

Advancing Solid Oxide Fuel Cells at Acumentrics

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HRD41-1
2009 Fuel Cell Seminar

Outline

- **Acumentrics Background**
- Increasing the operational envelope
- Consortium update
- Conclusions

Acumentrics Corporation

Strategic Partners

GENERAL DYNAMICS
Strength on Your Side™



- *Based in Westwood, MA*
- *~40,000 sq. ft facility*
- *Profitable*
- *Critical disciplines in-house*

Electrical Engineering
Mechanical Engineering
Chemical Engineering
Thermal Modeling
Ceramics Processing
Manufacturing
Sales & Marketing
Automation
Finance

Acumentrics Power Conversion Technology

ACG2500 RUPS

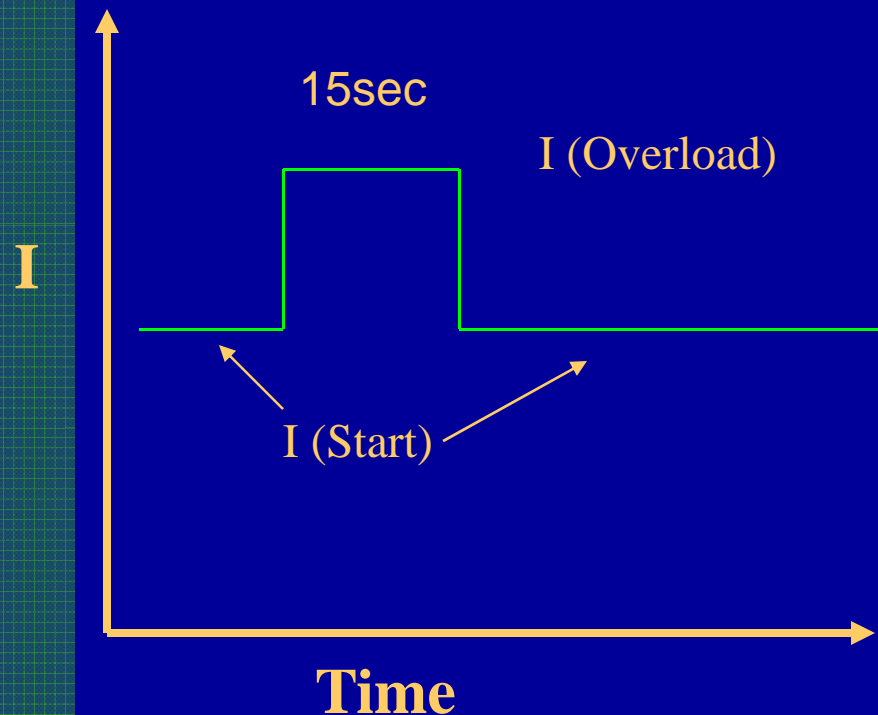
- Output: 115VAC, 60Hz;
2500VA / 2000 Watt
- Universal AC Input: 80VAC-
265VAC, 47Hz-400Hz
- External 28VDC input
- 15 minute battery back-up
- Parallel operation increases
power
- MIL-STD 810F Power –
Combat Proven



