



Fuel Cell Power System for Transportation – Gasoline Reformer

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Agenda

- Technical Goals and Objectives
- Organization and Team Structure
- Background and Program Overview
- Timeline
- Testing Status and Results
- Summary

DOE Technical Goals and Objectives

“Develop a 45% efficient reformer-based fuel cell power system for transportation operating on clean hydrocarbon or alcohol-based fuel that meets emissions standards, a start-up time of 30 seconds, and a projected manufactured cost of \$45/kW by 2010 and \$30/kW by 2015.”

- Transportation Technical Barrier D-Fuel Cell Power System benchmarking, being addressed with reformer based integrated fuel cell power system program

UTC OVERVIEW

Pratt & Whitney



Otis



UTC Power



Hamilton Sundstrand



Sikorsky



Utilities / Commercial / Industrial

Transportation



CA1451

Fuel Cell



CA1807

Microturbine



CA1832

Organic Rankine Cycle



CA1622

Fleet Vehicles



CA0815

Space



CA1569

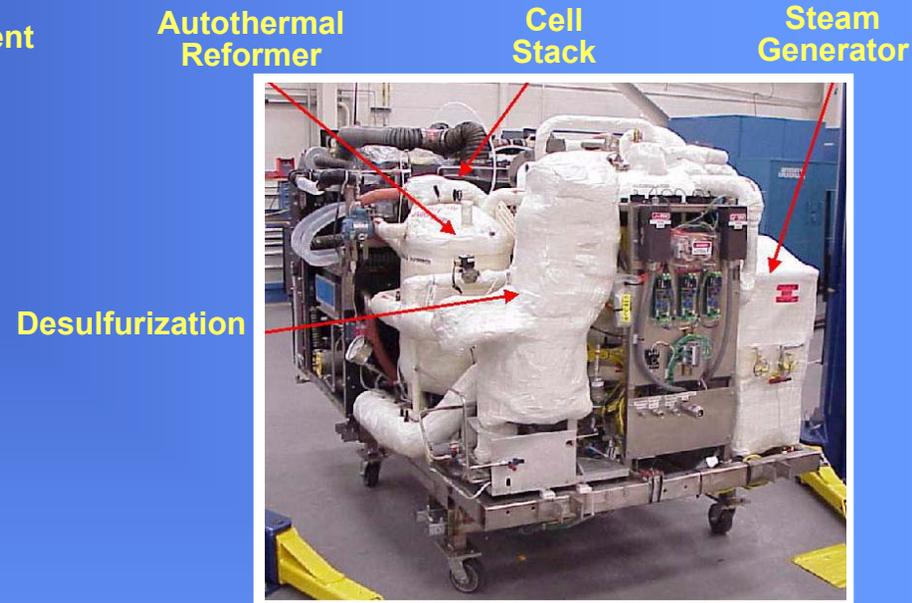
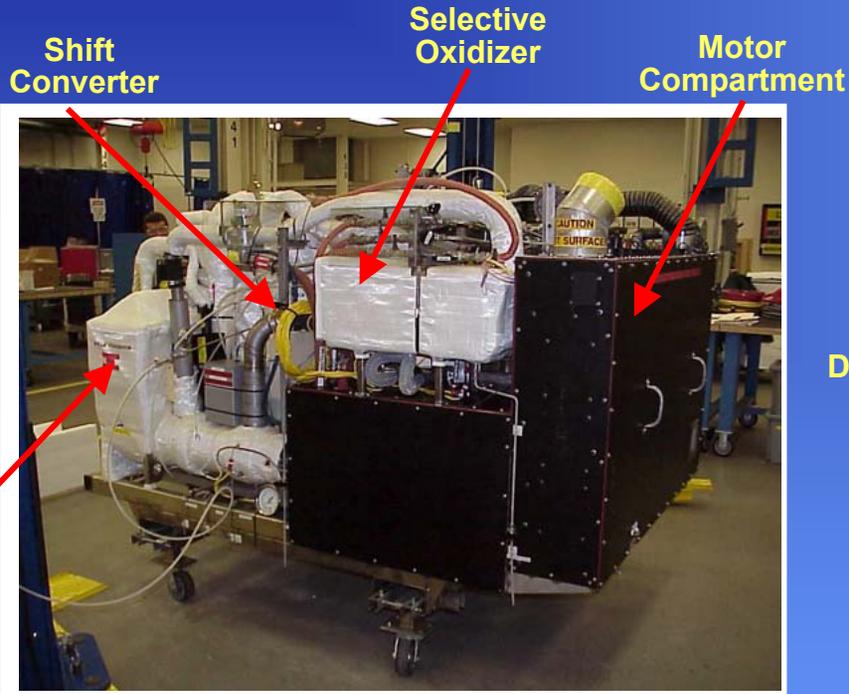
Automotive

