SAND2008-0586P

Sandia National Laboratories – H$_2$ Systems Analysis Project
Quarterly Progress Report – 12/31/2007   SAND Number: xxxx-xxxx x

QUARTERLY PROGRESS REPORT

Project Title: Hydrogen Systems Analysis

Covering Period: October 1, 2007 through December 31, 2007

Date of Report: January 21, 2008

Recipient: Sandia National Laboratories

Subcontractors: None

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QUARTERLY PROGRESS REPORT

Project Title: Hydrogen Systems Analysis: Task 1 – Macro System Model

Covering Period: October 1, 2007 through December 31, 2007

Date of Report: January 16, 2008

Recipient: Sandia National Laboratories

Subcontractors: None

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Project Objective: The goal of this project is to support the DOE Hydrogen, Fuel Cells, and
                        Infrastructure Technologies Program in the development of a Macro
                        System Model (MSM) that will enable existing or new component models
                        to be linked together to analyze crosscutting issues involved with the
                        production, distribution, or use of hydrogen for light-duty vehicle
                        transportation. Among the many types of models to be linked are models
                        that determine feasible or desirable schedules for deployment of
                        hydrogen infrastructure, models that compute the costs for producing
                        hydrogen, models that determine the costs of building delivery and
                        distribution infrastructure, and models that determine the emissions
                        produced from various pathways for producing, distributing, and using
                        hydrogen. Some of the crosscutting issues the MSM is being used to
                        examine include identifying critical / risky links in potential hydrogen
                        pathways, determining if the Program's current technical targets are
                        appropriate or best, and looking for interdependencies between the
                        technical targets.

Background: In a 2004 report, the National Research Council recommended that a systems analysis function be formed within the DOE to analyze the systems and subsystems under development, the character of competitive approaches for providing energy services, potential future energy scenarios, and how proposed technologies might fit into a national system. When this systems analysis function was stood up, it recognized that the Hydrogen Initiative had already developed or had begun developing many models covering different aspects of a possible hydrogen infrastructure for light duty vehicle transportation.

The Systems Analysis function determined that a macro-system model (MSM) would be necessary for analyzing cross-cutting issues because no existing model encompasses the entire system sufficiently. For example, no single model adequately represented all of the phenomena involved in the early stages of deployment of a hydrogen fuel infrastructure and hydrogen fueled vehicles. In addition, developing the MSM was expected to expose inconsistencies in methodologies and assumptions between different component models that arose because the individual models were developed under different philosophies and without thought of eventually integrating them.

In 2005, the Systems Analysis function of the DOE Hydrogen Program designated an investigator from NREL, Mark Ruth, as the Macro System Model Engineer, responsible for developing and implementing a plan for building the MSM. Mark Ruth and the DOE Hydrogen Program also determined in late 2005 that SNL had expertise in integrating component models that would be useful for building the MSM. Consequently, beginning in FY 2006, SNL undertook to construct the MSM, with Mark Ruth providing guidance and requirements.

Comparison of Progress against Project Goals:

In the first quarter of FY2008, the SNL Hydrogen Systems Analysis team, working together with Mark Ruth, completed a number of enhancements to the MSM and started others. We have incorporated new versions of H2A Production, HDSAM, HyARC, and GREET models into the MSM. We have also started work on allowing access to more parameters of these models through the MSM's web GUI. Based on feedback received at the September 11, 2007 peer review, we undertook a number of enhancements that were not on our original list of milestones, but which users deemed to be a high priority. Specifically we are adding a capability to upload files specifying input parameters from a user's desktop to the MSM, as well as modifying the email sent out to notify the user that their job is complete or incomplete due to error to be more

descriptive by including metadata such as job title, description, and submission time.   We are also incorporating the capability to print MSM output as PDF. The team met or exceeded all goals/milestones for Q1 FY08.

Status: In the first quarter of FY2008, the Hydrogen Systems Analysis team spent most of its effort on enhancements/bug fixes to the newly deployed MSM. These included changes in the website front end suggested by users at the peer review held on 9/07.

Plans for Next Quarter:
                       For the second quarter of FY08, the team plans to make the DAKOTA integrated version of the MSM accessible via the web site. The team also plans to resume integration of new models into the MSM, beginning with HyTRANS and HYPRO.

Patents: No patents were applied for during this last quarter.

Publications/Presentations: No publications were applied for during this quarter.

Websites: http://h2-msm.son.sandia.gov

Collaborations:
                       The SNL team continued fruitful collaborations with researchers from Argonne National Laboratories (ANL), NREL, and Oak Ridge National Laboratories (ORNL) in the process of conducting analyses and validating the MSM.
Other:
                       The team continued to improve the MSM software during this quarter.