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New Testing Techniques

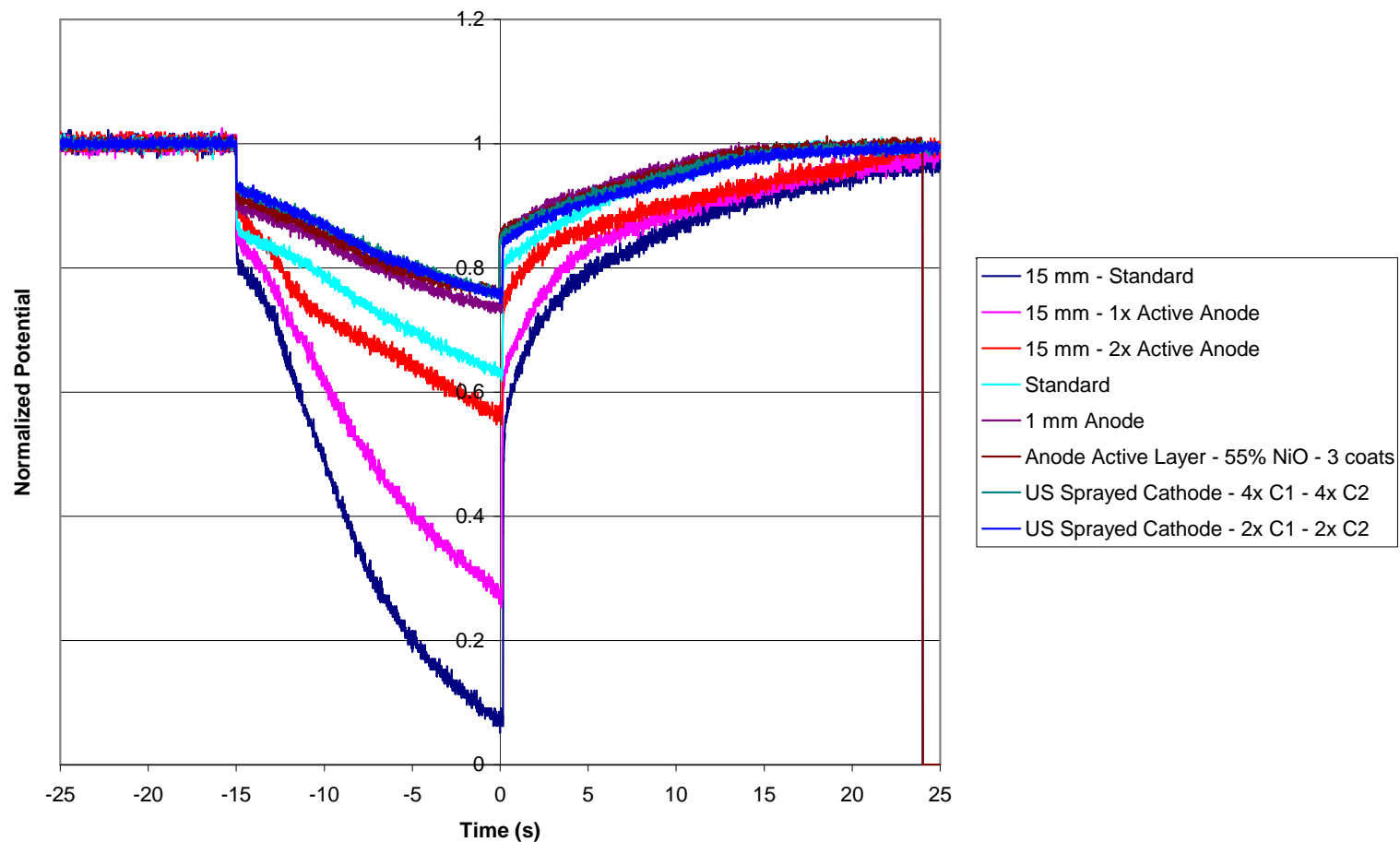


Current Overload	Fuel Utilization
33%	100%
50%	113%
66%	125%
83%	138%
100%	150%

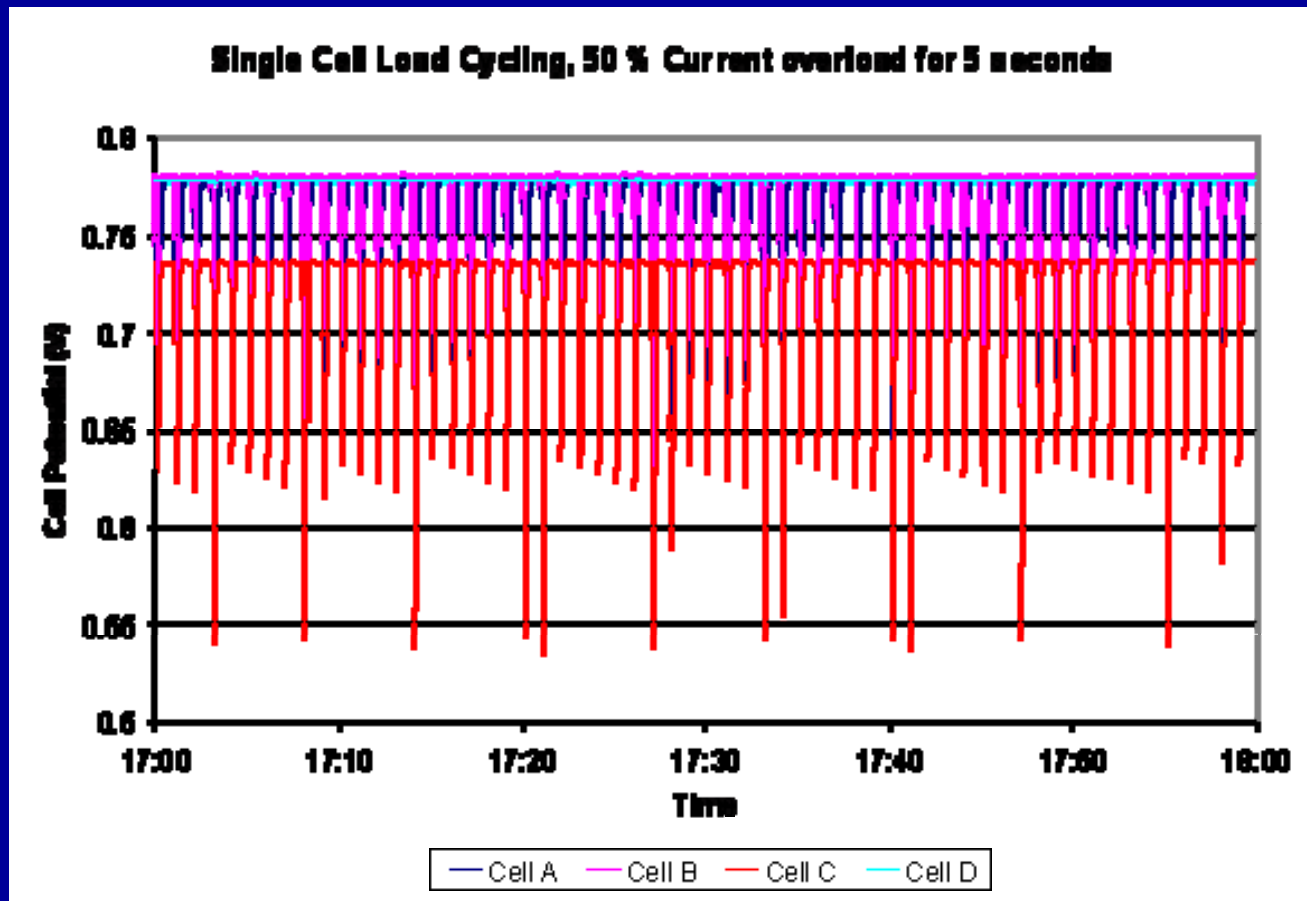
At a set fuel flow, the current is increased and then returned to the initial value
No other parameter is modified