Program Team



Develop, manufacture and sell Fuel Processors for the fuel cell and hydrogen fuel markets.

Background - Series 200 ATR Based FPS

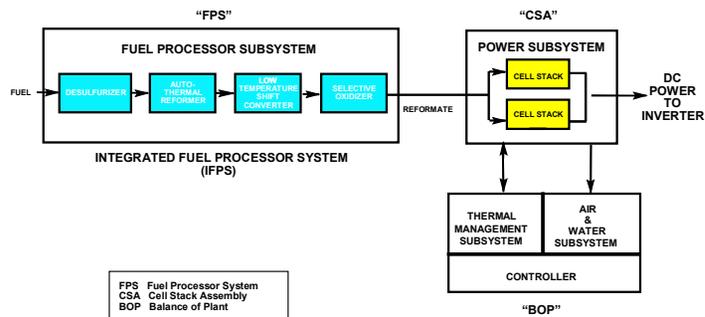


- Fully integrated system
- Ambient pressure

Series 200 Data

- ~45 minute start time
- Efficiency 25% at full power (53 kW)
- Volume ~ 870L

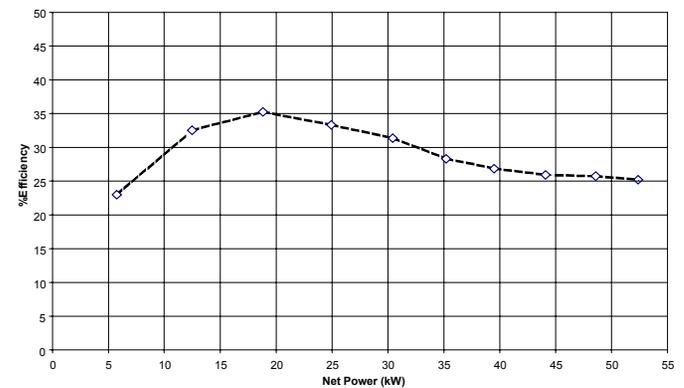
50 KW Gasoline Fuel Cell Power Plant



FC11748-PPT
R010910

50 KW Gasoline Fuel Cell Power Plant

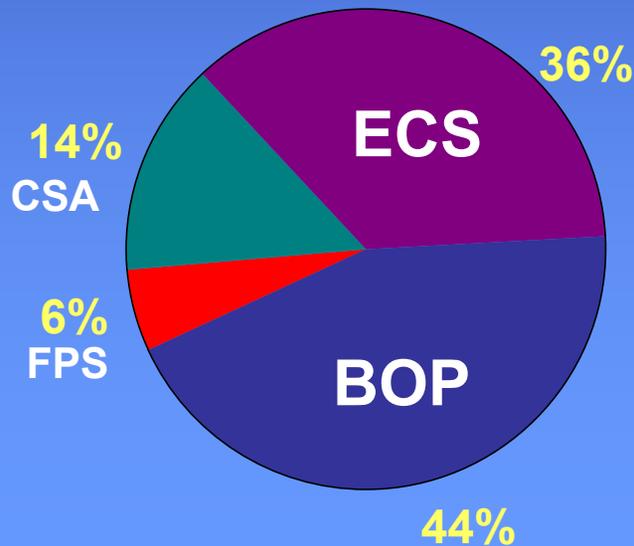
Efficiency



PPT02566
R010910

Next Generation Series 300

- Focus on Fuel Processor System (FPS) technology, catalyst development
- Start time
- FPS volume
- Two step approach, Integrated FPS (FP1) and Integrated power plant (PP1R)



