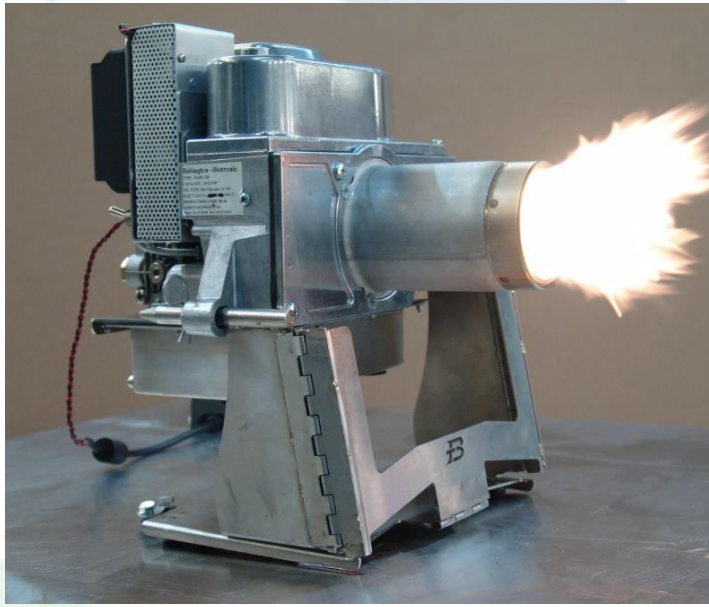
2018 NORA Technical Workshop

April 3 & 4 2019

Babington Burner Company

Reinventing Fire



Andrew Hamer – Chief Engineer
Andy Babington – President

The Product: ***A Computer That Makes Clean Fire***

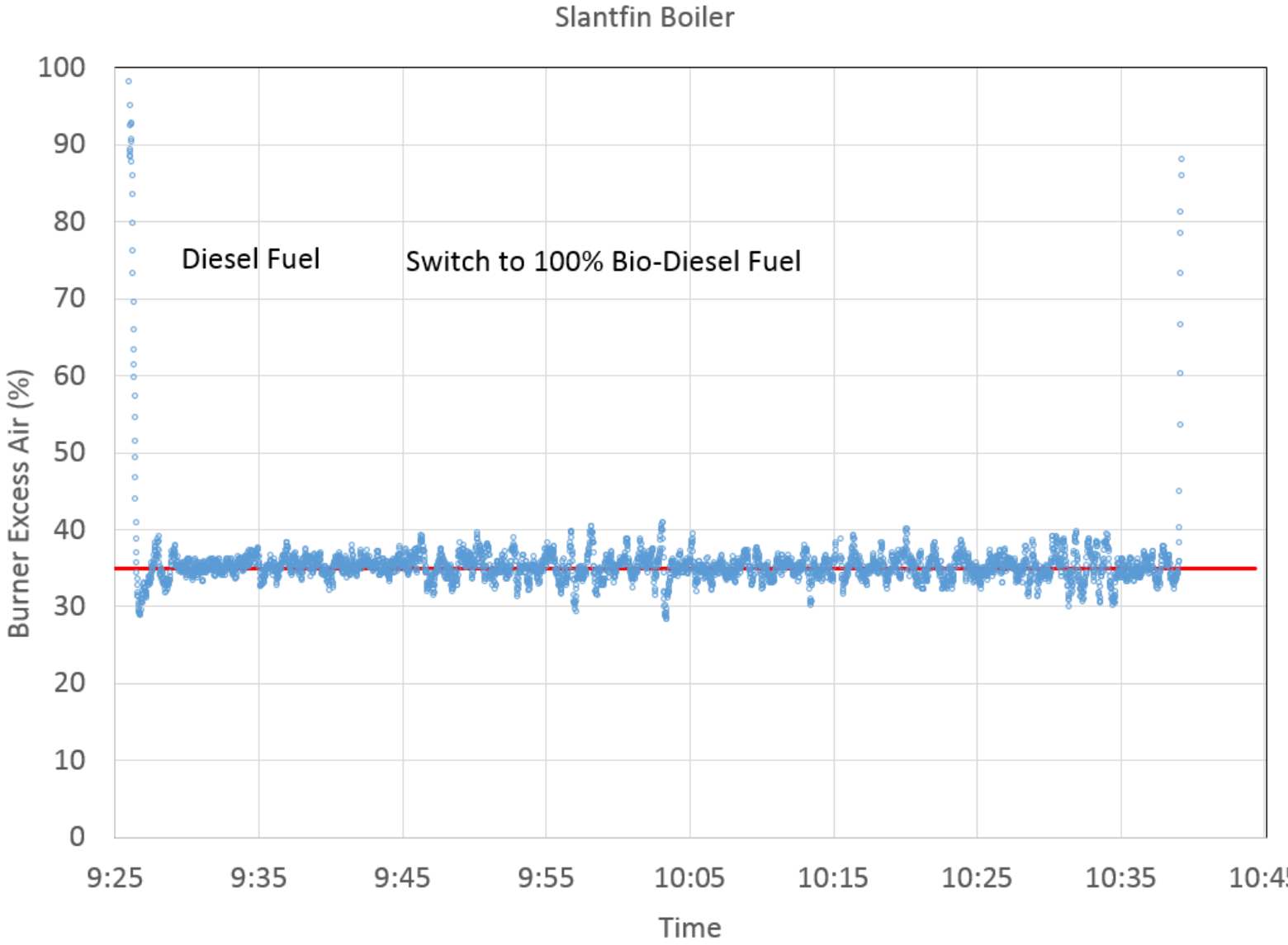
Development Approach: Combine our proven low pressure air-atomizing technology with modern power electronics and intelligent control to enable adaptive multi-fuel heating systems