Results with Current Overload

66% Current Overloads, Normalized



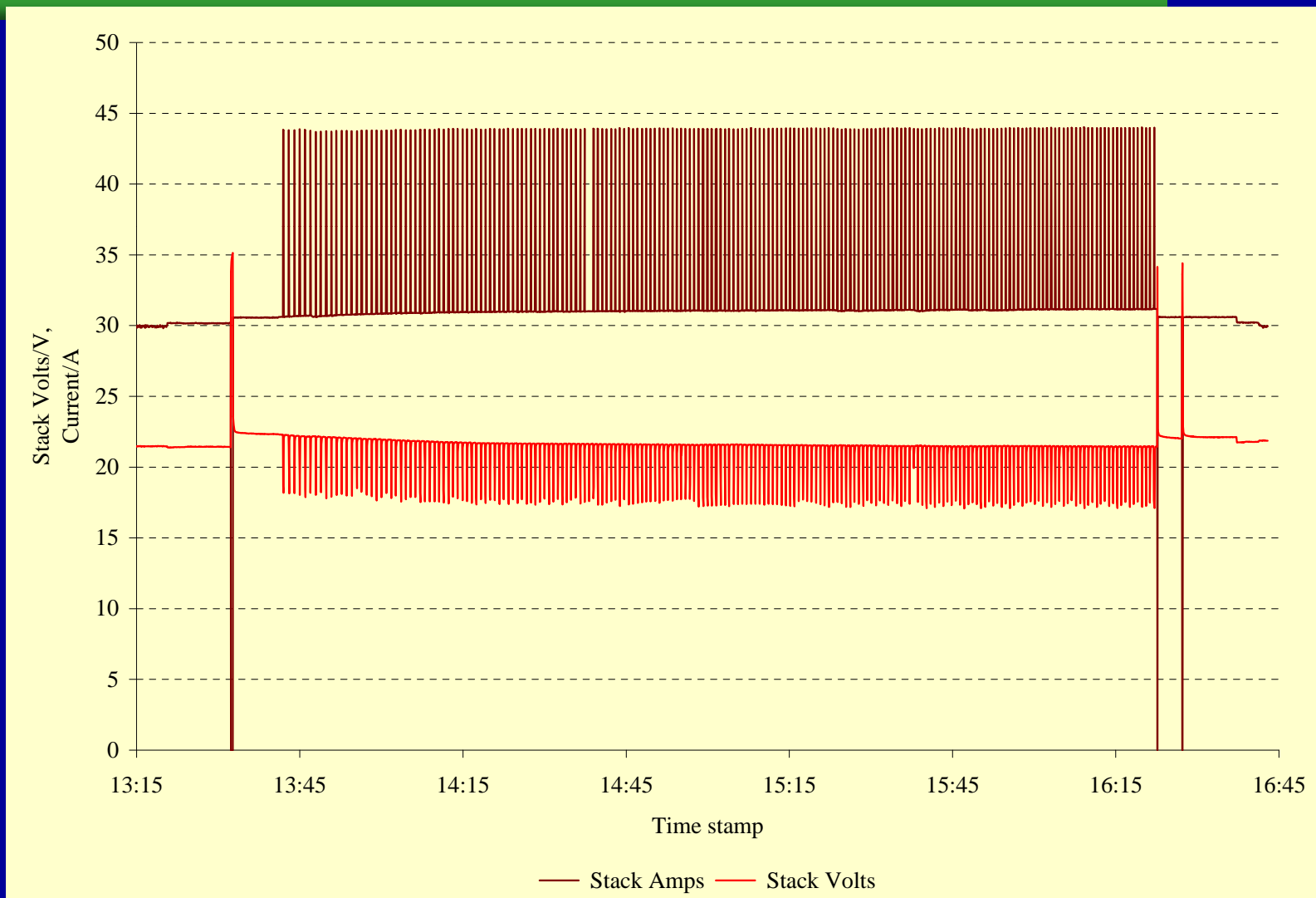
1000x Load Cycling



1000 50% Current Overload Cycles on 4 Single Cells



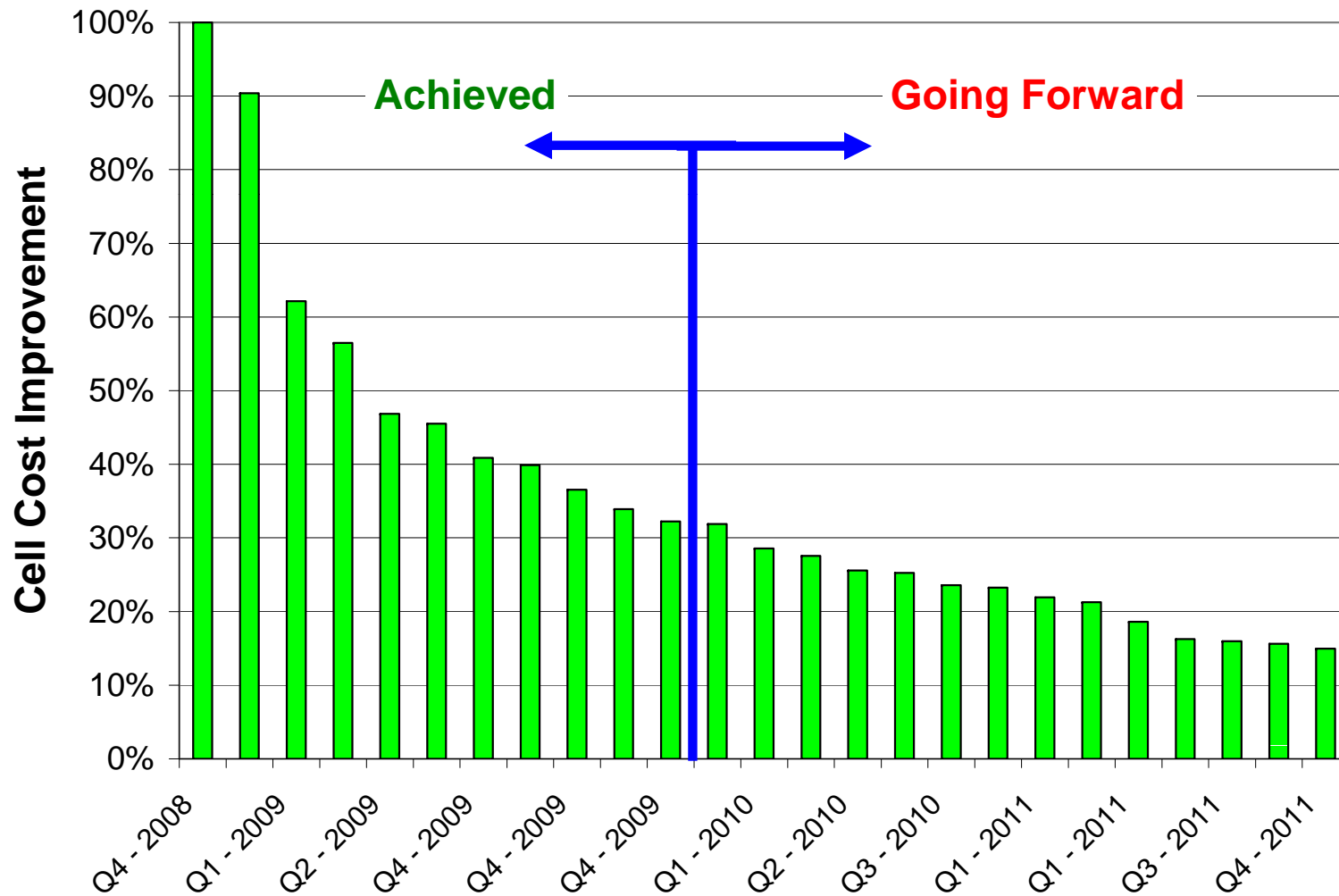
200 Stack Current Overload Cycles



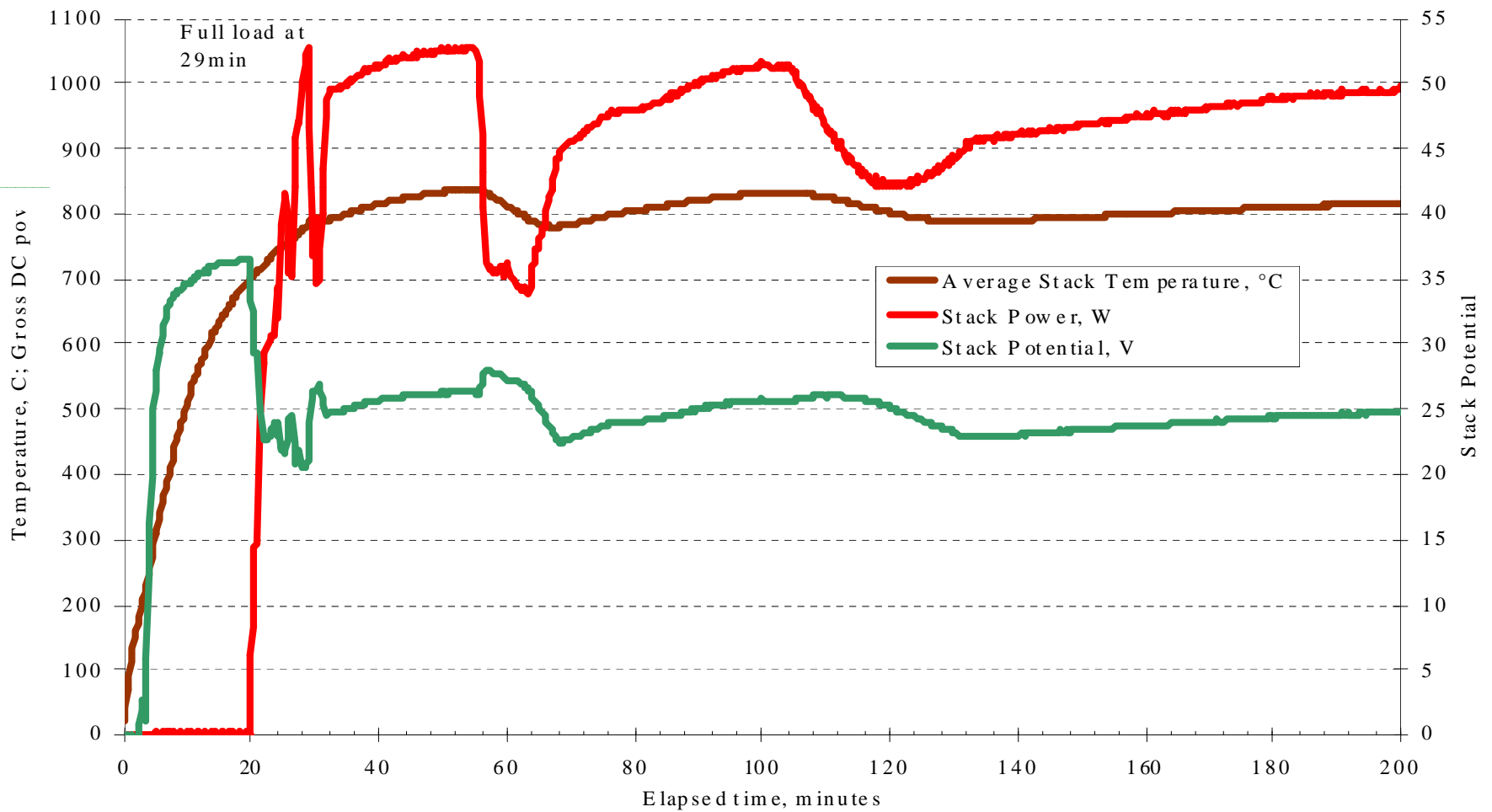
Cycling Summary

- >35 different single cells have been current cycled to 100% FU or greater
 - Of those, >15 different single cells have been current cycled to at least 150% FU
- FU has been pushed as high as 200% (current overload of 266% from baseline of 75% FU)
- Stacks have been cycled 200 times without effect

