (EIA)[14] reveals that the Average Monthly Consumption in the State of Mississippi to be 1,218 kWh (1,218 X 12 months = 14,616 kWh per year or 14.616 MWh per year.)

Based on these factors, a 730 MW Plant can support 437,521 households in Mississippi. (730 MW X 24 hours X 365 days = 6,394,800 MWh per year divided by 14.616 MWh)

These 437,521 households are divided by 1,000, which equals 437.5 X the 0.3 acres per 1,000 equals 131 acres for a 730 MW Plant.

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[13] Natural Gas: Helping to Ensure our Energy Future, March 2012, Page 20.
[14] EIA Study Titled: Residential Energy Consumption 2015 avg. monthly.

Table A-34-1 - Land Cost Range

Range Factors	Cost Per Acre	High/Low Cost Range
Acres at 56% Capacity (74 Acres) per /EIA Low Range	$9,892.00	$732,008
Acres at 100% Capacity (131 Acres) High Range	$9,892.00	$1,295,852

Q: Is this your recommendation?

A. No. CTC recommends that the IMs together with MPC physically visit the site with an independent licensed land surveyor and agree upon the area needed for the CC. This area would then be surveyed to establish the required acreage as well as provide a detailed legal description. Determining the acreage and multiply it by the actual average cost per acre will provide the recommended amount to be allowed in rate base.

Q: As between MPC and Southern Company, do you have a view as to which entity was the hands-on cause of the difference between what the CC should have cost and the costs that were expended to build it as part of the overall Kemper Project?

A: Yes, the latter.

It is my understanding that the Transport Integrated Gasification (TRIG™) Technology was developed as a result of emerging needs for cleaner coal in the United States and globally. Southern Company in conjunction with Kellogg Brown & Root (KBR) jointly developed the technology in response to this need on a much smaller scale in a testing facility located in Wilsonville, Alabama. Once they were sufficiently confident with the testing results, Southern Company took the project to the next level and planned a commercialized power plant (Integrated Gasification Combined Cycle - IGCC) to be designed and constructed near Orlando, Florida utilizing the TRIG™ technology. This project was in partnership with Southern Company, Orlando Utilities Commission, and the U.S. Department of Energy. The project was to be a 285 MW IGCC coal plant at the

Stanton Energy Center near Orlando, Florida.

In November of 2007, Southern Company cancelled the IGCC portion of the project two months after groundbreaking took place, citing concerns of uncertainty about potential state regulations on greenhouse gas emissions.

Due to the large amounts of Lignite Coal in Eastern Mississippi, Southern Company then pursued the opportunity to design, construct, and operate a much larger IGCC (roughly 830 MW gross, and 586 MW net) facility near Meridian, Mississippi in Kemper County. MPC, with a customer base of approximately 186,000 rate payers and a subsidiary of Southern Company was used as the forefront of Southern Company's desire to build the FOAK project in Mississippi. After exhaustive approval measures, the project was approved by the MPSC and – in light of the high risks - with strict orders and requirements. As the implementation of the project took place, the risk continued to increase as the funding and schedule also increased with the gasifier portion of the project ultimately ending up being canceled in June of 2017, leaving only the combined cycle to operate on natural gas.

Southern Company, who holds all equity ownership of assets within their system, was the spearhead behind the project as well as the developer of the TRIG™ technology, was planning to sell the technology to others and was the major decision maker in deciding to rush going forward with the project. Its subsidiary, SCS, served as the EPC Contractor, while MPC was minimally involved in the day-to-day decisions of the entire project.

However, MPC acquiesced in decisions made by Southern Company and SCS, submitted the application for a CPCN, and signed off on proceeding with the plant under the conditions imposed by the Commission. Accordingly, I am advised by counsel that it is responsible for the rate consequences of those decisions.

