



 **ENERFUEL**TM

High Temperature PEM
Fuel Cell Stacks and System

- Who is EnerFuel?
- History
- Technological Accomplishments

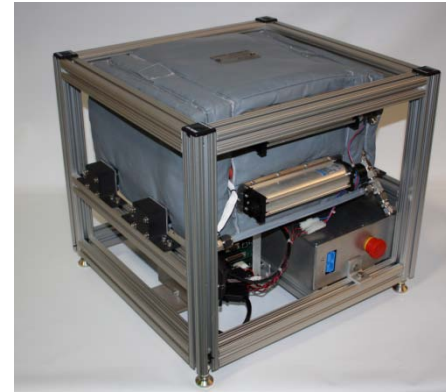


Recently Completed Programs

2008 Gen1 FCRE Demo Vehicle



2010 Gen2 Power Module



2010 Gen2.0 FCRE Demo Vehicle



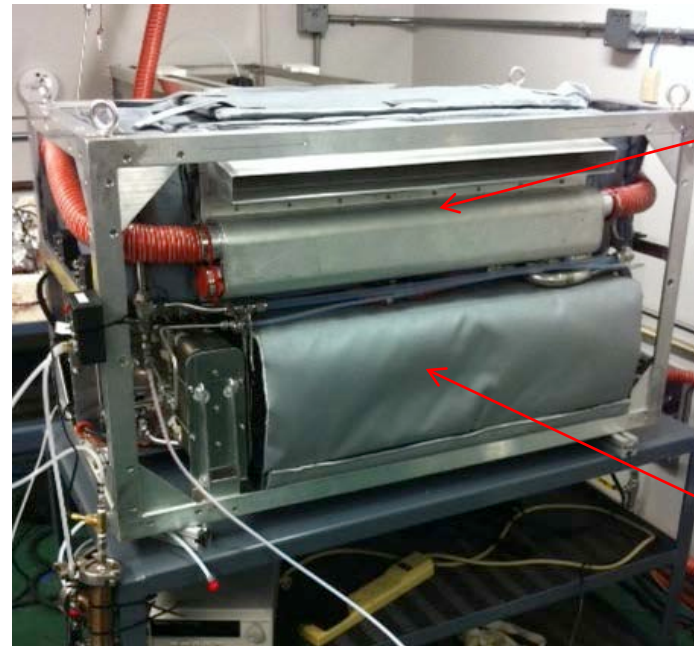
2011 Gen2.1 Ethanol Power Module