Product Specs	
High-Efficiency Performance	Ultra-clean combustion, no smoke, odor or CO
Automatic Variable Firing Rate	0.38 to 0.75 GPH (phase 1)
Biodiesel and Multi-Fuel Compatibility	No. 2 oil up to B100 without changing any parts
Self-Tuning via Intelligent Control	Real-time fuel-air adjustments to compensate for changes in excess desired excess air level (or O2 or CO_2)
Plug and Play Replacement	Compatible with existing oil-fired appliances
Internet of Things (IoT) Enabled	Remote operation and performance monitoring w/ trend analytics enables new adaptive BioHeat® appliances

Under the Hood - Intelligent Control

Fuel-Air ratios are controlled by the Babington Controller, i.e. a ***computer that makes fire***. The controller determines the schedule (i.e. specific speeds and durations) for all three motors from pre-purge, ignition, operation, shutdown and post-purge. [Additionally the controller reads Proof of Flame signals and sets ignition time and duration.] Closed loop feedback on the exhaust oxygen level can drive the burner to operate at any user desired excess air level. Closed loop feedback on a water temperature or exhaust temperature can drive the burner to operate an any appropriate firing rate.

Multi-Fuel Capability
Switching From No. 2 to B100 on the fly



Switch fuels during operation from no. 2 fuel oil to bio-diesel

Multi-Fuel Capability
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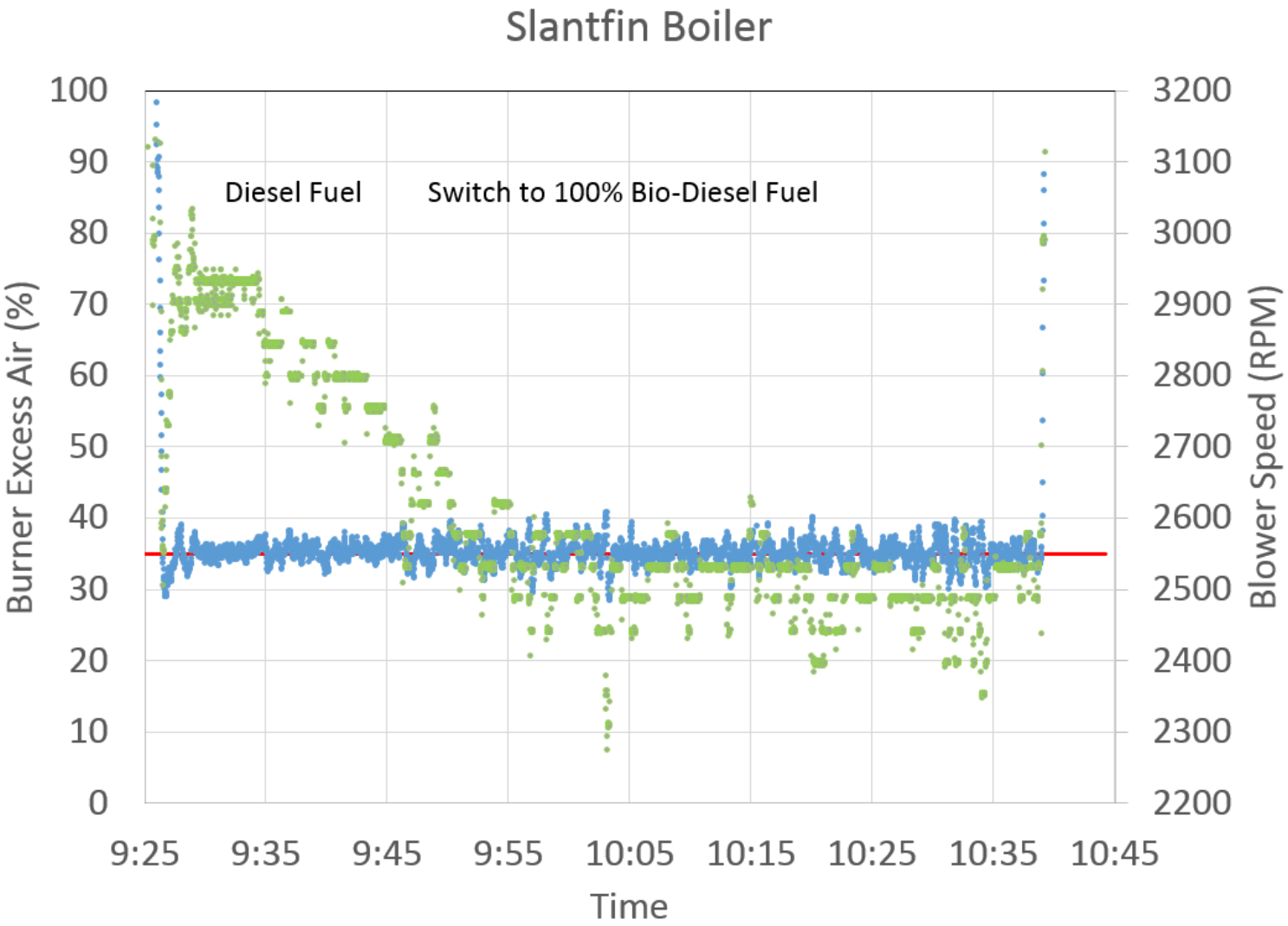
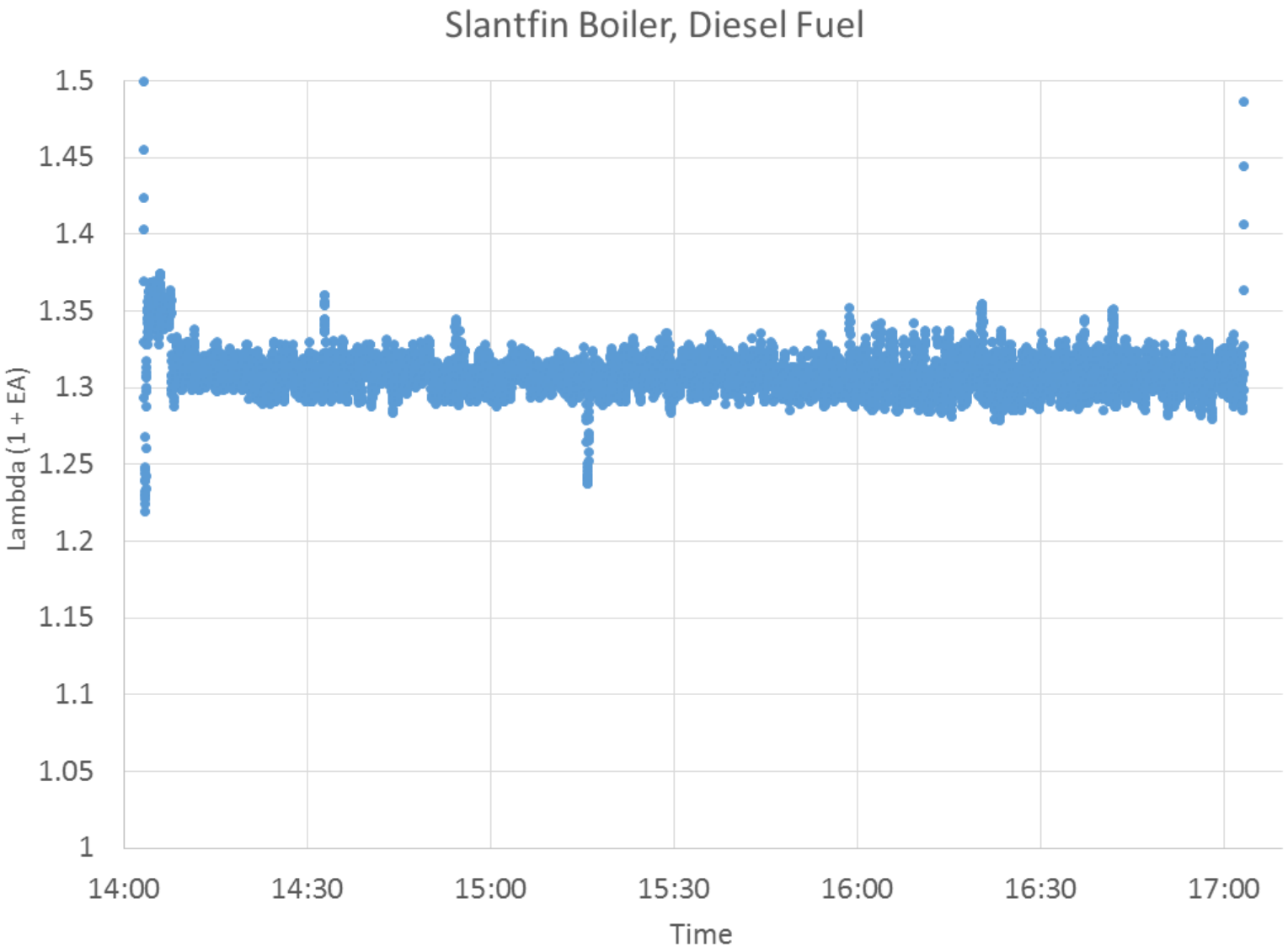


Green data shows blower speed is actively being changed to maintain the target of 35% EA