Exhibit “A”

“Basis of Estimate – Combined Cycle

CRITICAL TECHNOLOGIES CONSULTING
BASIS OF ESTIMATE

FOR THE

MISSISSIPPI PUBLIC UTILITIES STAFF

KEMPER IGCC PROJECT
MERIDIAN, MISSISSIPPI

COMBINED CYCLE POWER PROJECT DESIGNED FOR USE WITH NATURAL GAS OR SYNTHETIC GAS PRODUCED ON SITE FROM GASIFICATION OF COAL

FOR A COMMERCIAL OPERATION DATE OF:

JULY 1, 2014

OVERVIEW

In 2017 Critical Technologies Consulting, LLC (CTC) was tasked by the Mississippi Public Utilities Staff (MPUS) with producing a detailed capital cost estimate for the Kemper IGCC project under construction located in Meridian, Mississippi. The plant consists of a combined cycle power plant that is designed to burn natural gas or synthetic gas made from coal gasification on site

CTC decided that July 1, 2014, would be a reasonable commercial operation date based on the start date of the project. CT utilized information supplied by the Kemper project team including costs of major equipment components that were purchased earlier for the combined cycle plant that support the projected commercial operation date that we proposed. Where possible, bulk material quantities provided by the Kemper project team were sorted into categories to coincide with the preparation of the cost estimate. While pricing of the major equipment costs was available in most cases from the information provided by the Kemper project team, the bulk material costs were developed by the CTC cost estimating team since individual bulk material cost items were not available in the information provided by the Kemper project team. However, overall CTC's cost estimating teams total value produced was close to the total costs of major equipment items and bulk materials in the Kemper project team's information transmitted to CTC.

CTC determined that an Engineering, Procurement and Construction EPC approach to the project would be the best structure to use for the cost estimate. The CTC team decided that there would be one overall EPC contractor that would subcontract the work consisting of site work, concrete, masonry, metals, pre-engineered buildings, building architectural, major equipment installation, piping erection, electrical installation and instrumentation and controls installation. The EPC contractor would purchase the major equipment and major bulk material items while the subcontractors would purchase the balance of bulk material items.

The subcontractors would be responsible for their construction equipment and the majority of their other required indirect cost items. The EPC contractor would be responsible for any indirect cost items where it would be a cost advantage to have one company supply that indirect cost component. The EPC contractor is responsible for the overall project management, engineering, start-up and testing.

Due to the large need for skilled craft that are not local to the project site area, the cost estimate includes a substantial amount for per diem and overtime costs in order to attract the massive amount of skilled field construction labor necessary to construct a project of this magnitude. Fortunately, the base labor rates for the skilled craft are not as high as some other areas of the country; although, we anticipate that field labor productivity would be below average.

CTC developed bulk material costs and indirect costs based on prior experience contained within our cost database which was used in this EPC cost estimate. Included is work from similar projects where detailed engineering was performed. This information allowed us to adjust our cost estimate model in our database for the anticipated conditions for the project.

The CTC EPC Combined Cycle cost estimate is based on an Engineering, Procurement and Construction firm taking on the full responsibility with all of the risks involved in producing a turnkey operating Combined Cycle facility to operate at the required output of electricity and heat rates required. The CTC EPC cost estimate also includes costs as associated with an EPC contractor and subcontractors such as General Liability Insurance, Umbrella Coverage and Payment and Performance Bonds.

Major equipment items include 2 Siemens Gas Turbine Generators, 1 Siemens Steam Turbine Generator, 2 Heat Recovery Steam Generators, a Condenser, a Cooling Tower, 3 Generator Step-Up Transformers and 2 Auxiliary Transformers.

A Distributed Control System is also included as the main component of the plant control systems. A Continuous Emissions Monitoring System is included for the 2 steel stacks in the Combined Cycle Plant in order to measure the plant emissions from each of the Heat Recovery Steam Generators.

Pilings for foundations have been included in the cost estimate based on site geotechnical information and detailed information received from the Kemper project team. The cost of land, interest during construction and owner's costs are not part of this EPC cost estimate. Any credit for Department of Energy funds that may be received are also excluded from this EPC cost estimate.

DIRECT COSTS

MAJOR EQUIPMENT AND BULK MATERIALS

Major equipment is priced based on the information received from the Kemper project team cost estimate database. Balances of plant material quantities were developed from the Kemper project team's information that was provided and sorted by CTC. When necessary CTC selected EPC cost estimate models, as well as information from other CTC similar projects, to supplement the Kemper project team's information.

CONSTRUCTION LABOR

Labor rates used in our estimate model are based on the labor rates and associated costs such as fringe benefits obtained from published data received by CTC for the project site location. CTC then prepared a construction field labor calculation for approximately thirty-five various crafts composed as noted below.

CTC included the construction field labor rates and fringe benefits along with any special conditions related to field labor. CTC then blended these rates to the mid-point of construction for the cost estimate and entered them into the EPC cost estimate model.

