ADVANCED WATER-COOLED PHOSPHORIC ACID FUEL CELL DEVELOPMENT

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Quarterly Technical Progress Report No. 44 for October - December, 1991 Activity

FCR-12145

January 1992

Work Performed Under Contract No.

DE-AC21-88MC24221

Prepared for

U.S. Department of Energy
Morgantown Energy Technology Center
P.O. Box 880, 3610 Collins Ferry Road
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PROGRAM HIGHLIGHTS

- Post-test analyses of 10-ft² short stack components continue. Component strength and acid transfer measurement were completed
- A decision was made with the METC COR to proceed with the final small area short stack test

I. INTRODUCTION

The Advanced Water Cooled Phosphoric Acid Fuel Cell Development program is being conducted by International Fuel Cells Corporation (IFC) to improve the performance and minimize the cost of water-cooled, electric utility phosphoric acid fuel cell stacks.

The program adapts the existing on-site Configuration B cell design to electric utility operating conditions and introduces additional new design features. Task 1 consists of the conceptual design of a full-scale electric utility cell stack that meets program objectives. Tasks 2 and 3 develop the materials and processes required to fabricate the components that meet the program objective. The design of the small area and two 10-ft² short stacks is conducted in Task 4. The conceptual design also is updated to incorporate the results of material and process developments, as well as results of stack tests conducted in Task 6. Fabrication and assembly of the short stacks are conducted in Task 5 and subsequent tests are conducted in Task 6. The Contractor expects to enter into a contract with the Electric Power Research Institute (EPRI) to assemble and endurance test the second 10-ft² short stack. The management and reporting functions of Task 7 provide DOE/METC with program visibility through required documentation and program reviews.

This report describes the cell design and development effort that is being conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives.

II. STATUS

TASK 1 - CONCEPTUAL DESIGN

Objectives

The objective in this task is to define the conceptual design for a cell stack having a performance level of at least 175-W/ft² and a manufactured cost of less than \$400/kW. The stack must be capable of operating for a minimum of 40,000 hours at electric utility conditions.

Activity

This activity was completed. Conceptual design updates are reported in Task 4 as part of the stack design activity.

TASK 2 - COMPONENT DEVELOPMENT

SUBTASK 2.1 - MATERIALS DEVELOPMENT

Objectives

The objectives of this subtask are to provide an improved substrate, verify the stability of low cost substrate and electrolyte reservoir materials at pressurized cell operating conditions, and increase the thermal conductivity of the electrolyte reservoir.

Activity

There was no activity on this task during this reporting period.

SUBTASK 2.2 - SINGLE CELL TESTING

Objectives

The objectives of this subtask are to test subscale cells to evaluate improvements in cell components consisting of substrates, electrolyte reservoir plates (ERP), catalyst and matrix; verify performance and endurance of components fabricated for short stacks; optimize the hydrophobicity of catalyst layers made from the GSB-18 and GSB-18P catalysts for operation at power densities of 200 WSF or greater; evaluate a higher performing laboratory catalyst for this application, and define the permissible range of operating conditions.

Activity

Subscale Cell Tests on Optimized Electrodes – No activity during reporting period.

GSB-18P Cathode Catalyst – Two subscale cells (Builds 6751 and 6774), fabricated with new production GSB-18P catalyst, began the quarter on test to evaluate long term performance stability. Both cells operated at 120 psia and 400°F at 300 ASF (Table 2-1). Build 6774 was one of the five “track the 10-ft² short stack” cells. These two running cells were shutdown after completing their test objectives. A complete graphic performance history of Build 6751 and Build 6774 are shown in Figures 2-1 and 2-2, respectively.

Table 2-1. Performance of Pressurized GSB-18P Single Cells 120 PSIA/300 ASF/400°F						
			Current Performance			
	Initial Performance		Beginning of Quarter		Final Performance	
Build No.	Hours	Volts	Hours	Volts	Hours	Volts
6751	79	0.764	7133	0.685	8225	0.659
6774	156	0.772	5026	0.695	6117	0.681

Electrode Optimization Trials – No cells were on test during this reporting period.

Improved Catalyst Layers – No cells were on test during this reporting period.

Figure 2-1. Performance History of Build 6751 GSB-18P Catalyst

Figure 2-2. Performance History of Build 6774 GSB-18P Catalyst

TASK 3 - PROCESS DEVELOPMENT

SUBTASK 3.1 - SUBSTRATES

Objective

The objectives of this subtask are to develop the process technologies required to produce electrode substrates and electrolyte reservoir plates that meet the technical requirements and cost objectives established in the conceptual design.

Activity

This activity was completed.

SUBTASK 3.2 - INTEGRAL SEPARATOR

Objective

The objective of this subtask is to develop the process technology to fabricate integral separators, up to 10-ft² in size, that meet the technical requirements and cost objectives established in the conceptual design.

