



Fact Sheet:

Enabling & IT to Increase RAM for Advanced Powerplants DOE Contract No: DE-FC26-03NT41448

I. Project Participants:

A. Prime Participant:

General Electric Company, General Electric Power Systems

B. Sub-Award Participants:

General Electric Company, Global Research

General Electric Company, Aircraft Engine

General Electric Company, Energy and Environmental Research Corp.

General Electric Company, Energy and Industrial Services, Inc.

Georgia Institute of Technology

Sandia National Laboratory

II Project Description:

A. Objective:

Advanced analytical part lifing models, advanced sensors and controls, and highly integrated information technology (IT) platforms will be demonstrated in merchant coal/IGCC (Integrated Gasification Combined Cycle) gas turbine combined cycle powerplants located in the United States. The new technologies will be used to optimize the performance and life cycle cost of the power generation assets on a real-time basis, including the effects of power demand and ambient conditions for IGCC powerplants, as well as non-IGCC powerplants. The key success metrics will be increased powerplant reliability, availability and maintainability (RAM), performance (e.g. output and efficiency), and operability; as well as significantly reduced pollutants.

B. Background/Relevancy

Background:

The proposed project will develop, validate and accelerate the commercial use of enabling technologies for powerplant Condition Assessment and Condition Based Maintenance. The purpose of Condition Assessment is the real-time, automatic extraction of useful information from operating data to guide decisions, which differentiates it from traditional powerplant monitoring. By contrast, Condition Based Maintenance relies upon the use of derived information to accurately predict capital parts consumption and maintenance outage schedules.



Relevancy:

Significant benefits to the U.S. public will be additional electricity delivered to the power grid, with fewer interruptions, particularly during periods of peak demand; and reduced generation cost resulting from lower equipment maintenance costs, lower insurance premiums, more stable and reliable power transmission and distribution, and shorter learning curves when new power generation technologies are introduced to the market. Additional benefits include significant reduction in pollutants and improved capability for burning a wide variety of gaseous and liquid fuels in advanced power plants. These advances will benefit future coal/IGCC powerplants and existing natural gas powerplants.

C. Period of Performance: March 01, 2003 to February 28, 2008

D. Project Summary:

The project will develop, validate and accelerate the commercial use of enabling technologies for coal/IGCC powerplant condition assessment and condition based maintenance. The purpose of condition assessment is the realtime automatic extraction of useful information from operating data to guide decisions, which differentiates it from traditional powerplant monitoring. By contrast, condition based maintenance relies upon the use of this derived information to accurately predict capital parts consumption and maintenance outage schedules.

III Project Costs

A. DOE Costs: \$9,230,528 (60%)
Sandia NL: \$263,000 (50%)

B. Prime Contractor Cost Sharing: \$\$6,153,634 (40%)
Sandia NL: \$263,000 (50%)

IV Major Accomplishments Since Beginning of the Project:

Dates:

- March 2003

Accomplishment:

An outage was completed at the Duke Energy Maine Independence Power Plant; which included thermal measurements of stage one turbine buckets, pyrometer line-of-sight calibration and spectrometer measurements. These data will be used for prediction of part residual life during gas turbine operation.



- Aug 2003 Sensor requirements for advanced technology coal/IGCC powerplants were identified, ranked, and prioritized; the need for further development was assessed; and sensor functional specifications were generated.
- Sep 2003 The Universal On-Site Monitor (UOSM) and Condition Assessment Platform (CAP) software were successfully demonstrated at several non-IGCC gas turbine sites.

V **Major Accomplishments Planned During Next 6 Months:**

Planned Activity:

- Task 1 – Purchase materials and initiate specimen machining. Begin model development and confirm plans to evaluate hardware.
- Task 2 – Complete the Quality Function Deployment (QFD) to identify and rank the sensor requirements of a coal/IGCC power plant. Develop sensor functional specifications using the results of the QFD.
- Task 3 – Construct a combustion process modeling roadmap and identify sub-models for the physics-based approach. Formulate physics-based models for key combustion processes involved in combustion dynamics and emissions production.
- Task 4 – Install and configure the Universal On-Site Monitor at the TECO Polk One (Coal/IGCC) powerplant.

VI **Major Accomplishments Planned In Outyears (6 to 18 Months):**

Planned Activity:

- Task 1 – Complete specimen machining, start testing, and continue with model development, and final hardware evaluation plans.
- Task 2 – Install the fuel quality and flame temperature sensors at powerplant test sites.
- Task 3 – Formulate model-based combustion control strategies and build prototype hardware for implementing them in combustion tests. The main focus of control systems is dynamics and emissions reduction.
- Task 4 – Test the initial release of GateCycle IGCC. Integrate new sensors into the Universal On-Site Monitor.