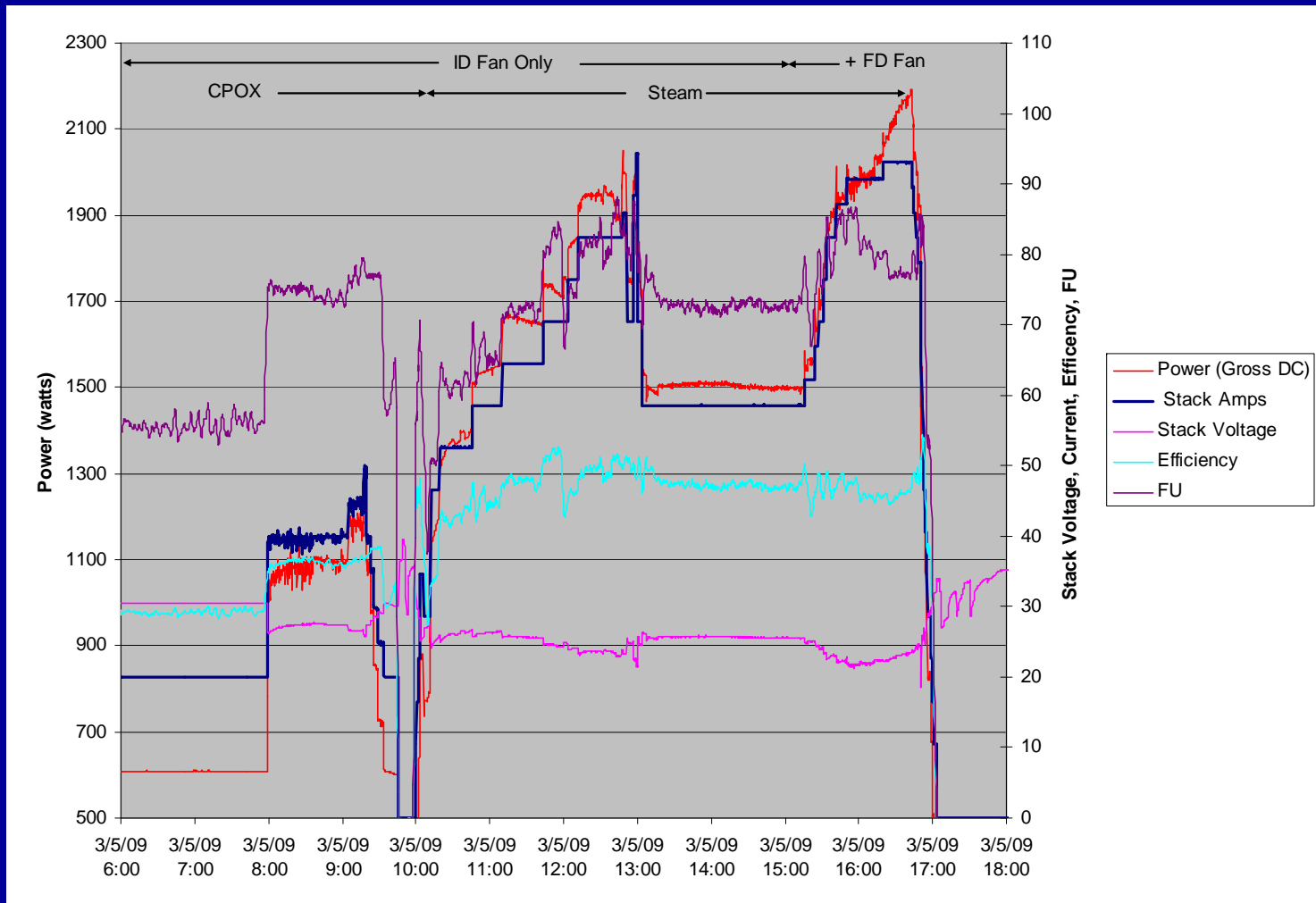
Cell Cost Improvements