Milestone Status Tables:

FY07 AOP Milestone Status Table:

Task/Milestone Description	Planned Completion	Actual Completion	Comments
1. Integration of Component Models into Macro System Model			
Integration of Deployment Optimization Model	4/07		Deferred to 3/08 due to reprioritization

Integration of Mass/Energy Balance Model	8/07		Deferred indefinitely due to reprioritization
Integration of Exergy Calculator Model	10/07		Deferred due to reprioritization.

FY08 AOP Milestone Status Table:

Task/Milestone Description	Planned Completion	Actual Completion	Comments
1. Macro System Model			
1.1 Integration of Component Models into Macro System Model			
Integration of HyPRO into MSM	5/08		
Updating of links to H2A Production and HDSAM	7/08		
Integration of HYDRA into MSM	9/08		
Integration of Power Parks Simulation			
Exergy calculation demonstration	9/08		
1.2 Enhancement of Graphical User Interface (GUI)			
Enhance GUI with additional MSM component configurations	9/08		
1.3 Infrastructure Systems Analysis			
Provide assist to enable utilization of the alpha version of MSM	11/07	ongoing	

QUARTERLY PROGRESS REPORT

Project Title: Hydrogen Systems Analysis: Task 2 – Analysis of Effect of Existing
Infrastructure on Development of Hydrogen Infrastructure

Covering Period: October 1, 2007 through December 31, 2007

Date of Report: January 10, 2008

Recipient: Sandia National Laboratories

Subcontractors: None

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Project Objective: The goal of this project is to support the DOE Hydrogen, Fuel Cells, and
Infrastructure Technologies Program in the development of a Macro
System Model (MSM) that will enable existing or new component models
to be linked together to analyze crosscutting issues involved with the
production, distribution, or use of hydrogen for light-duty vehicle
transportation. Among the many types of models to be linked are models
that determine feasible or desirable schedules for deployment of
hydrogen infrastructure, models that compute the costs for producing
hydrogen, models that determine the costs of building delivery and
distribution infrastructure, and models that determine the emissions
produced from various pathways for producing, distributing, and using
hydrogen. Some of the crosscutting issues the MSM is being used to
examine include identifying critical / risky links in potential hydrogen
pathways, determining if the Program's current technical targets are

appropriate or best, and looking for interdependencies between the
technical targets.

PROJECT STATUS:

***Subtask 2 – Analysis of Existing Energy and Water Infrastructures and Potential Effects
on the Development of a Hydrogen Fueling Infrastructure***

As one half of the DHS-funded National Infrastructure Simulation and Analysis Center (NISAC),
SNL has developed and has access to a number of software simulation and analysis tools for
studying the critical infrastructures and their interdependencies. These tools include but are not
limited to the National Petroleum System Simulator, the Agent-based Laboratory for Economics,
and the Interdependent Energy Infrastructure Simulation System (a comprehensive simulation
environment for the electric power and natural gas systems). The DOE Technology Analyst has
an interest in determining the limitations and likely impacts of existing energy and water
infrastructures on the course of possible buildout of a hydrogen refueling infrastructure. The
main objective is to quantify the likely impacts of widespread deployment of hydrogen fueling
infrastructure on existing water, electricity, and natural gas resources.

Activity on this subtask did not officially start until December 2007 due to delays in receiving
funding. In what remained of the first quarter FY08, a project lead was identified and a team
assembled to formulate a detailed statement of work.

PLANS FOR NEXT QUARTER

***Subtask 2 – Analysis of Existing Energy and Water Infrastructures and Potential Effects
on the Development of a Hydrogen Fueling Infrastructure***

Assess the capabilities and forge collaborative relationships with Sandia analysts working on
infrastructure simulation and surety projects for the Department of Homeland Security. The goal
is to leverage tools, databases, and other analytical resources in order to identify and address
key concerns of the impact an emergent hydrogen fueling infrastructure may exert on existing
resources such as water, gas, and electricity. We intend to investigate impacts on the natural
gas infrastructure in the coming quarter.

FY08 AOP Milestone Status Table:

Task/Milestone Description	Planned Completion	Actual Completion	Comments
2. Analysis of Existing Energy and Water Infrastructures and Potential Effects on the Development of a Hydrogen Fueling Infrastructure			
Analysis of water infrastructure impacts	1/08		Postponed due to delays in receiving funding and redirection of effort
Analysis of natural gas infrastructure impacts	4/08		
Analysis of electricity infrastructure impacts	9/08		