VII **Major Milestones for Entire Project:**

Task 1:

- Site 1 HGP Inspection 1
- Site 2 HGP Inspection 1
- Site 1 HGP Inspection 2



- Site 2 HGP Inspection 2
- Validate Bucket and Combustor Life Models

Task 2:

- Validate Gen 1 IR Pyrometer
- Validate Gen 2 Flame Detector
- Validate Fuel & Emissions Sensors

Task 3:

- Integrated Combustion Design Tool
- Validate Combustor Control Strategies

Task 4:

- CAP Pilot at Non-IGCC site
- CAP Pilot at Coal/IGCC site
- Initial Release of GateCycle IGCC
- EfficiencyMap Pilot at Coal/IGCC site

Task 5:

- Project Kick Off Meeting (30 days of Award)
- Monthly Highlight Status Reports (Monthly)
- Technical Progress Report (Semi-annual)
- Program Fact Sheet (Semi-annual)
- Technical/Project Status Briefing (Annual)
- Financial Status Report (Quarterly)
- Federal Cash Transaction Report (Quarterly)
- Final Report (End)

VIII Issues:

No issues have been identified.



IX Attachments:

- Project Schedule

ID	Task Name	2003				2004				2005				2006				2007			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	TASK 1: Combustor and HGP Parts Life Prediction																				
2	1.1: Physics-Based Metallurgical Tool Development	[Bar chart showing duration from Q1 2003 to Q4 2005]																			
3	1.2: Analytical Life Assessment Model Development	[Bar chart showing duration from Q1 2003 to Q4 2006]																			
4	1.3: Experimental Verification of Life Assessment Methodology	[Bar chart showing duration from Q1 2004 to Q4 2006]																			
5	1.4: Field Validation of Life Assessment Methodology	[Bar chart showing duration from Q1 2004 to Q4 2006]																			
6	SITE 1 HGP Inspection 1 (MILESTONE)	[Milestone diamond at Q1 2003]																			
7	SITE 2 HGP Inspection 1 (MILESTONE)	[Milestone diamond at Q4 2005]																			
8	SITE 1 HGP Inspection 2 (MILESTONE)	[Milestone diamond at Q2 2006]																			
9	SITE 3 HGP Inspection 1 (MILESTONE)	[Milestone diamond at Q3 2006]																			
10	Validate Bucket and Combustor Life Models (MILESTONE)	[Milestone diamond at Q4 2007]																			
11	TASK 2: Material In-Service Health Monitoring																				
12	2.1: Identify Powerplant Requirements	[Bar chart showing duration from Q1 2003 to Q2 2003]																			
13	2.2: Sensor Capability Studies	[Bar chart showing duration from Q1 2003 to Q4 2006]																			
14	2.3: IR Pyrometer for Condition Based Maintenance	[Bar chart showing duration from Q1 2003 to Q4 2006]																			
15	2.4: Sensor Networking and System Integration	[Bar chart showing duration from Q1 2004 to Q4 2006]																			
16	2.5: Field Deployment and System Validation	[Bar chart showing duration from Q1 2004 to Q4 2006]																			
17	Validate Gen 1 IR Pyrometer (MILESTONE)	[Milestone diamond at Q2 2006]																			
18	Validate Gen 2 Flame Detector (MILESTONE)	[Milestone diamond at Q3 2007]																			
19	Validate Fuel & Emissions Sensors (MILESTONE)	[Milestone diamond at Q4 2007]																			
20	TASK 3: Advanced Methods for Combustor Monitoring and Control																				
21	3.1: Physics-based Combustion Dynamics Modeling	[Bar chart showing duration from Q1 2003 to Q4 2005]																			
22	3.2: Development of Active Control Methods	[Bar chart showing duration from Q1 2004 to Q4 2006]																			
23	3.3: Validate Monitoring and Control System	[Bar chart showing duration from Q1 2004 to Q4 2006]																			
24	Integrated Combustion Design Tool (MILESTONE)	[Milestone diamond at Q2 2006]																			
25	Validate Combustor Control Strategies (MILESTONE)	[Milestone diamond at Q4 2007]																			
26	TASK 4: Information Technology Integration																				
27	4.1: Performance Modelling of CoalIGCC	[Bar chart showing duration from Q1 2003 to Q4 2006]																			
28	4.2: Powerplant Data Integration	[Bar chart showing duration from Q1 2003 to Q4 2005]																			
29	4.3: Information Technology Validation	[Bar chart showing duration from Q1 2003 to Q4 2006]																			
30	CAP Pilot at non-IGCC site (MILESTONE)	[Milestone diamond at Q1 2003]																			
31	CAP Pilot at CoalIGCC site (MILESTONE)	[Milestone diamond at Q2 2003]																			
32	Initial Release of GateCycle IGCC (MILESTONE)	[Milestone diamond at Q3 2005]																			
33	EfficiencyMap Pilot at CoalIGCC site (MILESTONE)	[Milestone diamond at Q3 2007]																			
34	Task 5: Program Management and Reporting																				
35	5.1: Program Management	[Bar chart showing duration from Q1 2003 to Q4 2006]																			
36	5.2: Program Reports	[Bar chart showing duration from Q1 2003 to Q4 2006]																			