



Project No. DE-FC26-03NT41889

**System Study For Improved Gas Turbine Performance For
Coal IGCC Application**

Fact Sheet

I Project Participants:

A. Prime Participant:

General Electric Company, General Electric Power Systems

B. Sub-Award Participants:

None

II Project Description:

A. Objective:

This study identifies improvements in gas turbine performance for coal Integrated Gasification Combined Cycle (IGCC) application by identifying vital gas turbine parameters and quantifying their influence in meeting the DOE Turbine Program overall IGCC plant goals of 50% net HHV efficiency, \$1000/kW capital cost, and low emissions. Focus is on air-cooled gas turbines for near-term(2008) operation in coal fed oxygen blown IGCC power plants with commercially demonstrated gasification, gas cleaning, and air separation technologies. A roadmap towards achieving DOE's goals for the Turbine Program will be defined, and will provide a total systems-level perspective to identify the development needs and improvements that have the highest impact/ payback to the program.

B. Background/Relevancy

Background:

In the near term, as reliance on natural gas increases and prices escalate, opportunities will arise to reinvest in the use of coal, our nations most abundant fossil fuel resource. Estimates suggest that more than 30 gigawatts of new coal-based power generation will be installed over the next 15 years. The US generates approximately 50% of its power from coal. Much of this added capacity could be based on integrated gasification combined-cycle technology (IGCC). Significant improvements in overall cycle efficiency and cost per unit of power will dramatically reduce generation costs and emissions. This will help provide low-cost, environmentally acceptable power from a domestically abundant low cost fuel.



Relevancy:

Clean, efficient and cost effective coal based power systems depend on advanced power turbine technology to achieve higher levels of efficiency. IGCC technology has been demonstrated to show superiority in both performance and emissions compared with conventional coal power generation technology. However, additional enhancements in IGCC will be needed to gain superiority in life cycle electricity costs. One area of improvement is in the gas turbine portion of the cycle, which is the primary energy conversion device within an IGCC power plant. Increases in gas turbine conversion efficiency of coal derived syngas energy to power and higher utilization of exhaust energy will help drive lower IGCC plant level generating costs.

Meeting DOE's overall IGCC plant goals of 50% net HHV efficiency, \$1000/kW capital cost, and low emissions for a 500 MW coal plant could provide annual generating cost savings of approximately \$50 MM/yr compared to current F-Class IGCC systems and approximately \$20 MM/yr compared to conventional PC technology. Additional enhancements in the area of emitted NOx and SOx could also be realized, making IGCC the technology of choice for coal based power production.

C. Project Summary:

This 15-month project identifies vital gas turbine parameters and quantify their influence in meeting the DOE Turbine Program overall Integrated Gasification Combined Cycle (IGCC) plant goals of 50% net HHV efficiency, \$1000/kW capital cost, and low emissions. The project analytically evaluates gas turbine conceptual cycle designs and quantifies their influence on IGCC plant level performance. The study will also provide DOE with information to set strategy for follow-on Turbine Program phases through identification of future technologies for advancing IGCC gas turbine performance.

Overall DOE Turbine Program plant level goals were established from DOE Vision 21 and IGCC Power Plant Roadmap Studies. Using GE's Six Sigma Methodology, gas turbine plant level requirements were identified. These gas turbine plant level requirements were used to quantify and prioritize gas turbine cycle parameters. A Baseline Conceptual IGCC System Design was established utilizing current General Electric (GE) F-class gas turbine technology based on a Midwest US IGCC site. An overall IGCC System Performance Model has been constructed utilizing GE in-house proprietary software for the gas turbine and team turbine, and commercially available software for the balance of the systems. The model was exercised through parametric analysis to quantify gas turbine performance impact at IGCC plant system level. Various FB technology gas turbine cycle design options were evaluated to determine performance impact on IGCC efficiency, cost and emissions. Results from the system analysis will be used to identify gas turbine technology improvements for development consideration in future Turbine Program phases.



The program consists of the following five major tasks utilizing GE’s Design for Six Sigma methodology:

1. Overall IGCC Plant Level Requirements Identification
2. Requirements Prioritization & Flow-Down to Gas Turbine Subsystem Level
3. IGCC Conceptual System Analysis
4. Gas Turbine Cycle Options vs. Requirements Evaluation
5. Recommendations for Gas Turbine Technical Improvements

D Period of Performance: January 01, 2004 to March 31, 2005

III Project Costs: Total: \$497,227

- A. DOE Costs:** \$298,336 (60%)
- B. Prime Cost Sharing:** \$198,891 (40%)
- C. Partner Cost Sharing:** \$ N/A

IV Major Accomplishments Since Beginning of the Project:

Dates:	Accomplishment:
• February 28, 2004	Gas Turbine Plant Level Requirements identified from Overall IGCC Plant Level Goals. This completes the 2Q04 DOE Headquarters Quarterly Milestone.
• April 30, 2004	Gas Turbine Subsystem Cycle Parameters prioritized from Gas Turbine Plant Level Requirements. This completes the 3Q04 DOE Headquarters Quarterly Milestone and the program Joule Milestone.
• June 30, 2004	Baseline F Class O2 Blown coal IGCC Model completed. This completes 4Q04 DOE Headquarters Quarterly Milestone.
• August 25, 2004	Determination of Influence of Vital GT Parameters on Plant Completed. This also completes the 1Q05 DOE Headquarters Quarterly Milestone.
• December 20, 2004	Selection of all 18 Conceptual Design Options have been completed.



V Major Activities Planned During Next 3 Months:

Planned Activity:

- Exercise coal IGCC Model for gas turbine cycle trade off studies
- Recommendation of gas turbine cycle design options
- Monthly Highlight Status Reports (Monthly)
- Financial Status Report (Quarterly)
- Federal Cash Transaction Report (Quarterly)
- Technical Progress Report (Semi-annual)
- Program Fact Sheet (Semi-annual)

VI Issues:

No issues have been identified.