3kW Ethanol APU Range Extender



Electronics and ancillary components



Fuel cell stack

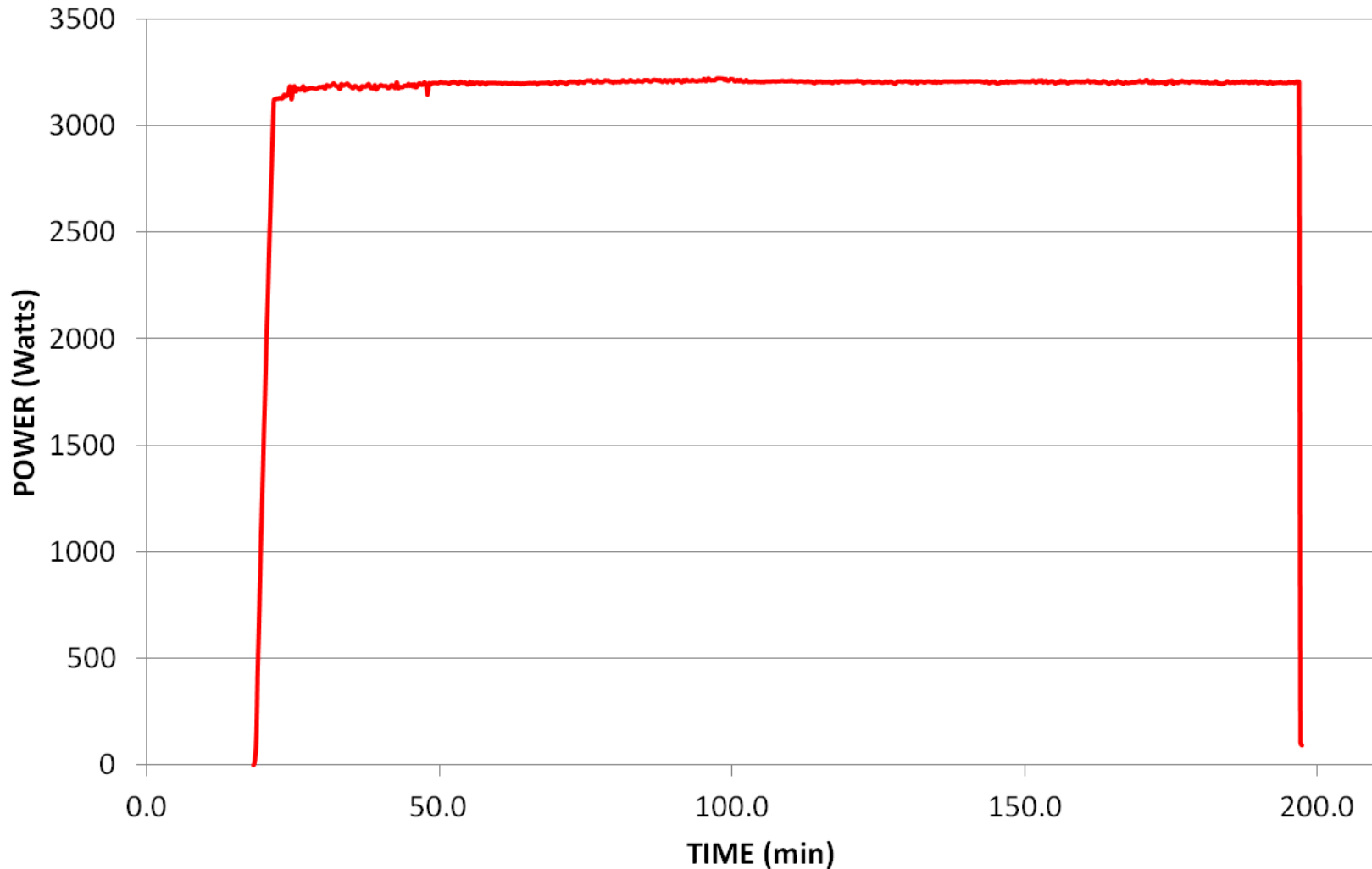
Fuel processor



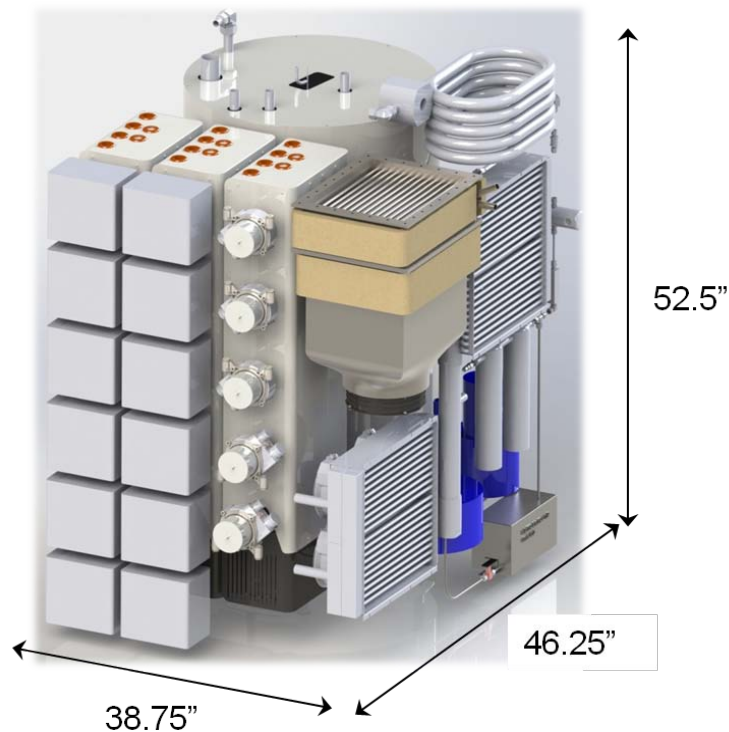
3kW Ethanol APU Range Extender

3kW APU Stack Performance @80% Power on Reformate

Nov. 22, 2011 Test Run



10kW Bio-Diesel Power Unit



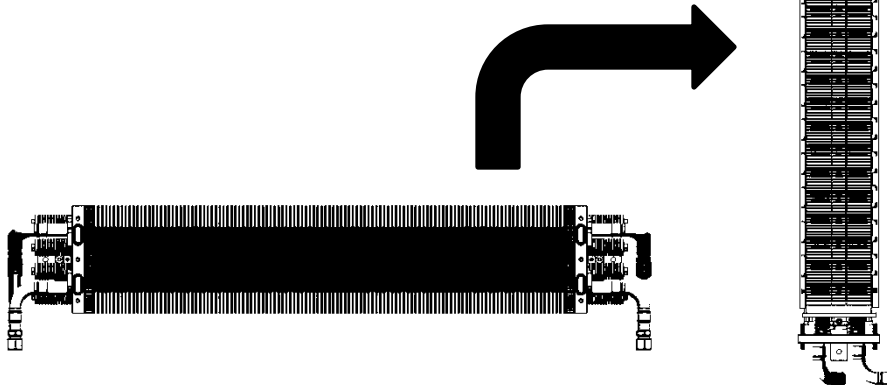
Description	Estimated Specification
Application:	Combine heat and power (CHP)
Power output range:	5-10 kW _{net}
Fuel cell type	Three, liquid cooled 4.2kW _{gross} HT-PEMFC stacks
Fuel processing	Steam reforming
Fuel/Feed:	Bio-Jet A Fuel (Bio-SPK)
SPU startup time to achieve rated output:	30 min
Useable heat output:	10 kW @115C
Weight:	500kg
Volume:	1540L