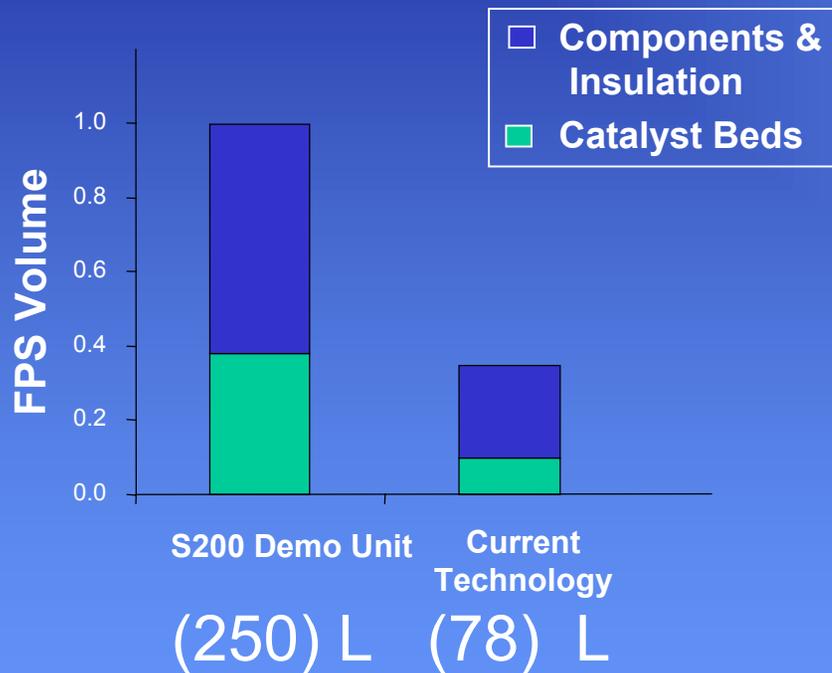
FP1



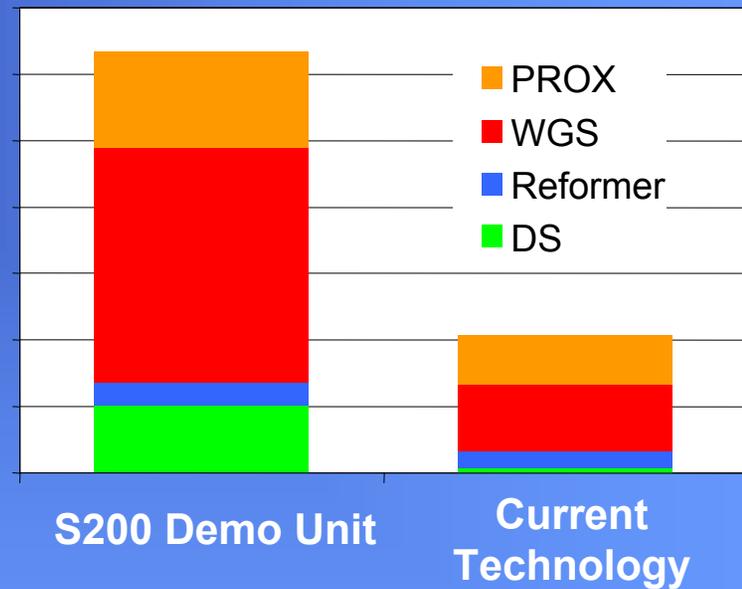
FPS

Improvements in FPS Volume

Component Volume



Catalyst Volume

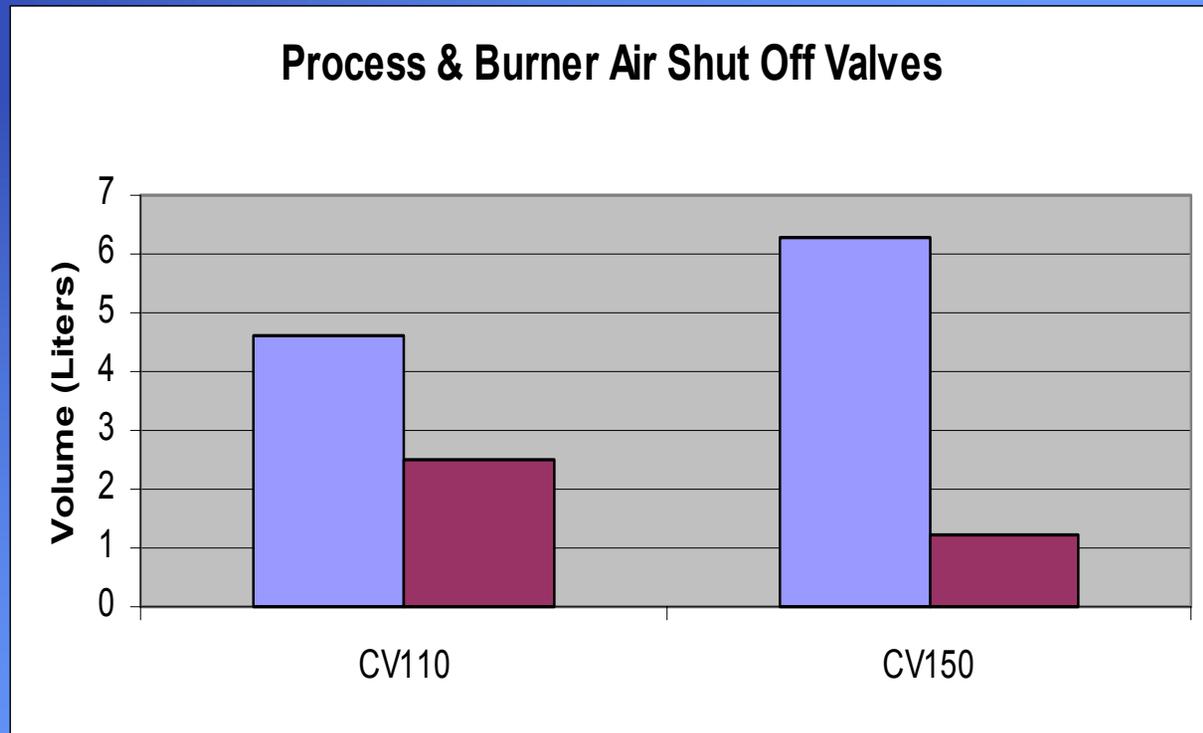


CPO Based FPS

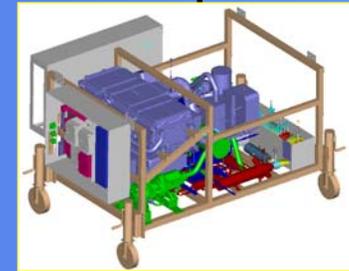
- Benefits
 - No steam generator (smaller)
 - Fuel flexibility (Low sulfur gasoline, naphtha, diesel, F-T diesel, CNG, ethanol...)
 - Reformer durability on CA RFG II / III gasoline (desulfurized by UTC FC)
 - Faster start (lower mass) than ATR
- Start Time: 10 sec CPO, ~ 5 min FPS
- Volume: 78L Packaged (150 kW H₂)
- Emissions: SULEV
- H₂ Production efficiency: 75% FPS, >80% CPO