The construction labor rates used in this EPC cost estimate are composite craft labor rates for the various craft and include all fringe benefits, workers' compensation costs and all other required insurances and taxes. Working foreman costs are built into the labor rates while non-working general foreman costs are included separately in the Construction Management Indirect Cost section for each of the subcontractor packages contained within the cost estimate.

Field labor productivity was calculated based on expected field construction labor conditions for the Kemper, Meridian, Mississippi site location. Labor productivity was adjusted based on the size of the project.

INDIRECT COSTS

CONSTRUCTION MANAGEMENT

This section of the cost estimate includes a detailed listing of the planned construction management team costs for the EPC Contractor. Costs in this section include a Construction Manager; an Assistant Construction Manager; Civil, Mechanical, Structural, Electrical and Instrumentation & Control Instrumentation & Control Instrumentation & Controls Superintendents; a Field Office Manager; Engineering Support; Cost Engineering; Planning and Scheduling; Safety; Quality Assurance/Quality Control; and Field Purchasing. The costs are calculated based on the estimated project schedule.

TEMPORARY FACILITIES AND UTILITIES

This section of the cost estimate includes a detailed listing of the elements needed in order to support the construction management staff and construction of the project. Items that are included in this section are site trailers, clean-up of trailer area, water, sanitary facilities, field office supplies, site security, fire protection, medical supplies, electrical power consumption, telephones, copy machines and computer hardware and software.

CONSTRUCTION EQUIPMENT AND OPERATORS

This section of the cost estimate includes a detailed listing of the construction equipment and operating engineers required in order to construct the mechanical and electrical portion of the project. In addition to the construction equipment and operating engineer cost, this section includes the cost of Truck Drivers, Maintenance Engineers, Fuel, Oil and Grease, Small Tools, Consumables, and Scaffolding. In this EPC cost estimate most of these costs are included with the individual subcontractors that are performing the civil, structural, architectural, mechanical, electrical and I&C portions of the work.

INDIRECT CONSTRUCTION SERVICES AND SUPPORT

This section of the cost estimate includes a detailed listing of the services needed in order to support the construction management staff and field forces. Items contained in this section of the cost estimate include Continuous and Final Site Clean-up, Rubbish Removal, Safety Equipment and Supplies, various testing including soils and concrete, Survey costs, Weather Protection, Dust Control, Piping Radiography and other testing, Testing of the Grounding System and Mechanical, Electrical and I&C Journeymen Support during Start-Up.

INSURANCE/TAXES/PERMITS/OTHER

This section of the cost estimate includes a detailed listing of a variety of components required in the cost estimate that are not applicable for inclusion in other sections of the estimate. Items normally included here are Freight Costs for major equipment and bulk materials that are not included in the cost of the Major Equipment as supplied by the manufacturer or in the bulk material unit cost, Travel Costs, Off-loading of major equipment and materials, Heavy Hauling of major equipment components not delivered directly to the site, General Liability and Umbrella Insurance costs, Start-Up Spare Parts, Permits, and Payment and Performance Bonds. Payment and Performance Bonds for the EPC Contractor as well as any subcontractors are part of this EPC cost estimate.

ARCHITECTURAL ENGINEERING

Architectural Engineering costs were calculated based on current information contained in the EPC cost estimate model used for this project and adjusted as required to support the Commercial Operation Date. CT based the cost for engineering hourly rates at an average cost for this service for work provided in the United States.

START-UP AND TESTING

The costs associated with the start-up and testing of the facility are included in the EPC cost estimate developed for this project. Journeyman stand-by time for mechanical, electrical and instrumentation and control support is included within these sections or in the Indirect Services and Support Section of the cost estimate. Start-up and test costs are based on no major issues arising during operations testing operations such as significant major equipment issues.

EPC CONTRACTOR CONTINGENCY

The CTC EPC cost estimate includes the anticipated contingency that will be applied by the EPC contractor based on the conceptual level of the information that is normally available at the time a Request for Proposal ("RFP") is issued for an EPC contractor as well as the risk involved for a project of this magnitude. The contingency percentages used in the cost estimate by CTC are based upon engineering judgment concerning the reliability of the data developed.