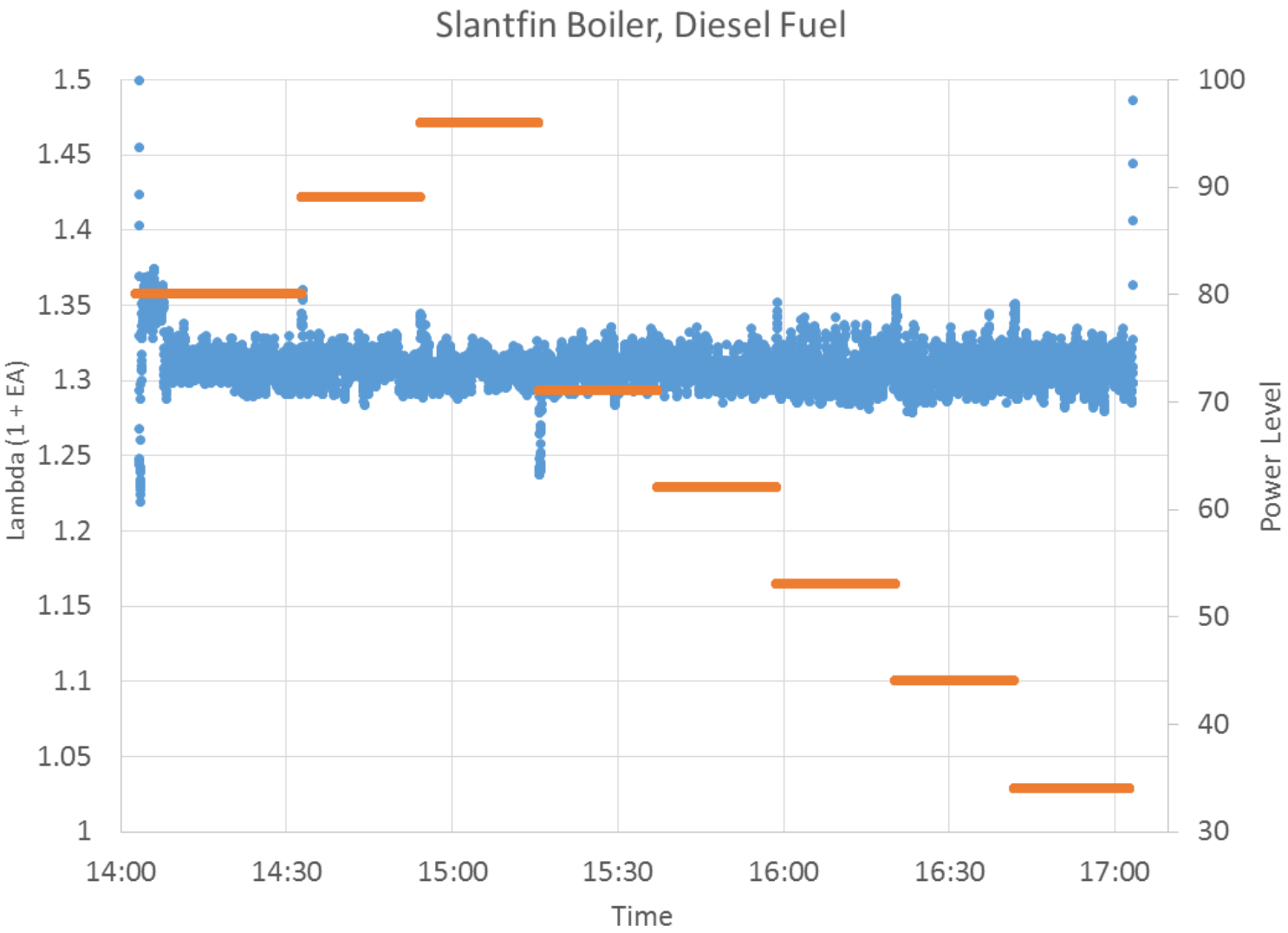
Switching firing rates on the fly



Firing rate was changed 8 times during this 3 hour run. Can you see where?

You probably can, but barely!