BOP Volume Reduction Opportunities



Series 300 Schedule



Program Goals

2001

Down select optimum system

2002/2003

FP1-Start Time, Controllability & Volume

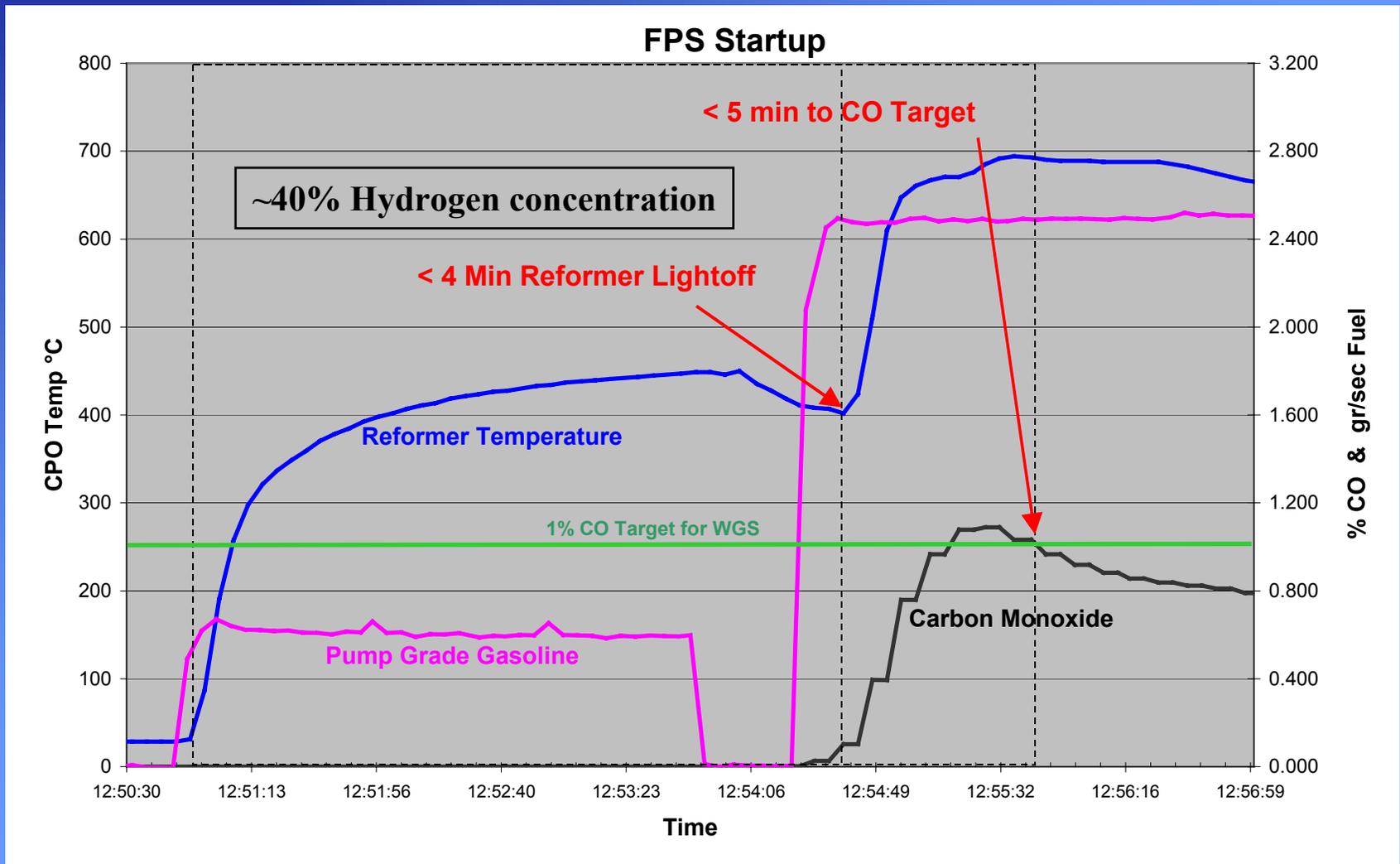
2003/2004

PP1R-Weight & Volume, Start Time
Controllability, Emissions & Efficiency

Summary of FP1 Performance Data vs. Target

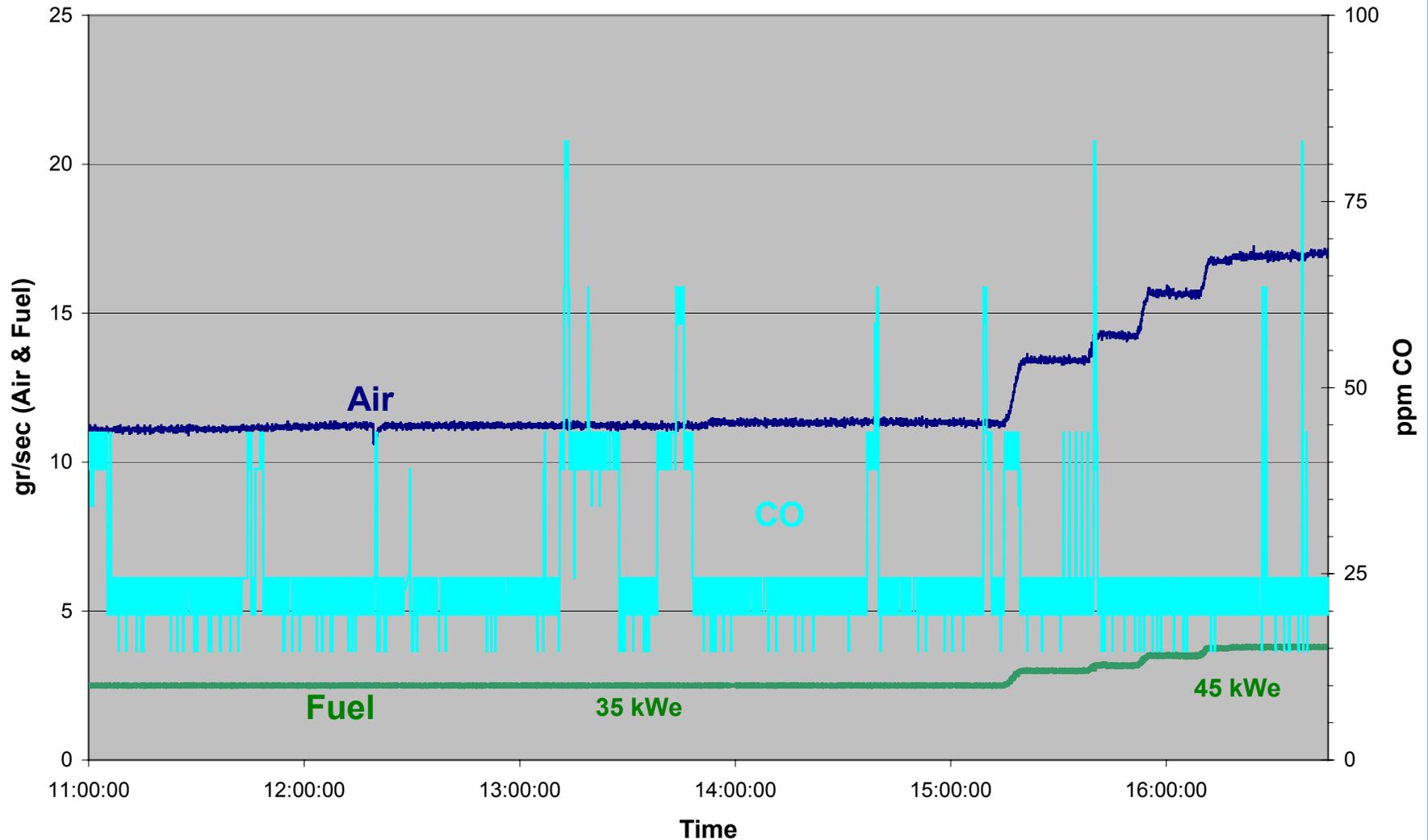
	<u>Target</u>	<u>Test Data</u>
• FPS Volume, liters	75	78
• Heat up time, s	165	290
• Transient (s for 20-90%)	10	200 (prelim)
• Number of start/stops	500	55
• Duration of operation (total hrs)	2000	150 hrs
– Longest single run, hrs		10 hrs
• Range of equivalent power, kWe	10-50	24-45
• LHV efficiency, % at rated	≥75	TBD
• LHV efficiency, % below rated	≥70	TBD
• Emissions (ppmvw)		
– Start (NMHC, CO, NOx)	< 34, 1791, 21	TBD
– Run (NMHC, CO, NOx, CH4)	< 22, 15, 1.6, 700	TBD
– Transient (CO, NH4, Aromatics)	< 100	TBD