EPC CONTRACTOR PROFIT

CTC evaluated current profit margins of constructors of a suitable size that could adequately perform on a project of this size. CTC used 15% for overhead and profit for all items except for major equipment which is marked up 5% for EPC contractor overhead and profit. All of the subcontractors are marked up at a total of 15% to cover overhead and profit costs with the exception of major equipment which we estimated at 5%. Based on today's market conditions it is assumed that the EPC contractor would subcontract all work to specialty subcontractors, take responsibility for the entire project and manage the work.

OWNER'S COSTS

OWNER'S SITE MANAGEMENT AND INTERNAL STAFFING

These costs are not included in the EPC cost estimates provided.

OWNER'S INSURANCE

These costs are not included in the EPC cost estimates provided.

OWNER'S ESCALATION

These costs are not included in the EPC cost estimates provided.

OWNER'S CONTINGENCY

These costs are not included in the EPC cost estimates provided.

ANY OTHER OWNER'S RELATED COSTS

These costs are not included in the EPC cost estimate provided. This includes, but is not limited to, permitting and licensing, the cost of land, taxes, owner engineering services, interest during construction and legal costs.

NON-VALUE ADDED FUNCTIONAL FEATURES OF THE "AS-BUILT" KEMPER CC

This Exhibit serves as a list of some of the features of the "as-built" Kemper CC which were engineered and constructed in order to enable the Kemper CC to be fueled with either syngas or natural gas. Given, however, the decision to abandon fueling the CC with syngas, and to fuel it only on natural gas, these features provide no value. Further, unless one had direct contact with the equipment manufacturers, it is very difficult to quantify the costs of the engineering, fabrication, and installation of these additional features. Further details, however regarding some of the "non-value added" features are provided below.

1. The single Steam Turbine and the associated Steam Turbine Generator, were sized to power the very large (230 MW) station load of the Gasifier Island. Each were designed to accomplish the following:
   a) Utilize heat energy (obtained through the necessary cooling of the syngas) to generate additional Super-Heated Steam to be sent to the Steam Turbine, and
   b) Enabled the Steam Turbine Generator to generate additional electricity.

   As a result, both the Steam Turbine, the Steam Turbine Generator, and the associated support systems appear to be over-sized. For syngas operations, the gross output of the two Combustion Turbine Generators plus Steam Turbine Generator had to be 830 MW, but – to achieve the current net rating of 730 MW – it need only be roughly 750 MW.

2. Another point with respect to the Steam Turbine, it had to be modified from a "stock issue" Steam Turbine so that it could accept and effectively utilize the additional Super-Heated Steam that was coming from each of the two gasifier trains "Syngas Coolers".

3. Each of the two Combustion Turbines and the air compressors associated with each were sized to provide compressed air not only for the two Combustion Turbines, but also for the large gasifier island demand for compressed air. Therefore, it appears the Combustion Turbines and associated Air Compressors are larger than they need be.

4. Another point with respect to the Combustion Turbines is that they required different (from "stock issue") combustors (to prevent the backflow of hydrogen when fueled by syngas).

5. There are additional interfaces which are no longer necessary. For example, there is no longer a need for the process steam resulting from the hot exhaust gasses from the CT which was originally used by the gasifier island.

Exhibit "D"

"Orlando Gasification Project Demonstration of a 285MW Coal-Based Transport Gasifier"

(Attached Separately)

STATE OF PENNSYLVANIA

COUNTY OF WASHINGTON

DONALD N. GRACE, with Critical Technology Consulting being first duly sworn, deposes and says that the statements contained in the foregoing Testimony to the Mississippi Public Service Commission, in Docket No. 2017-AD-112 are true and correct to the best of his knowledge, information and belief.

Donald N Grace

[NAME]

Subscribed and sworn to before me this the 23rd day of October 2017.

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Kayla M. Hillen, Notary Public
Peters Twp., Washington County
My Commission Expires May 20, 2021
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

Kayla M Hillen

Notary Public

My Commission Expires: 05/20/2021

Orlando Gasification Project
Demonstration of a
285 MW Coal-Based Transport Gasifier

MIT Carbon Sequestration Initiative

November 1, 2006

SOUTHERN COMPANY

KBR

OGP Overview

- 285 MW IGCC comprised of two distinct projects:
  - 1x1 combined cycle (Owned 100% by OUC)
  - Jointly owned gasifier island (Owned: 65% Southern/35% OUC)
- Located at OUC's Stanton Energy Center in Orlando, FL
- PRB coal
- Electricity from the facility will serve OUC's customers
- Southern Company responsible for operation of the IGCC with a blended OUC and Southern Company staff
- KBR responsible for Gasification Island EPC
- DOE is participating in the project under CCPI2 and providing $235 million of co-funding
- June 1, 2010 COD for the IGCC