Switching firing rates on the fly



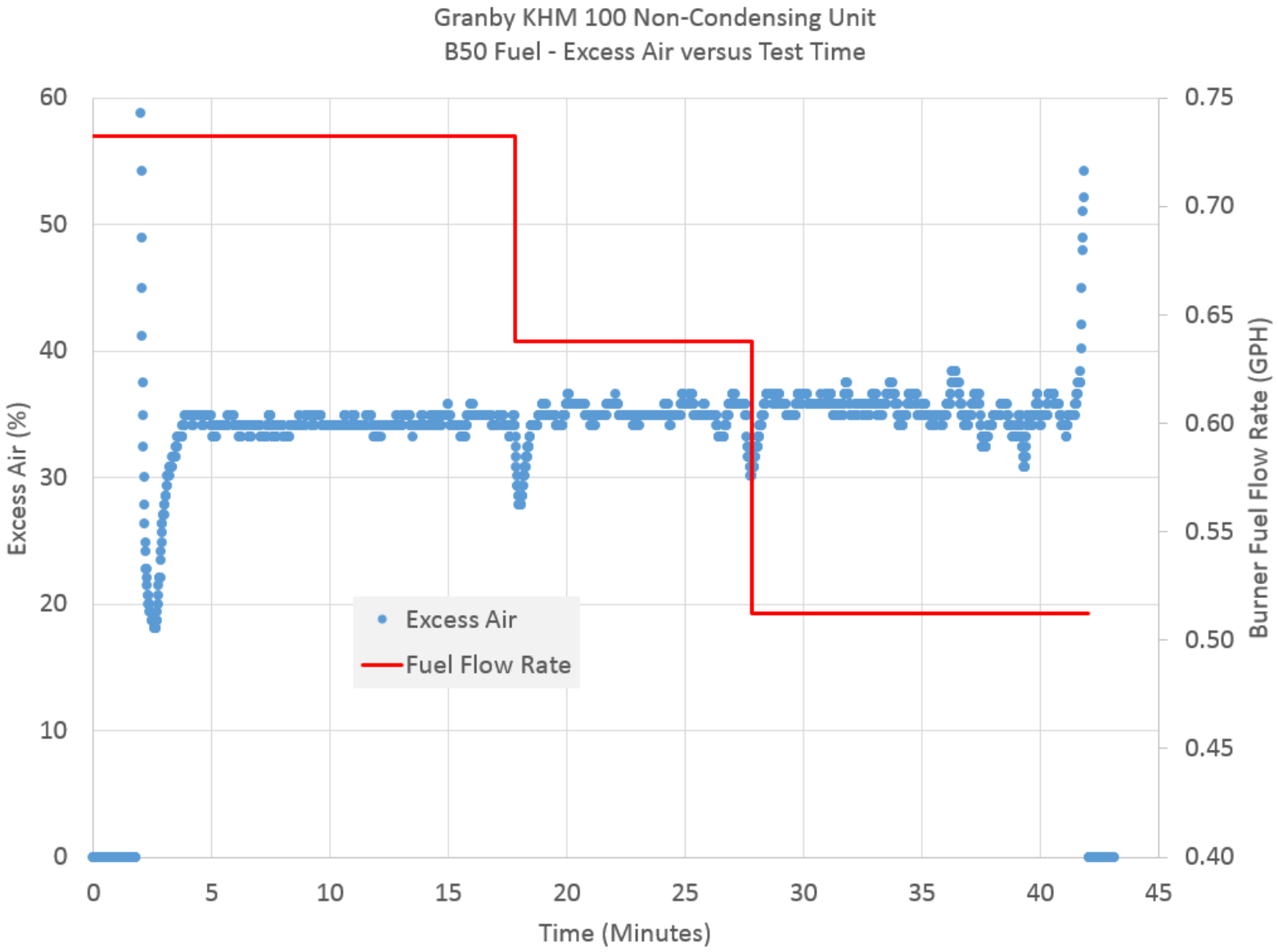
Horizontal lines show various power levels (i.e. firing rates) of the burner.

Granby Furnace Testing

Recent Testing: In addition to the three boilers being used for our laboratory testing, we have recently added two Granby furnaces to the suite of appliances which we can test burners in.

KHM-100 non-condensing furnace and the KLC-100 condensing furnace.

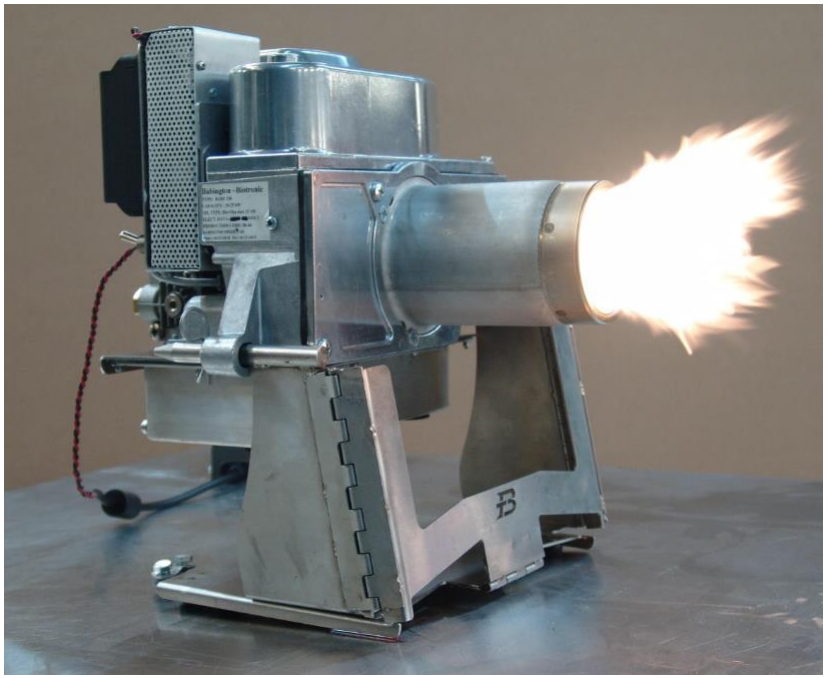
Granby Furnace Testing



Recent Work

Software Improvements

- **Improved motor commutation, more reliable motor performance**
- **Less power usage**
- **Increases motor slew rate capability by a factor of 15**
  - **Allows for faster movement up or down in firing rate**
  - **Should allow for better synchronization of fuel and air schedules**