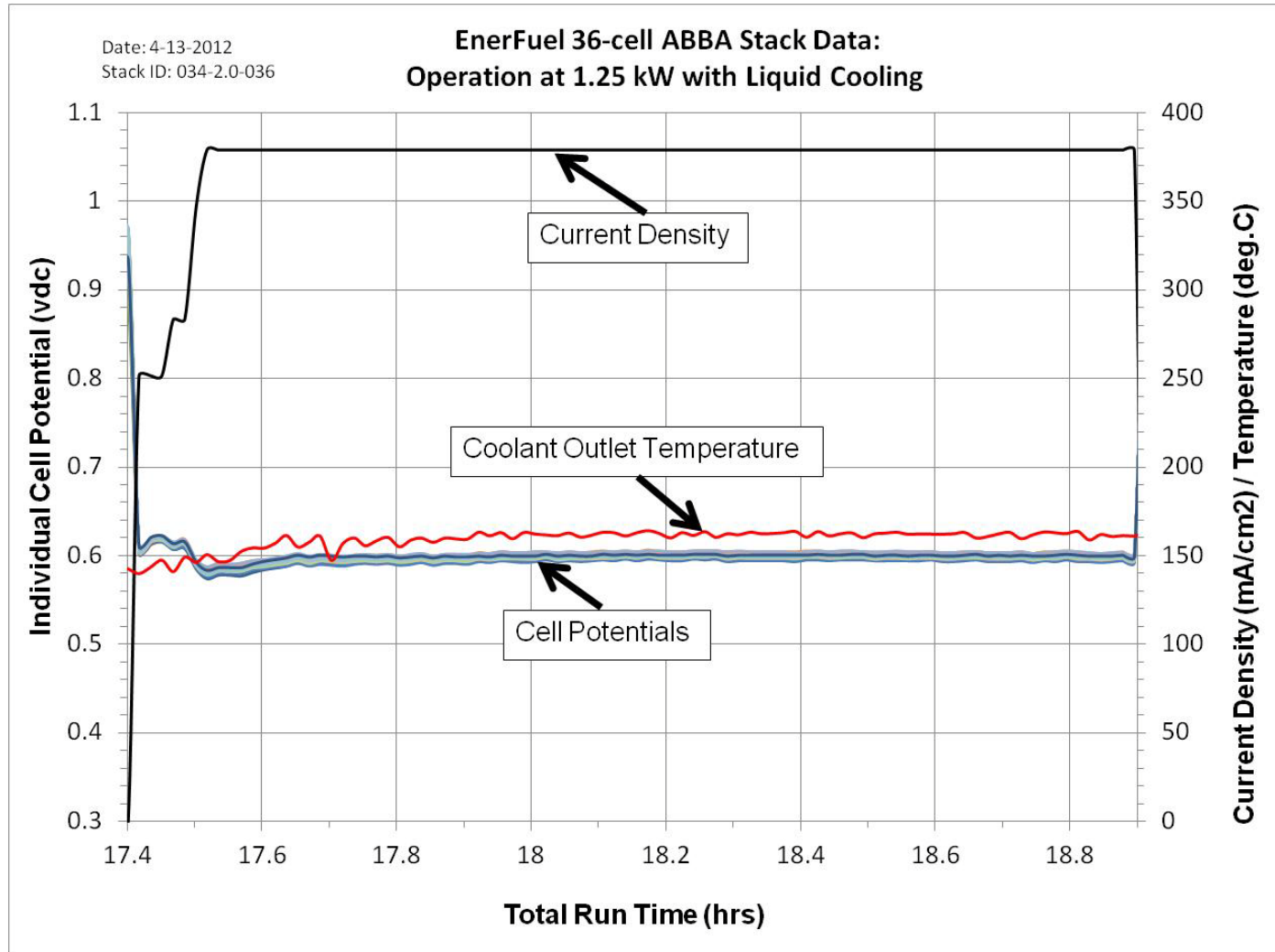
36-cell Stack Characteristics

- Liquid cooled
- Coolant exit temperature ~160 deg.C
- Nominal power 1.3 kW @ 60 A
- Max power 2.0 kW @ 100 A
- Max. Cell voltage variation <10 mV @ 60 A
- Cell temperature variation ~10 deg.C