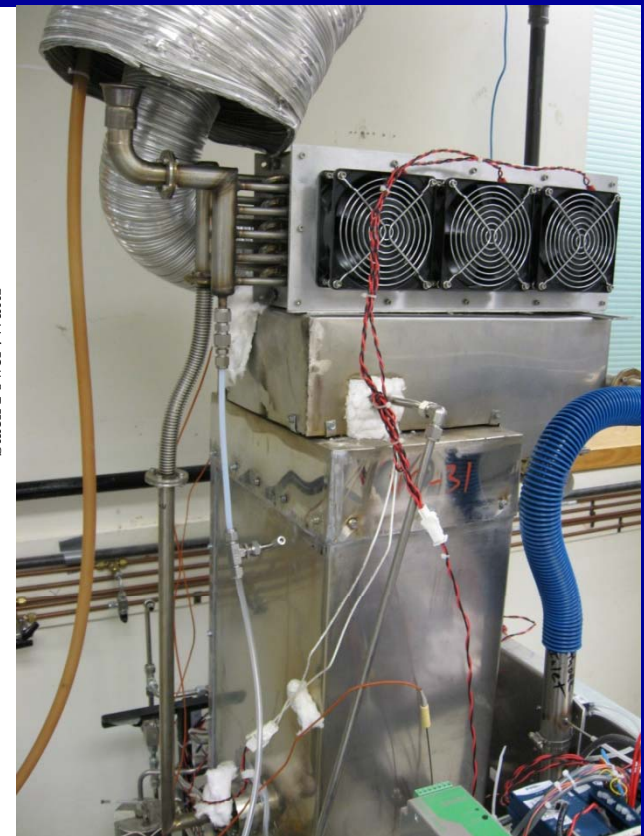
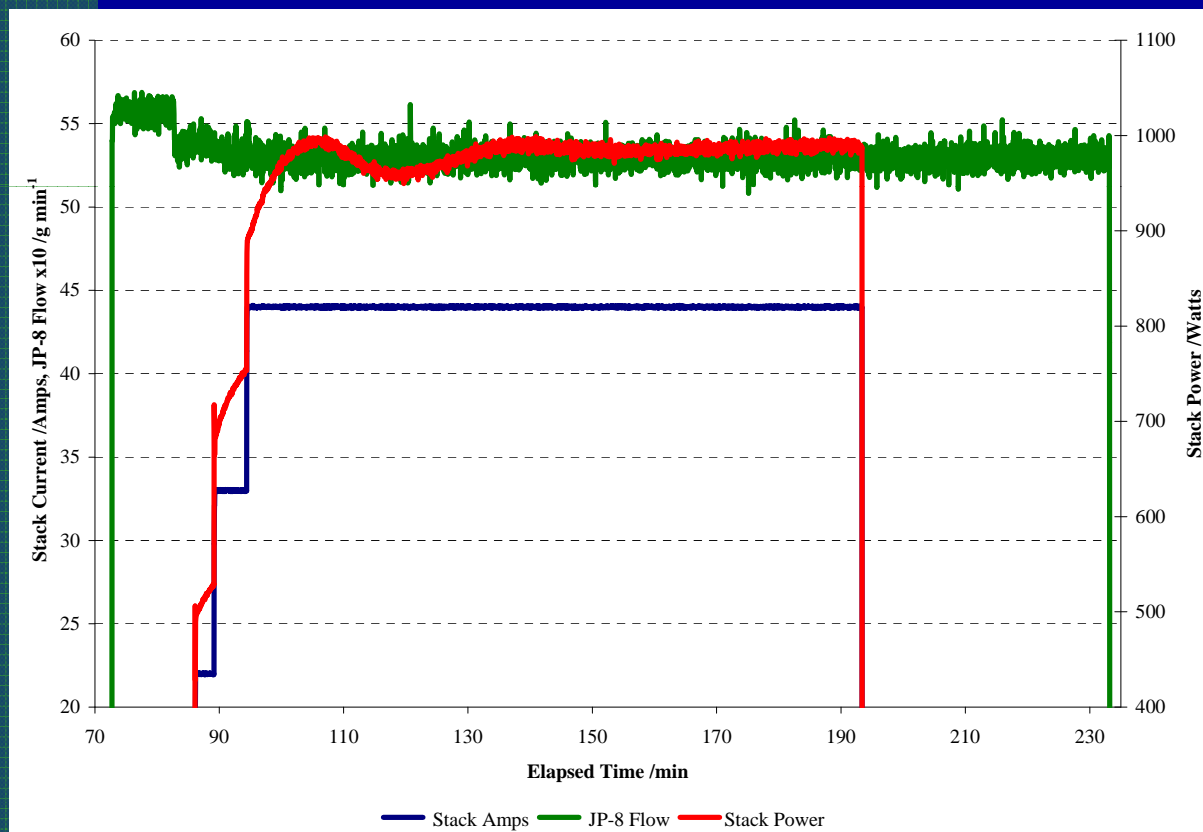
Fast Startup