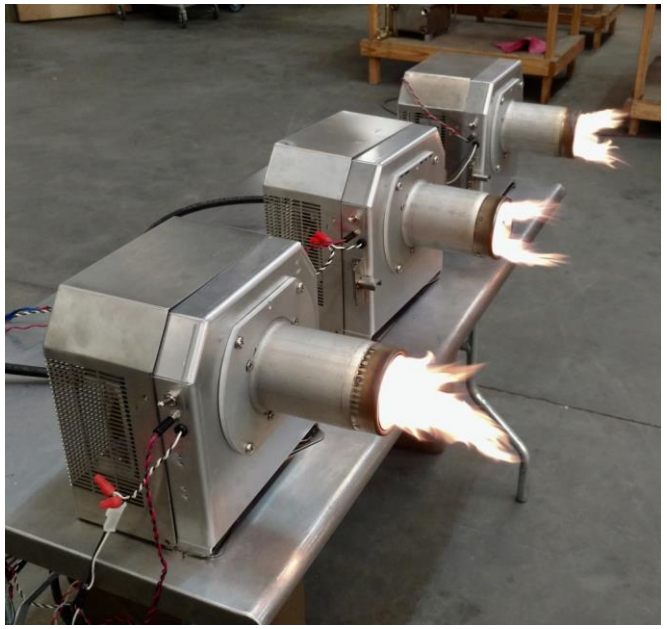
Current Efforts Focusing on

1) **Cost reduction (*Redesigning components for mass production)***
2) ***IOT backbone development***

Advanced Developmental and Biodiesel Testing

Developmental testing is done in our manufacturing facility in Rocky Mount, NC. Endurance testing (cold flow and hot flow) gravimetric testing, and emissions testing can all be performed in-house.

As we have a “Computer that makes fire” it’s easy to connect burners to a computer and automatically drive the testing sequence of different operational conditions – **and** fuels!



Diesel to B100-Compatible Boiler Testing

Peerless
WBV-03-WPCL

Energy Kinetics
Resolute 90+

Slantfin Intrepid
TR-20

Tyresöpannan
(German)

Currently using multiple boilers for emissions and performance testing. (Diesel to B100)