Activity

This activity was completed.

SUBTASK 3.3 - SEALS AND MATRIX

Objective

The objective of this subtask is to develop the technology to fabricate higher integrity seals and matrices that meet the technical requirements and cost objectives established in the conceptual design.

Activity

This activity was completed.

SUBTASK 3.4 - ADVANCED COOLERS

Objective

The objective of this subtask is to develop material and process technology to fabricate coolers 10-ft² in size that meet the technical requirements and cost objectives established in the conceptual design.

Activity

This activity was completed.

TASK 4 - STACK DESIGN**Objective**

The objective of this task is to update the full-scale conceptual design and to define designs for the two small area development stacks and one 10-ft² subscale stack.

Activity**Conceptual Stack Design**

No activity. The stack assembly drawings are complete based on 10-ft² subscale stack experience.

10-Ft² Subscale Stack

This activity was completed.

TASK 5 - FABRICATION

SUBTASK 5.1 - REPEAT COMPONENTS

Objective

The objective of this effort is to fabricate the repeat components for two small area development stacks and one 10-ft² subscale stack each consisting of approximately 30 cells. These stacks will be of the Configuration B cell design. The repeat components consist of the substrates, electrodes, electrolyte reservoir plates, and cooler assemblies.

Activity

10-Ft² Subscale Stack

The fabrication of repeat components for the 10-ft² subscale stack is complete. See Section 6.2 for description of testing.

SUBTASK 5.2 - NON-REPEAT COMPONENTS

Objective

The objective of this effort is to fabricate the non-repeat components for two small area development stacks and one 10-ft² subscale stack each of approximately 30 cells each. These stacks will be of the Configuration B cell design. The non-repeat components consist of the reactant manifolds, coolant manifolds, axial load system, power take-off hardware and the pressure containment vessel.

Activity

10-Ft² Subscale Stack

The fabrication of non-repeat components for the 10-ft² subscale stack is complete.

SUBTASK 5.3 - STACK ASSEMBLY

Objective

The objective of this effort is to assemble two small area development stack and one 10-ft² subscale stack of Configuration B cells.

Activity

10-ft² Subscale Stack

The assembly of the first 10-ft² subscale stack is complete.

SUBTASK 5.4 - COST ASSESSMENT

Objective

Estimate the manufactured cost of the full-height 10-ft² Configuration B cell stack assembly defined in the conceptual design activities (Tasks 1 and 4).

Activity

This activity was completed

TASK 6 - STACK TESTING

SUBTASK 6.1 - SMALL AREA DEVELOPMENT STACK TESTING

Objective

The objective of this task is to obtain early feedback on improved Configuration "B" cell packages at atmospheric and pressurized operating conditions.

Activity

This activity was completed.

SUBTASK 6.2 - TEN SQUARE FOOT SUBSCALE STACK TEST

Objective

The objective of this task is to verify the scalability of the Configuration "B" cell design and evaluate the intermediate levels of achievement from Tasks 2.0 and 3.0.

Activities

Post-test analysis of repeat components from the short stack that completed 3,000 hours of operation was continued.

The strength of substrates from representative positions within the stack were determined. These measurements showed no reduction in strength over the total planform of the anode. The measurements also showed no significant reduction in strength over the active area of the cathode components.

Measurements of electrolyte transfer across the separator plates were made. There was no indication of any acid transfer within the active area of the cell.

SUBTASK 6.3 - ON-SITE SMALL AREA STACK TEST

Objective

The objective of this task is to provide technology verification by operating a Configuration "B" on-site short stack for an extended period of time.

Activities

There was no activity on this task during this reporting period.

TASK 7 - MANAGEMENT AND DOCUMENTATION

Objectives

The objective of this task is to provide the program management necessary to maintain technical and budget control of the program activities, and to provide adequate documentation of its progress per contract requirements.

The following reports were submitted during the period October 1 through December 31, 1991.

- Quarterly Technical Report No. 41 for July-September 1991 activity (FCR-12013) was submitted on October 15, 1991.
- Monthly Cost Management Report No. 41 for September 1991 activity and the Cost Plan dated October 18, 1991 were submitted on October 22, 1991 (FCR-12012).
- Monthly Technical Report No. 42 for October 1991 activity (FCR-12034) was submitted on November 15, 1991.
- Monthly Cost Management Report No. 42 for October 1991 activity was submitted on November 22, 1991 (FCR-12037).
- Monthly Cost Management Report No. 43 for November 1991 activity was submitted on December 6, 1991 (FCR-12113).
- Monthly Technical Report No. 43 for November 1991 activity (FCR-12114) was submitted on December 16, 1991.
- The Annual Summary Report, the Annual Milestone Schedule Status Report, and the Revised Cost Plan dated 10/18/91 (FCR-12120) was submitted on December 10, 1991.

END

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