DOE/GO/10170--T5

2nd Interim Report:

Status of the International Energy Agency Annex 11 Subtask B

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Under
Subcontract Number 96DE-GFO01-EN1003
Prime Contract Number DE-FC36-96GO10170

July, 1997

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International Energy Agency Annex 11, Subtask B – Interim Report

This document is meant to describe the status of the International Energy Agency (IEA), Annex 11 (Integrated Systems), Subtask B (Analytical Tools) effort being carried out by the Member Nations. This includes Canada, Japan, Italy (inactive at this time), the Netherlands, Spain, Switzerland, and the United States. The Subtask status is taken as of the end of July 1997.

The goal of this Annex is to identify, compile, and integrate models of hydrogen technology components into system models that will describe overall pathways. Examples would include: PV/electrolysis/pipeline transport/hydride storage/PEM fuel cell utilization or natural gas steam reforming/liquefaction/truck transport/hydrogen refueling station. Component models are developed by the Member Nations and integrated into the desired overall system. Subtask B is concerned with identifying and compiling existing component models from Member Nations, or developing these models from data supplied by the Member Nations via Subtask A.

In a meeting of Annex 11 Subtask Leaders and the Operating Agent in Stüttgart, Germany in the summer of 1996, it was decided to approach the modeling of the various components by assigning a team to each component. The team would consist of a team leader and support members who would provide model development, data, and model validation. This approach was implemented at the Annex 11 Experts' Meeting in Tokyo, Japan in October 1996.

ASPEN Plus® was selected as the modeling platform of choice, and this software tool was only available within the group at ECN (Netherlands), and at NREL (USA). It was thus decided that these two organizations would perform the actual model construction after receiving the required input from the Technology Team leaders.

By the end of the Experts Meeting in Neunburg vorm Wald, Germany in April, 1997, and reported on at that time, component models had been completed on the following technologies:

• Coal Gasification	Netherlands (Team Lead)	Netherlands (Model supplier)
• Biomass Gasification	U.S.	U.S.
• Biomass Pyrolysis	U.S.	U.S.
• High Pressure Pipeline	U.S.	U.S.
• Low Pressure Pipeline	U.S.	U.S.
• NG Reforming	U.S.	U.S.
• Chemical Storage	Netherlands	Netherlands
• MeOH Transport	Netherlands	Netherlands

Brief descriptions of these models were given in the April report.

Since that time, one other model has been received. The completed component model, hydrogen storage by liquefaction, was supplied by the Netherlands. Japan was the team lead on the project. Briefly, the model calculates the power necessary to liquefy hydrogen using any of several user-selected power options, inputting the specific power consumption for the selected process. A black-

box approach is used, in which the necessary power is calculated based on the mass flow of the hydrogen that enters the liquefaction unit.

Other models are near completion as of the end of July. Some of the problems associated with model completion of some of the other components include:

- The only existing component model is in an integrated package not applicable to hydrogen, and must be decoupled.
- Models exist, but are built off proprietary data. Model must be modified to make it non-proprietary before release.
- Component manufacturers consider data and modeling inputs proprietary and will not provide information for the modeling effort.

A formatting change was agreed upon for some of the production technologies not yet completed. Rather than the previous breakout into PV, wind, and electrolysis, it was decided to couple them into PV-electrolysis and wind-electrolysis technologies, and to add grid-electrolysis. It was also decided to combine the technologies of hydrogen/natural gas blends and gas turbine combustion as a single utilization technology. Finally, two additional utilization component technologies have been added to the overall group – ICE/generator sets and hydrogen refueling stations.

An overall status of the component models as of the end of July 1997, as broken down by technology area, is shown in Tables 1-4. These include, in cases, the revised completion dates from the original January 31/March 15 options. As can be seen, the area of hydrogen utilization is still deficient, although the PEM fuel cell model is expected soon.

Table 1. IEA Annex 11 Subtask B -- Status of Source and Production Component Model Development

Technology	TT Lead	TT Support	Date of Receipt or Date Promised	Status
PV/Electrolysis	Spain/Canada	IT,JP,SP,SW,US	Before Next Meeting	Do Not Have
Wind/Electrolysis	USA/Canada	IT	After Next Meeting	Do Not Have
Grid/Electrolysis	USA/Canada	CN,IT,JP,SW,US	After Next Meeting	Do Not Have
NG Reforming	USA	CN	3/97	Completed
Biomass Gasification	USA	NE	1/97	Completed
Biomass Pyrolysis	USA		12/96	Completed
Coal Gasification	Netherlands	US	2/97	Completed

Table 2. IEA Annex 11 Subtask B -- Status of Storage Component Model Development

Technology	TT Lead	TT Support	Date of Receipt or Date Promised	Status
High Press CG	Canada	NE, SP	Before Next Meeting	Do Not Have
Low Press CG	Canada	IT, NE	After Next Meeting	Do Not Have
Metal Hydrides	USA	IT,SP,JP	Before Next Meeting	Do Not Have
Liquefaction	Japan	NE,US	6/97	Completed
Chemical Storage (MeOH)	Netherlands	JP	4/97	Completed
Chemical Hydrides	Switzerland	NE	After Next Meeting	Do Not Have

Table 3. IEA Annex 11 Subtask B -- Status of Transport Component Model Development

Technology	TT Lead	TT Support	Date of Receipt or Date Promised	Status
Transport Tanker	Japan	NE	After Next Meeting	Do Not Have
High Press Pipeline	USA	CN	1/97	Completed
Low Press Pipeline	USA	CN	1/97	Completed
Tank Truck	Japan	NE,US	After Next Meeting	Do Not Have
MeOH Transport	Netherlands	JP	3/97	Completed

Table 4. IEA Annex 11 Subtask B -- Status of Utilization Component Model Development

Technology	TT Lead	TT Support	Date of Receipt or Date Promised	Status
PEMFC	Canada	IT,NE,SW,US	9/97	Completed
PAFC	Spain	JP,SW,US		Do Not Have
SOFC	USA	CN,NE,SW		Do Not Have
MCFC	USA	JP,NE		Do Not Have
Gas Turbines/NG Blends	USA	JP, CN (blends)	After Meeting	Do Not Have
ICE/Gen Sets*	USA			Do Not Have
Refueling Stations*	USA	NE		Do Not Have

*Components added during Neunburg Meeting