Diesel to B100-Compatible FurnaceTesting

Add Granby furnaces

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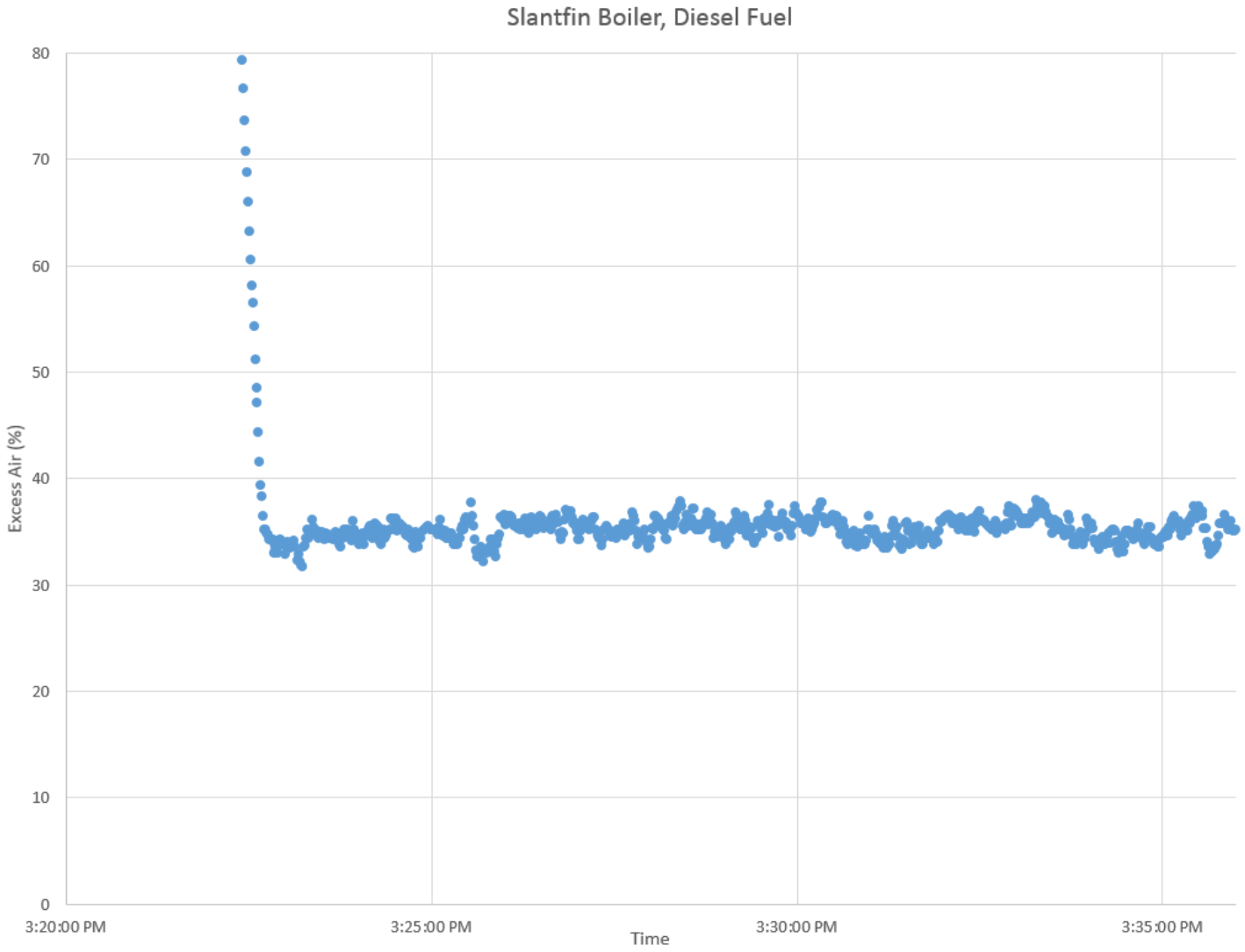
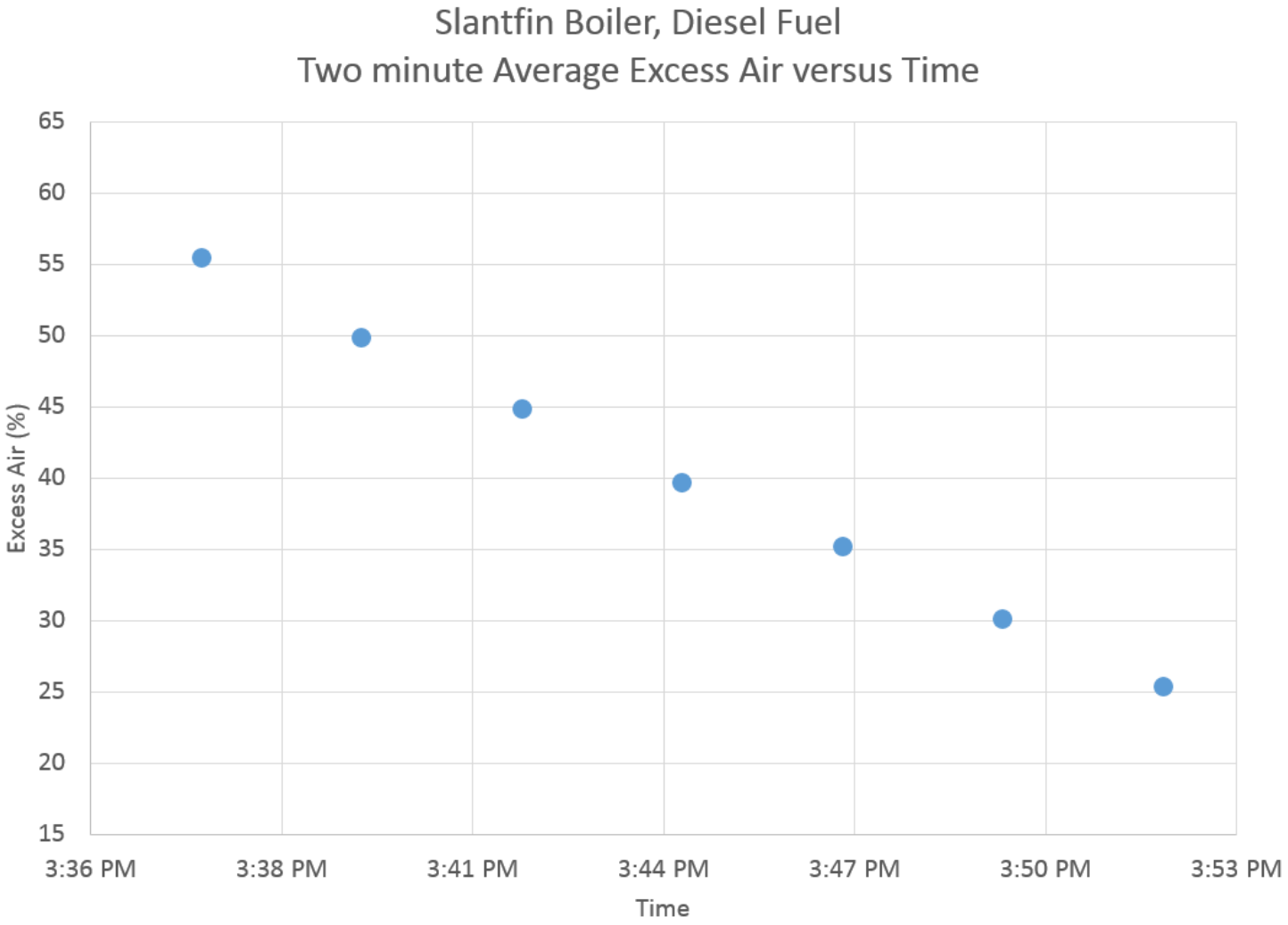
Startup Excess Air Target



Initial target from startup is 35% EA.

