

Improving Cost and Efficiency of the Scalable Solid Oxide Fuel Cells Power System

Project ID: FE0031941

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Public

Project Objective

Improving cost and efficiency of the scalable SOFC power system

Overview

1. 3 year/\$3.25M Project

2. Project Objectives

- 1. Develop analytical models and tools to optimize the Balance of Plant (BoP) design of a SOFC system.
- 2. Design and develop the 20kW range fuel cell power system (FCPS) and build the small scale SOFC power system.
- 3. Demonstrate the performance and durability of the 20kW FCPS for 5000 hours in a real-world environment at the University of Connecticut.
- 4. Develop a cost model, complete techno-economic analysis (TEA) and demonstrate pathways to achieve sub-\$1000/kW goals.

3. Deliverables

- 1. BP1: 20kW System design, build and commissioning for demonstration at UConn
- 2. BP2: 5000-hour demonstration, post-test analysis and TEA demonstrating pathways to achieve sub-\$1000/kW goals

Project Structure

	Columbus, I Project Management CFD Modeling Design	N Systems Modeling Structural Analysis Experimental Testing	
<image/>	Fridley, MN Power Electronics development Control Module development Testing		System demonstration Post-test analysis

Budget and Milestones



Budget

- Project Start Date: January 1, 2021
- Total Project Budget: \$3,251,307
 Total DOE Share: \$2,601,046
 Total Cost Share: \$650,261
 Total DOE Funds Spent*: \$1,480,219
 Total Cost Share Funds Spent*: \$377,843
 * As of June 30, 2022
- Project granted 1 year no cost extension in BP1 to implement new cell design

Task	Milestone	Status
2.0	M2: System requirements review and architecture definition	Complete
3.0	M3: Calibrated SOFC System Model	Complete
3.0	M4: Computational Fluid Dynamics (CFD) analysis complete	Complete
3.0	M5: Structural analysis complete	Complete
4.0	M6: Power electronics design qualified	11-30-2022
5.0	M7: Balance of Plant system defined	11-30-2022
6.0	M8: Demonstration system design complete	12-20-2022
6.0	M9: Demonstration system assembly complete	3-30-2023
6.0	M10: System commissioned at UConn Go/no-Go to BP2	6-30-2023
7.0	M11: 5000-hour test complete	6-30-2024
8.0	M12: TEA complete	11-30-2024
8.0	M13: Deliver Final Report to DOE	12-20-2024





- Move to new cell designed in DE-FE0031971
 - 780 cm² active area co-flow design
 - Reduced degradation from improved thermal gradients and more uniform current density
 - Fewer cells for same stack power improved \$/kW & kW/L

Task 3.0 Calibrated SOFC System Model











- SOFC system model calibration completed, results show reasonable match with baseline
 - Stack performance variables shown as an example
 - Similar trend observed for BOP simulation results



Baseline

Component

System

Task 3.0 Structural Analysis



• Results show no high stress areas

Task 4.0 Electrical System



- Completing electrical distribution box and control wiring and preliminary testing
- All CAD drawings have been completed

Task 5.0 BOP Design

Testing and simulation have been conducted for key components performance characterization



Component Characterization

Public

Cummins 9

Task 6.0 System Design

Compact system design: approximate dimension 750 mm x 700 mm x 1700 mm



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Project Next Steps

- Completion of BOP design and system validation tasks
- Completion of system build
- System to be commissioned at UConn
- Budget Period 2 Tasks:
 - Task 7.0: 5000h endurance test
 - Task 8.0: TEA analysis