FP1 Startup Data



FP1 CO Data

Stable CO Below 25ppm at FPS Exit



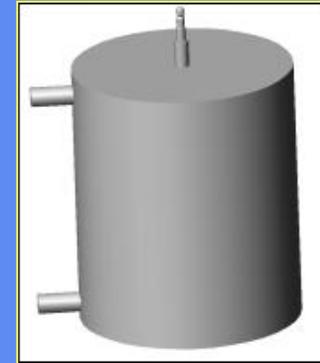
Fuel Cell Power System for Transportation – Gasoline Reformer



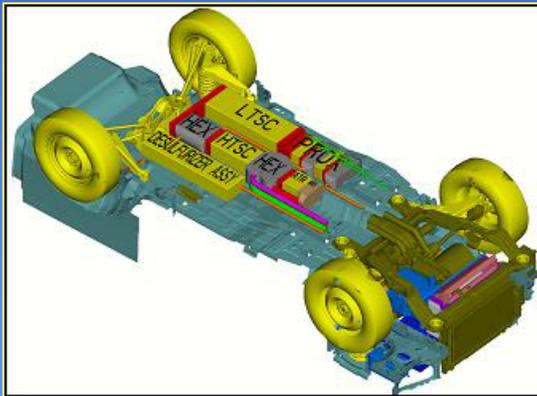
ATR



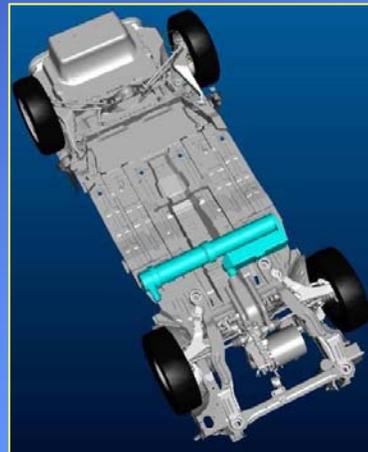
Current FPS



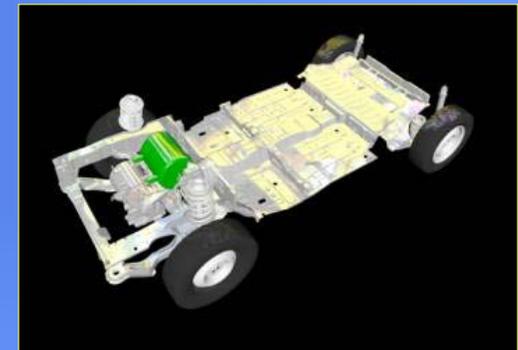
Next generation FPS



- 250 L
- 45 min start



- 78 L
- 4 min start



Goal

- 35 L
- 30 sec start

Summary

- Encouraging results achieved to date
- Complete testing of FP1 to document baseline
- Build FP1 into full power plant with UTC FC PEM Fuel Cell
- Test Power Plant

For More Information

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