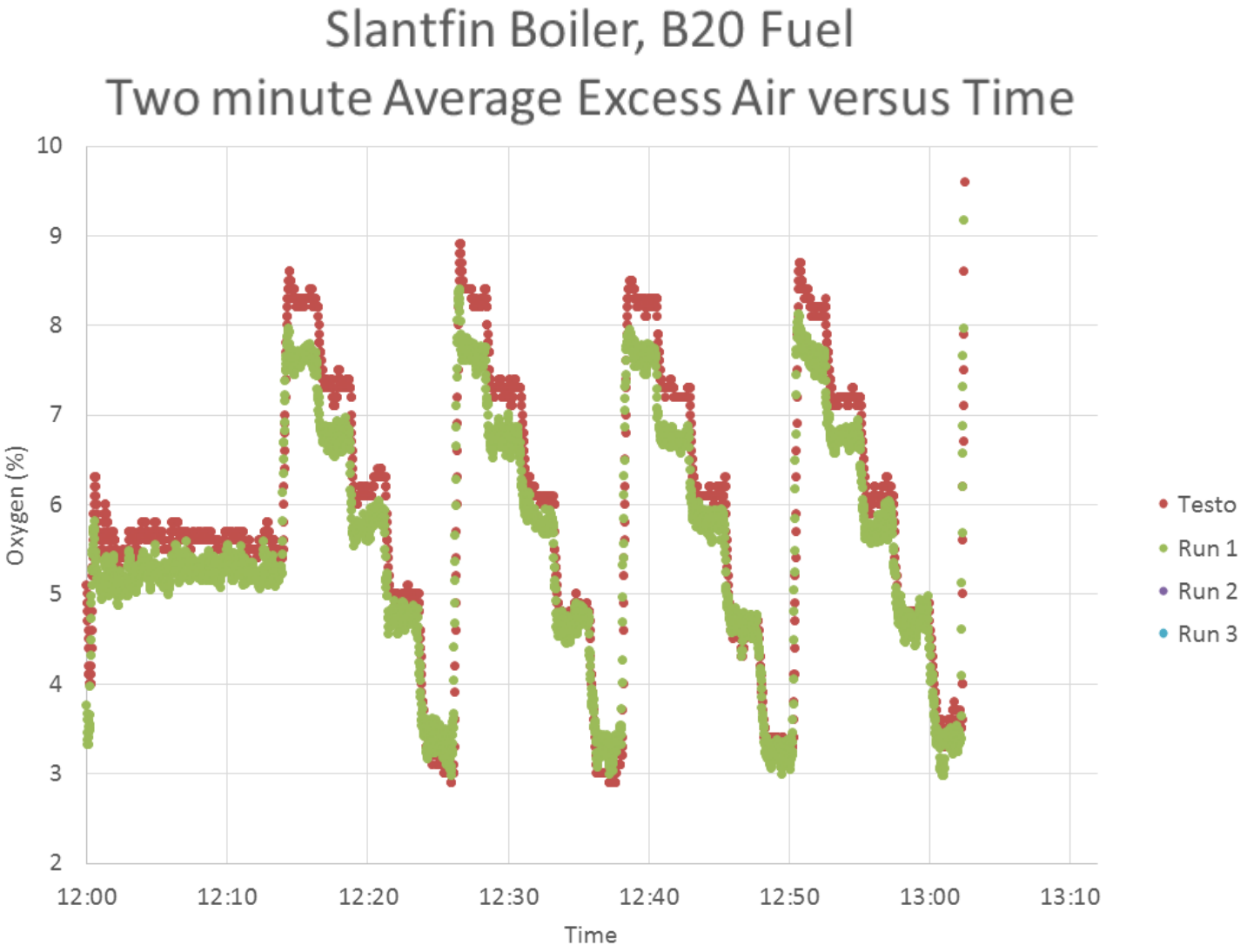
Additional Excess Air Levels



Now run 2 minute test at varying excess air levels with 25 seconds between points. Targets were 55, 50, 45, 40, 35, 30, and 25% EA.

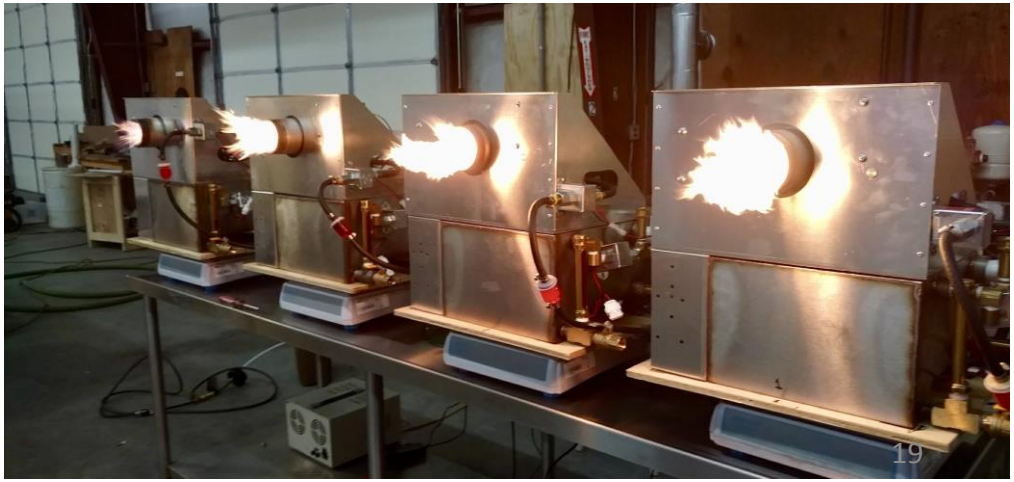
The 2 minute average EA is graphed. (Not the target!)

B20 Testing Repeat



Four different firing rates, each one sweeping excess air Then change firing rate and repeat EA sweep a fourth time.

Next Steps:
Burner Pre-Production and Field Trials

NORA has 3 burners installed in 3 boilers at their Plainview, NY test facility.

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