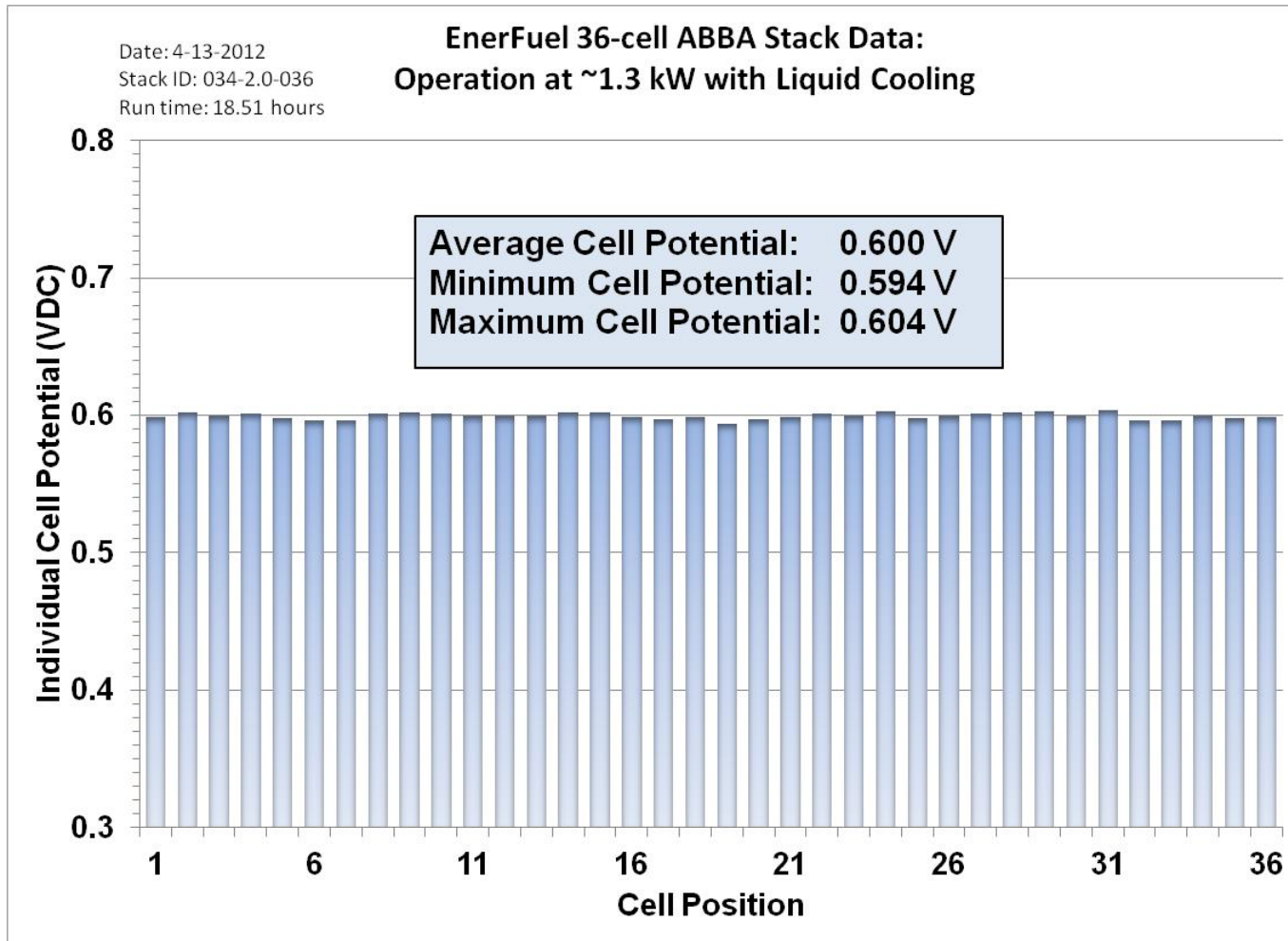
Gen 2.1 to Gen 2.2



36-cell Stack Test Results



36-cell Stack Cell Voltages

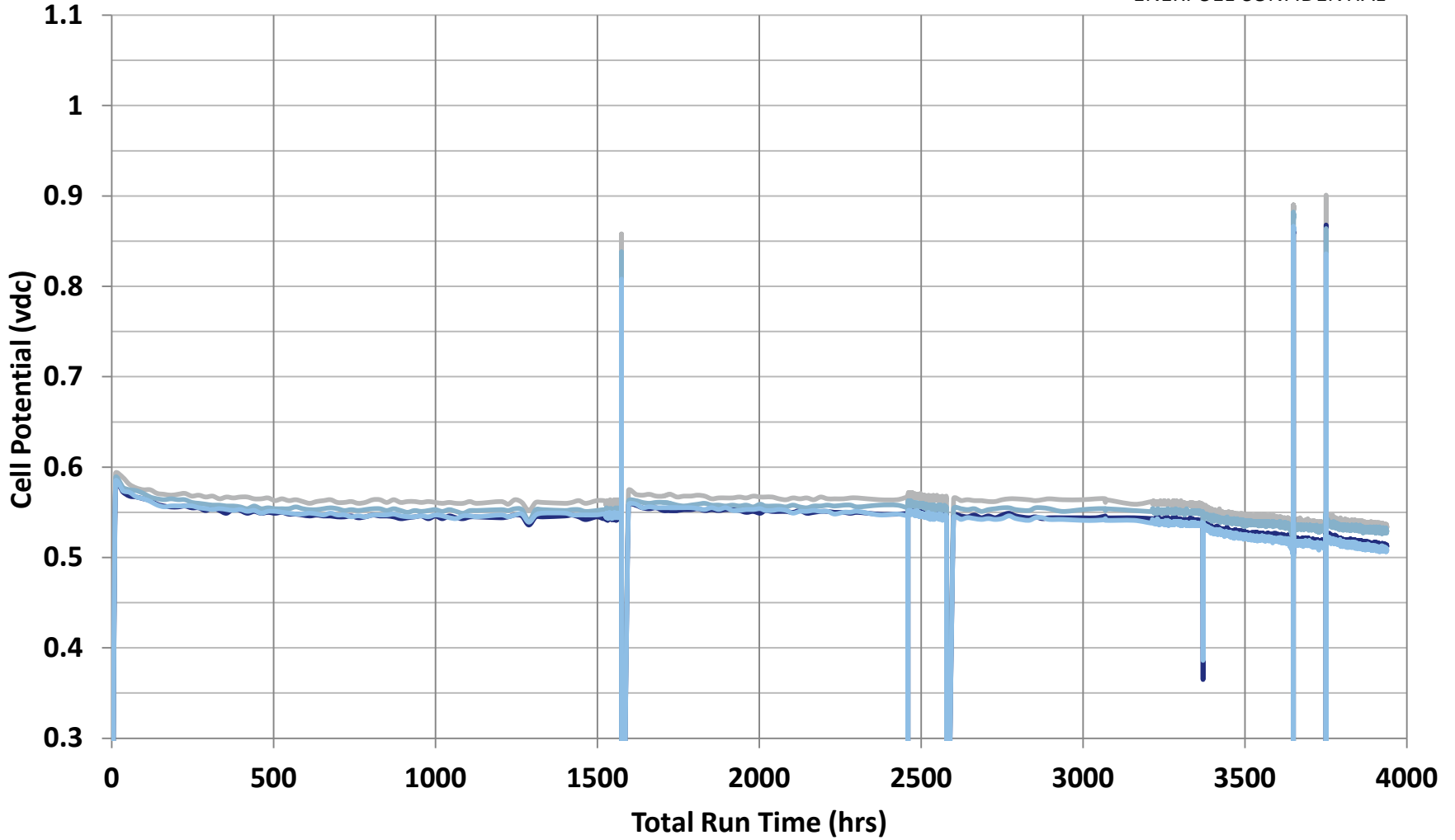


157-030-004 Hydrogen Durability Test Chart 1 of 4

Cell Voltage, Current & Power Over-Time @150 deg.C

Start Date: 10-12-2011 TS#4

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— V1

— V2

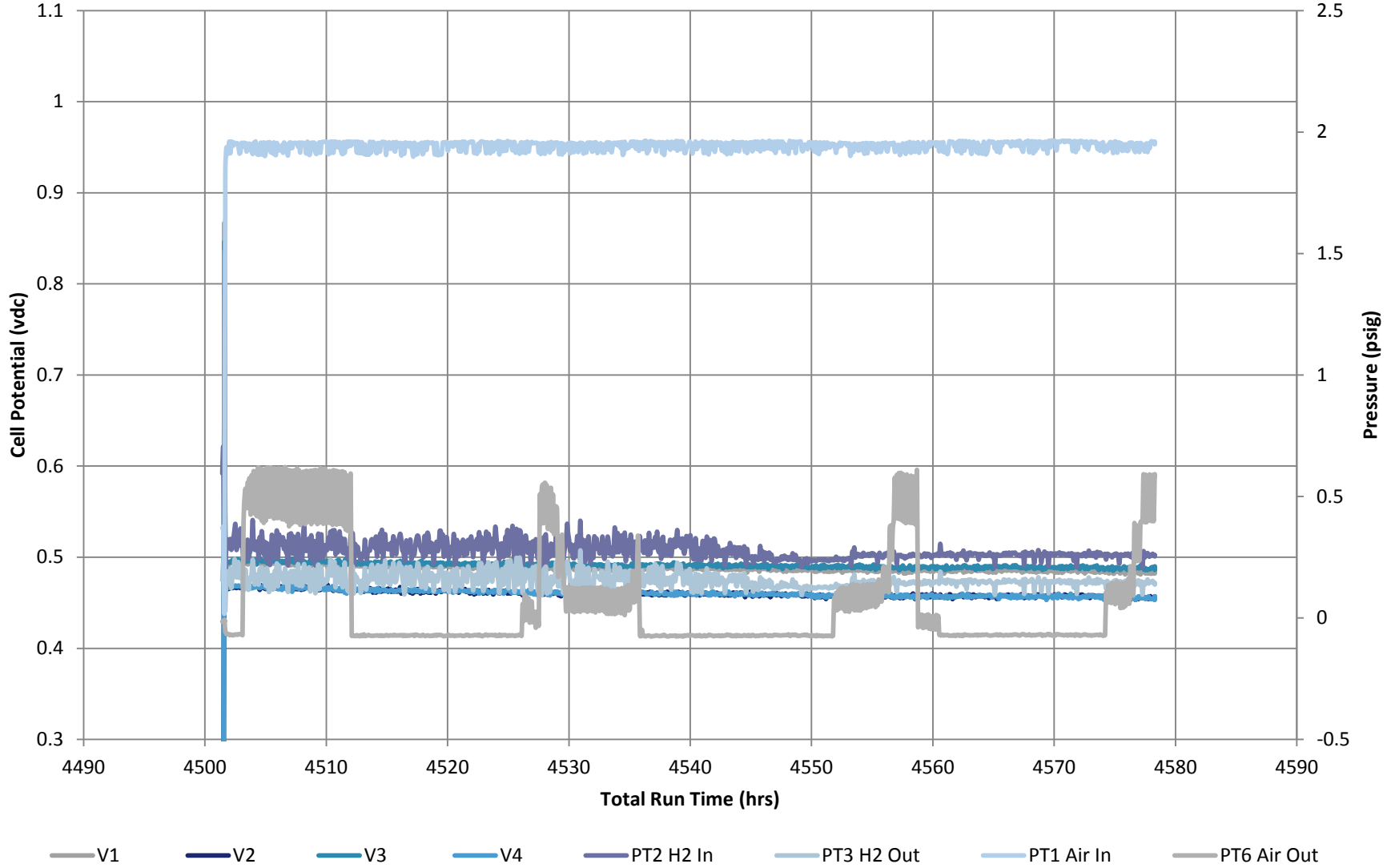
— V3

— V4



030-2.0-004 Hydrogen Durability Test

Date: 5/14/12 ts#4



3kW Stationary Power Unit



Description	Target Specification
Application:	mCHP/Back-up
Power output range:	3kW _{net} (continuous) 6kW (up to ½ hour)
Fuel cell type	Liquid cooled 4.2kW _{gross} HT-PEMFC stack
Fuel processing	Steam reforming
Fuel/Feed:	LPG/NG
SPU startup time to achieve rated output:	System instantly capable of meeting the full load
Useable heat output:	3kW @115C
Weight:	<375kg
Volume:	1550L



Thank you

My colleagues at EnerFuel: Daniel Betts, Michel Fuchs, Matt Graham, Vesna Stanic, Walt Pierce, Gaelle Garozzo, Yan Ngu, James Braun, Charlie Malone, Mario Nadal, Casey LaCroix, Marcela Torres, Santiago Bresani, Stephan McQuown, Skip Zabrieski

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