SOUTHERN COMPANY

KBR

Project Status

- All contracts with the Major Participants are in place
  - DOE/Southern Company Cooperative Agreement
  - EPC subcontract with KBR for Gasifier Island
  - Commercialization Agreement between Southern Company and KBR
  - GE contract for CT supply and syngas testing
  - All contracts between OUC and Southern Company
    - Including ownership, capacity purchase and O&M

Project Status

- Activities for 2006 include NEPA, SCA, Need for Power and FEED.
- OUC's Need for Power Application was approved by the Florida Public Service Commission on 5/24/06.
- The Supplemental SCA was submitted to the Florida Department of Environmental Protection (FDEP) on 2/17/06. The Site Certification process is expected to be completed this year.
- NEPA completion is expected in February 2007.
- FEED is progressing and will be completed 1st Qtr 2007
- Detailed design and equipment procurement will begin in April of 2007

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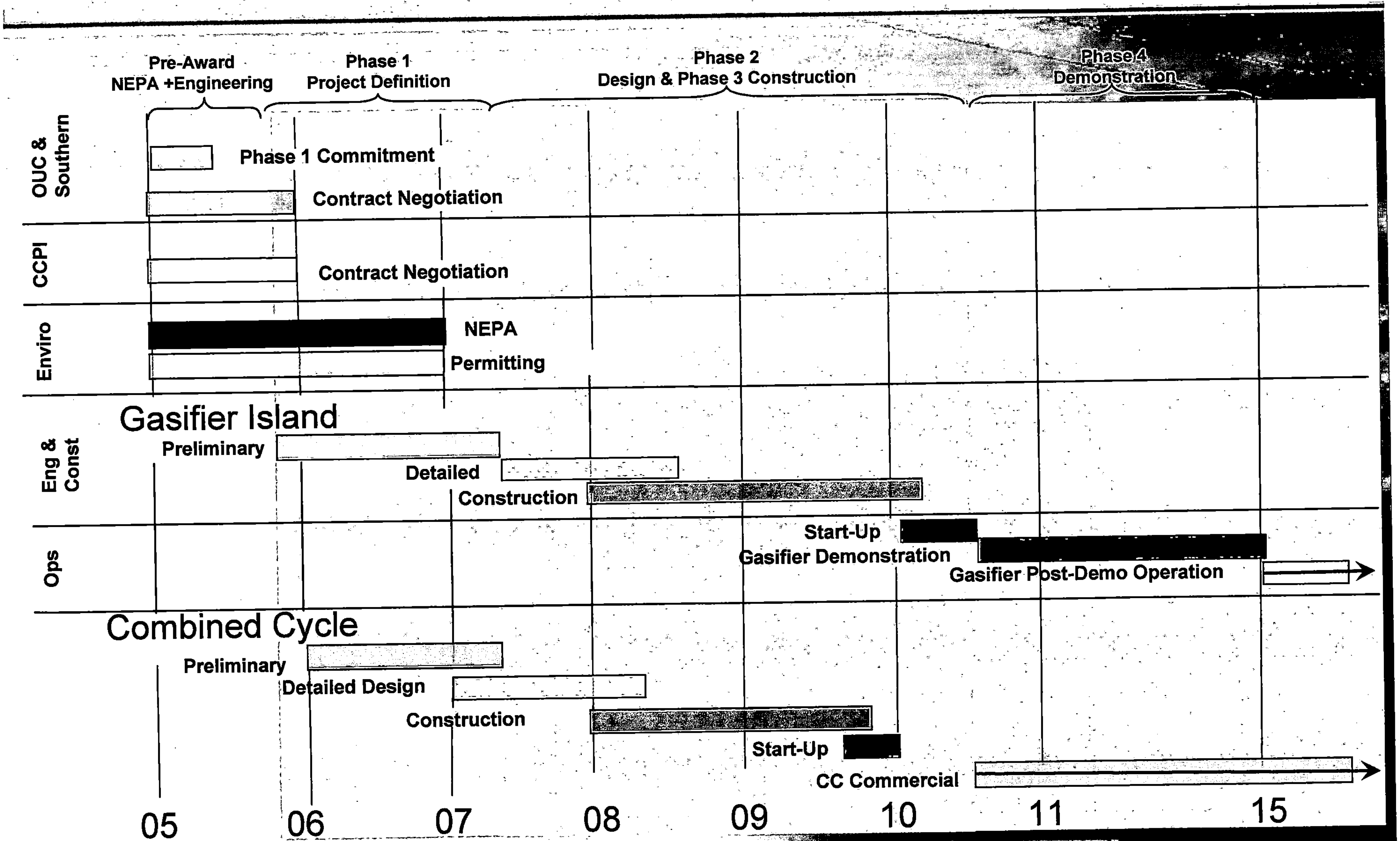
Orlando Project Timeline