Increased system power

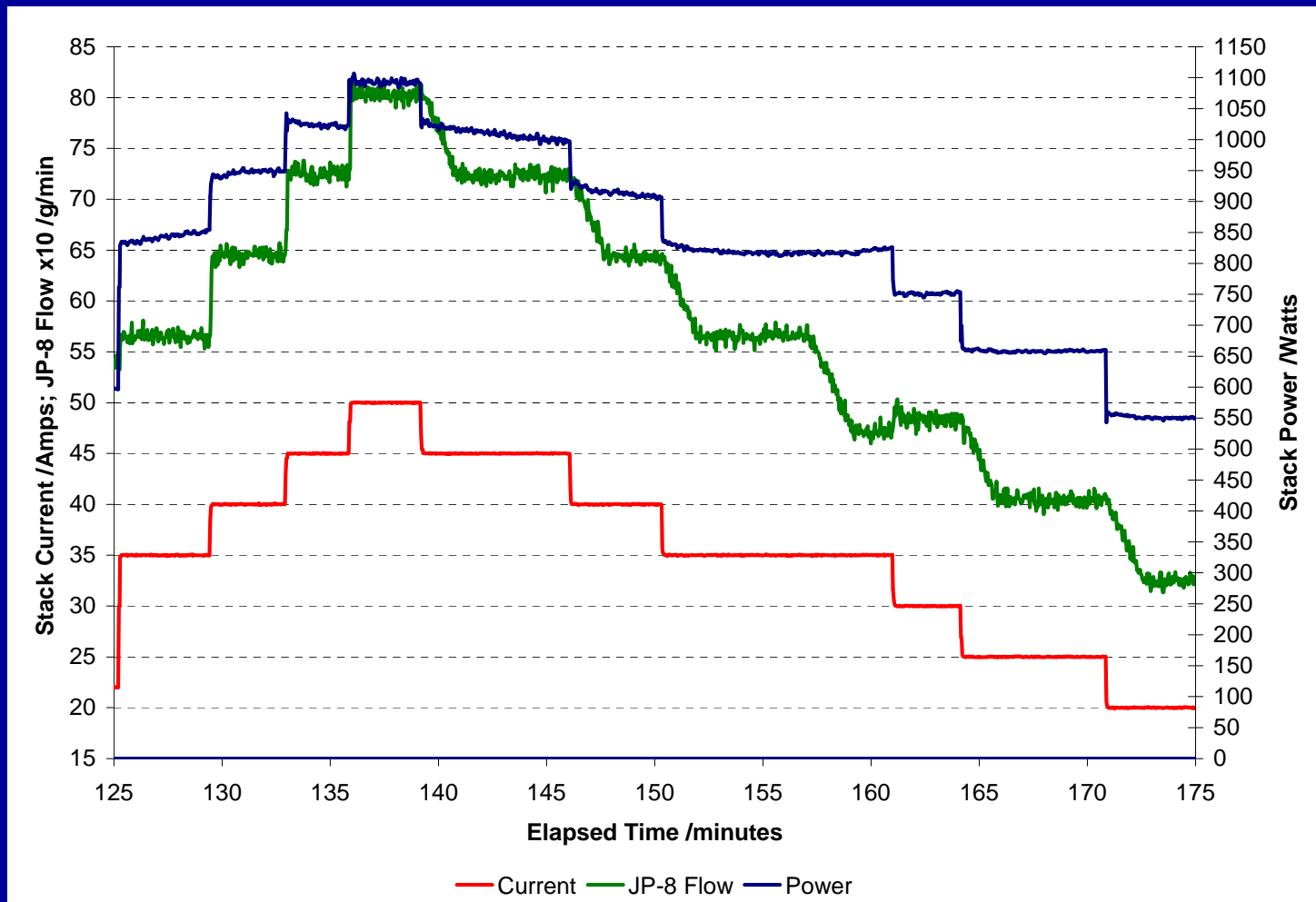


JP-8 280ppm S test with condensed water recovery

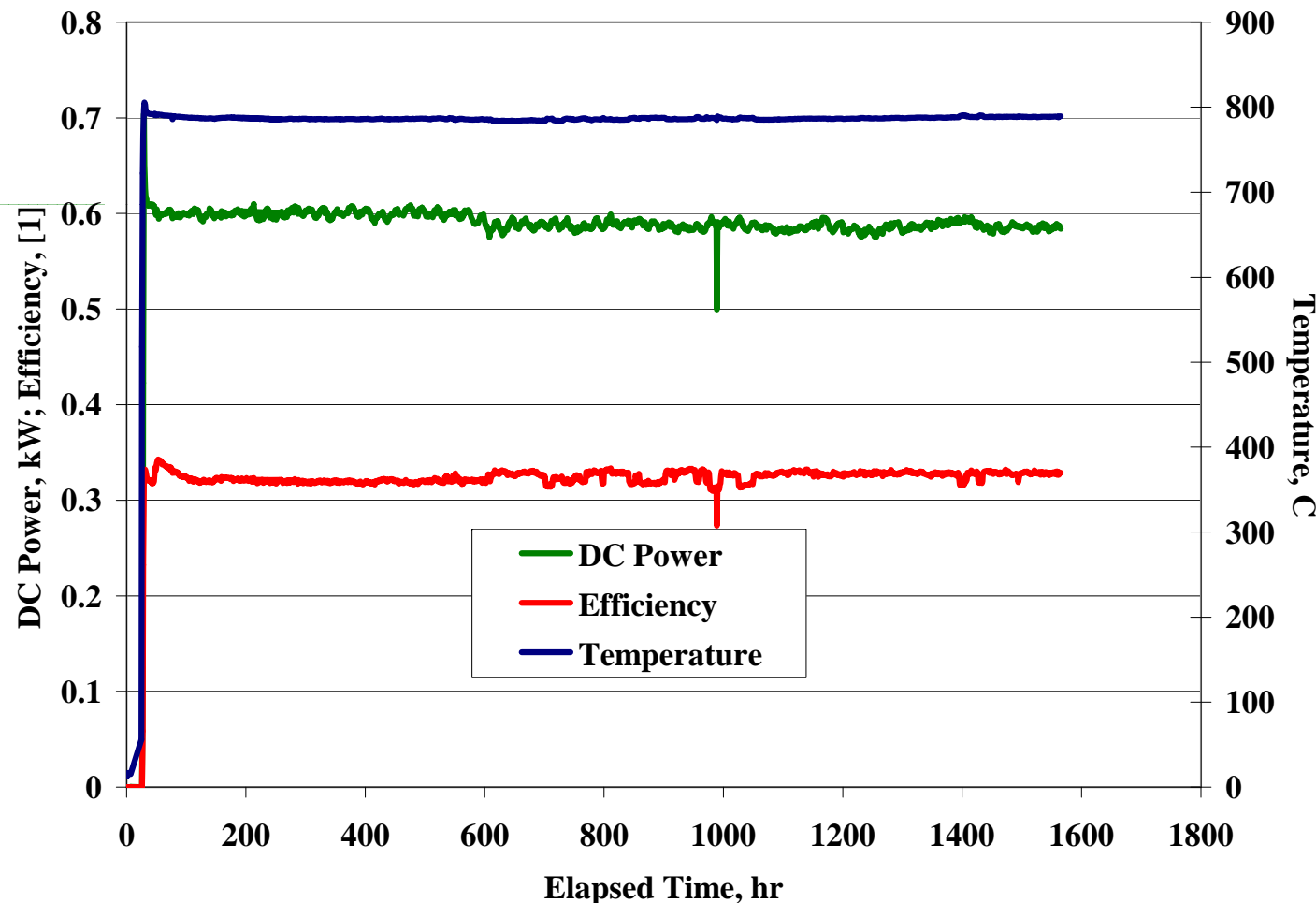


**94% water recovery,
150% of requirements**

Load Following on Liquid Fuels



Goal: 1500hr operation with
<1%/500hr degradation rate



Setup:

1kW nominal
-Previously had
~473hrs
operation
-Hour-averaged
data shown

Run:

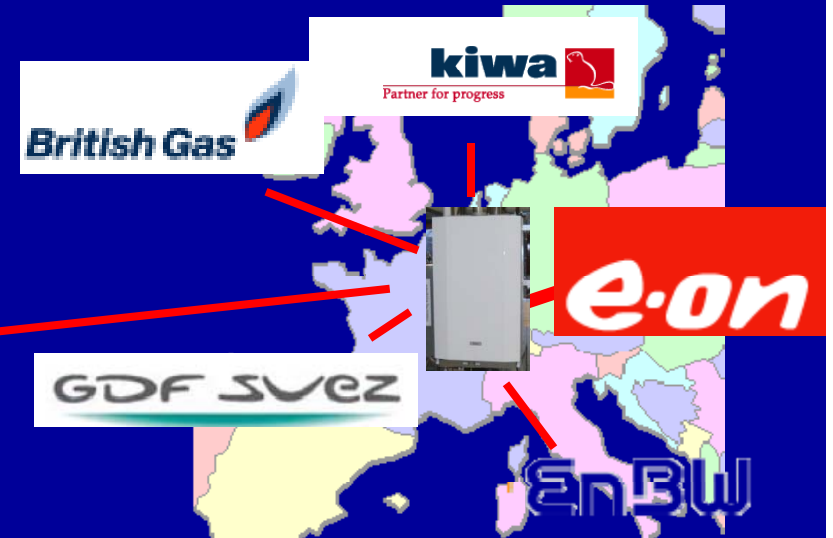
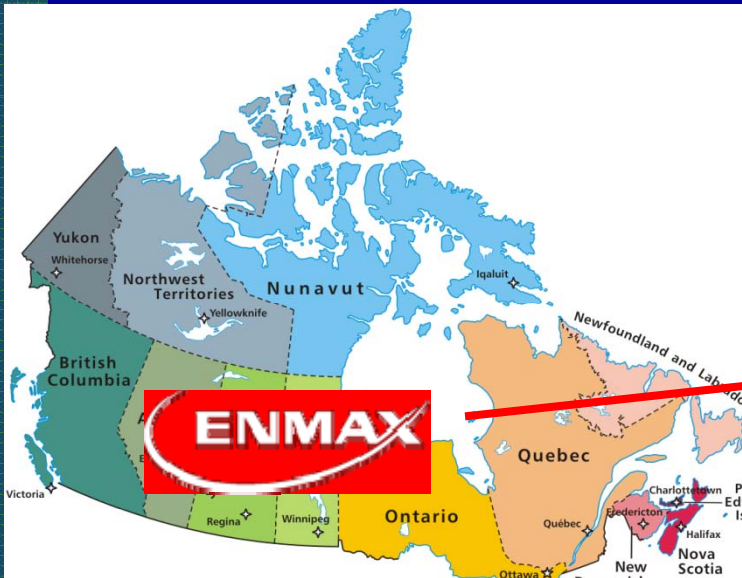
O/C=1.4
FU=65%

0.9%/1000hr
(0.7%/1000hr
counting
starting hours)

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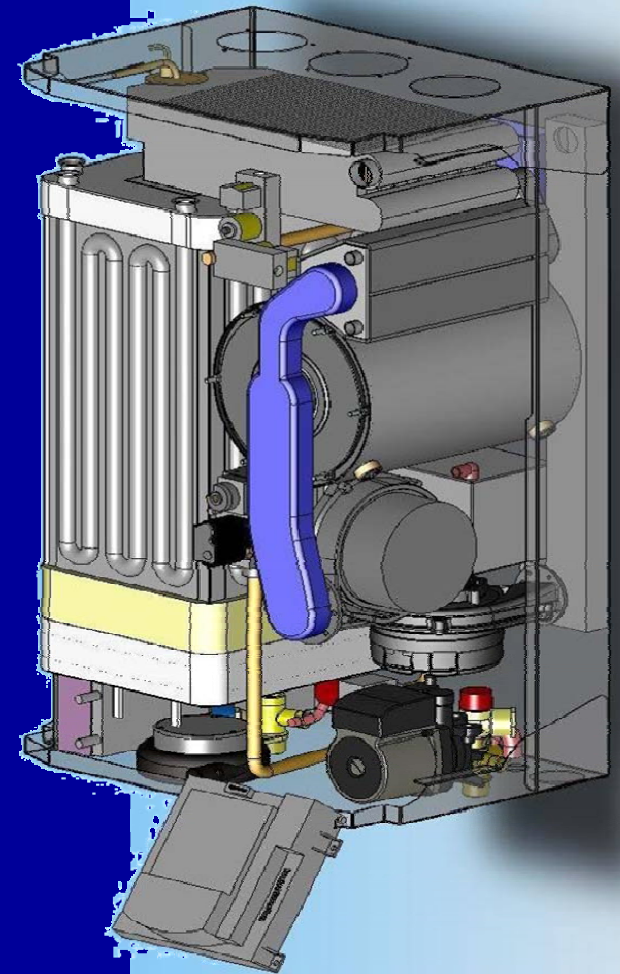
Consortium Members



CHP Appliance



- Wall-mount design for apartments and condos; larger floor mounted design
- Tankless water heater
- Incidental power while heating
- Easy on-off
- Multiple prototypes delivered



Status

HEA 102 Status

- Unit started June 2nd
- Steady State Operation – 4200 hrs continuous
- Efficiency 32.3% Gross DC
- Load Cycling Initiated
- No Thermal Cycles

HEA 101 Status

- Unit started June 19th
- Accumulated Operation – 3900 hrs
- With peak burner 25 kW; 90% Thermal Efficiency
- Thermal cycles started; 5 cycles completed so far

Near Term Activities

- Continue power cycling of HEA 102
- Continue thermal cycling of HEA 101
- Build HEA 103

- Testing at partner sites

Conclusions

- Acumentrics has continued to extend the operating envelope of its cells, and more importantly, generators
- Consortium testing is now ongoing and will continue through next year, evaluating the combined heat and power system
- Short term system degradation appears to be well within the envelope required for cost-effective operation.
- Moving forward, the challenge is the incorporation of the lessons learned and system capabilities.

Acknowledgements

- EERE
- ONR
- Consortium Members
- Acumentrics Team