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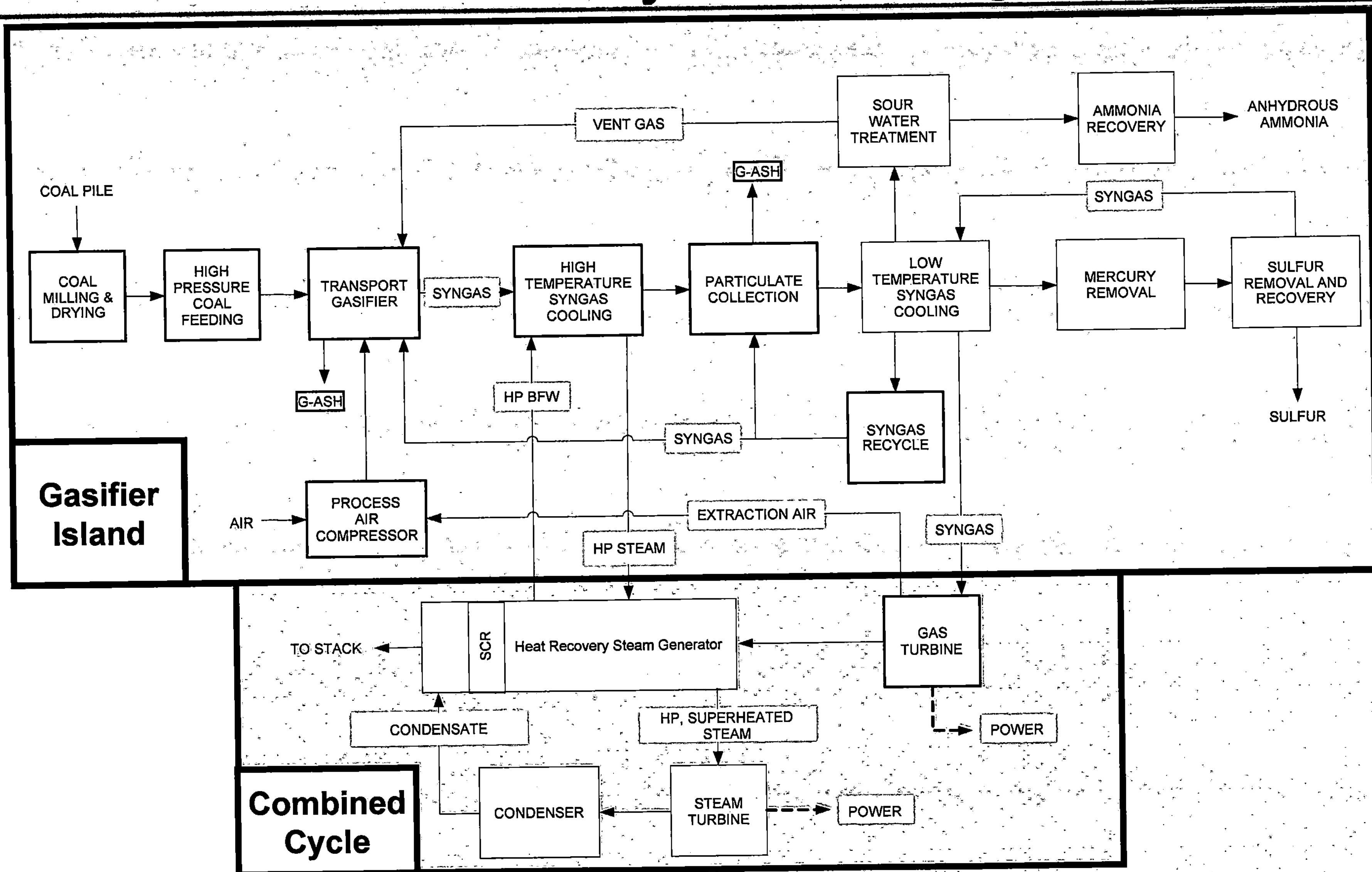
Summary Flow Diagram



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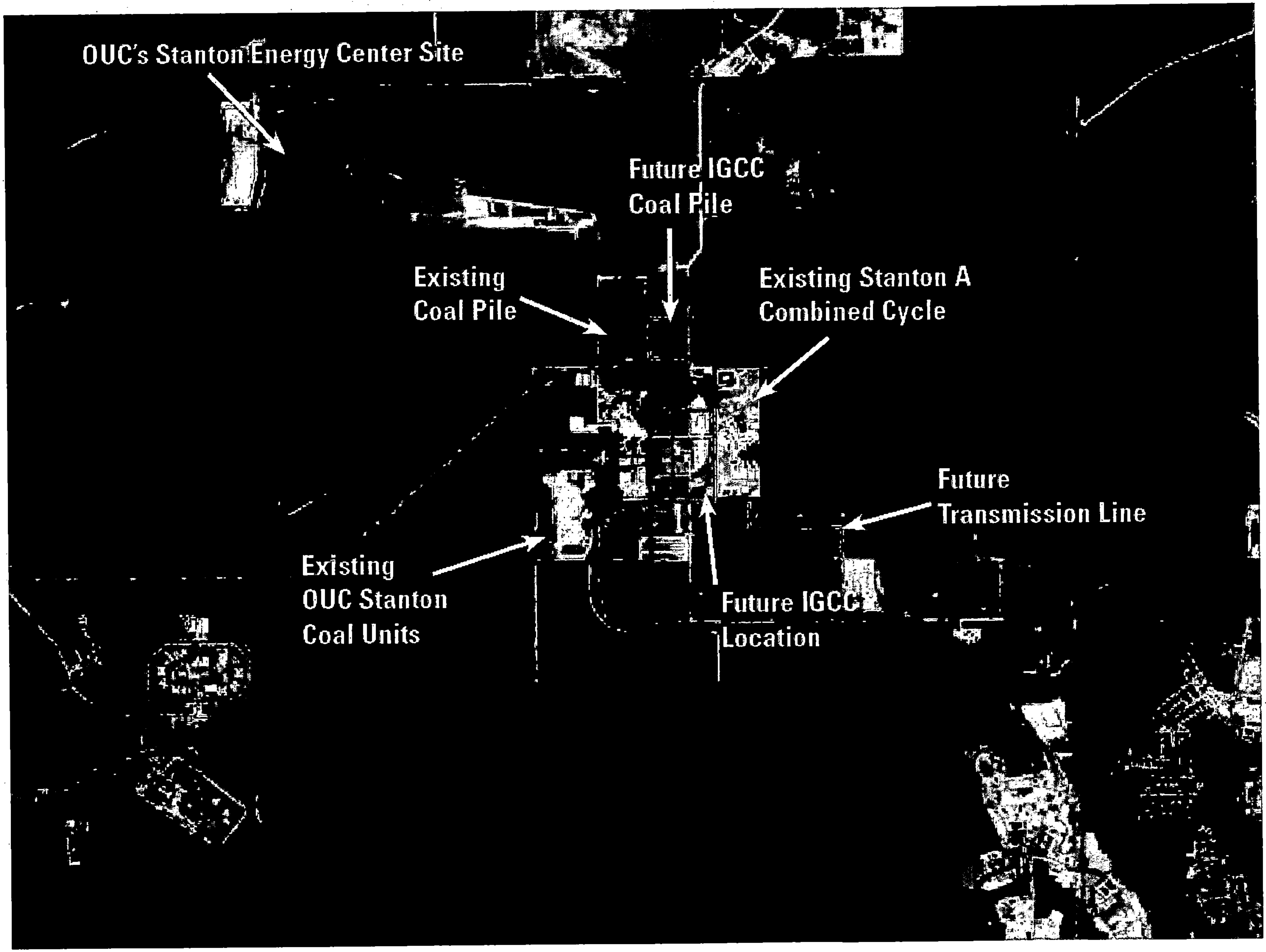
OUC's Stanton Energy Center Site
Future IGCC
Coal Pile
Existing
Coal Pile
Existing Stanton A
Combined Cycle
Future
Transmission Line
Existing
OUC Stanton
Coal Units
Future IGCC
Location

Stanton Energy Center

Combined Cycle Unit A

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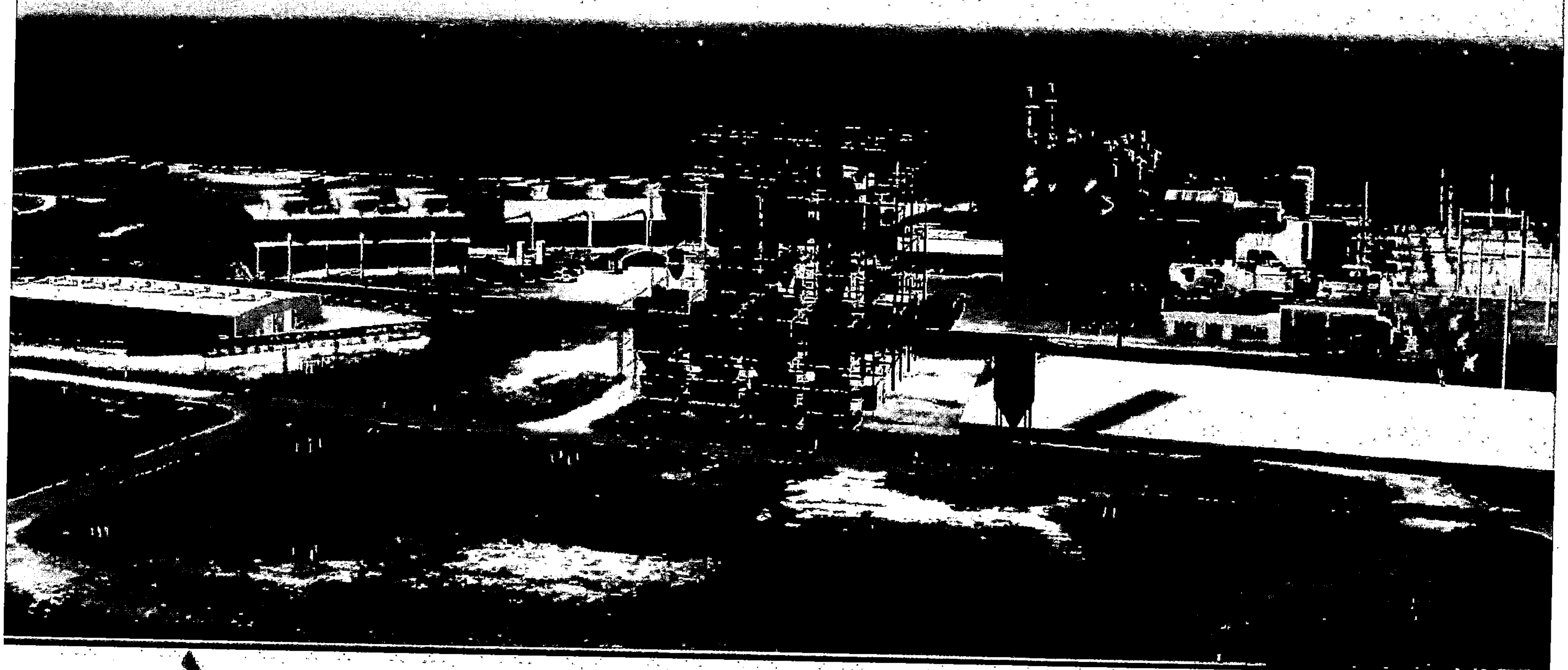
Air Blown Integrated Gasification Combined Cycle (IGCC) at the Stanton Energy Center



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TRIG™ Cost Studies

A series of conceptual power plant designs incorporating the Transport Gasifier were developed to:

- Compare oxygen-blown and air-blown gasification
- Evaluate the impact of capturing carbon dioxide
- Calculate plant performance, complete capital and O&M costs, availability, and emissions

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TRIG™ Cost Study - Conclusions

- For power production from a Transport Gasifier IGCC, fed with low-sulfur PRB coal, air-blown gasification is more economic than oxygen-blown
- Impacts of carbon dioxide capture are significant, but air-blown gasification is still more economic than oxygen-blown
- Complete results are available at http://psdf.southernco.com/tech_papers.html

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