

The Hot Rod Boiler 4 to 240klb/hr in 360 Secs

A Super Fast Response
High Turndown Boiler for Cogeneration



Morris Cogeneration Plant at LyondellBassell – Morris Illinois

- Large Steam Consumption – Plastics
 - Needed 900klb/hr of 650psig 750F superheat steam
 - Currently needs 250klb/hour.
- Calpine Cogeneration Project
 - 3 each Gas Turbines Duct Fired HRSG's Condensing ST
 - 900klb/hour steam 140 megawatts.
- Requires N+1 Redundancy for Steam.
 - Loss of Steam is >\$1 Million/day

Need for Backup Steam Boiler

- Running only 1 of the 3GT/HRSGs Saves \$8000/day.
 - 2 GT/HRSGs half load ~ Heat Rate >12,000/kw-hr.
- Problems running one GT/HRSG and Boiler
 - Only one boiler with big enough capacity.
 - Slow Boiler Response
 - 40 to 200klb/hour in 30 minutes.
 - 40klb/hour lower Turndown
- A New “Fast Start” Boiler
 - Expensive >\$7mill, Too Small <170klb/hour.

Boiler 6

- 250klb/hour 650psig, 750F superheat boiler.
- A-Type Economizer
- Single Burner, Spud Type
- 700hp 2300vac 1800 Rpm Fan
- Emissions of NO_x > 0.15lb/mmmbtu
- New Redundant CCS and BMS Controls

The Hot Rod Boiler Proposal:

High Turndown Fast Ramp Boiler

- Greater than 30 to one turndown
 - Guarantee of 8klb/hour.
- Ramp from 8klb/hour to 250klb/hour <500 secs
- Efficiency > 80% throughout the range.
- NOx Emission < 0.05lb/hour.

Combustion Air Fan

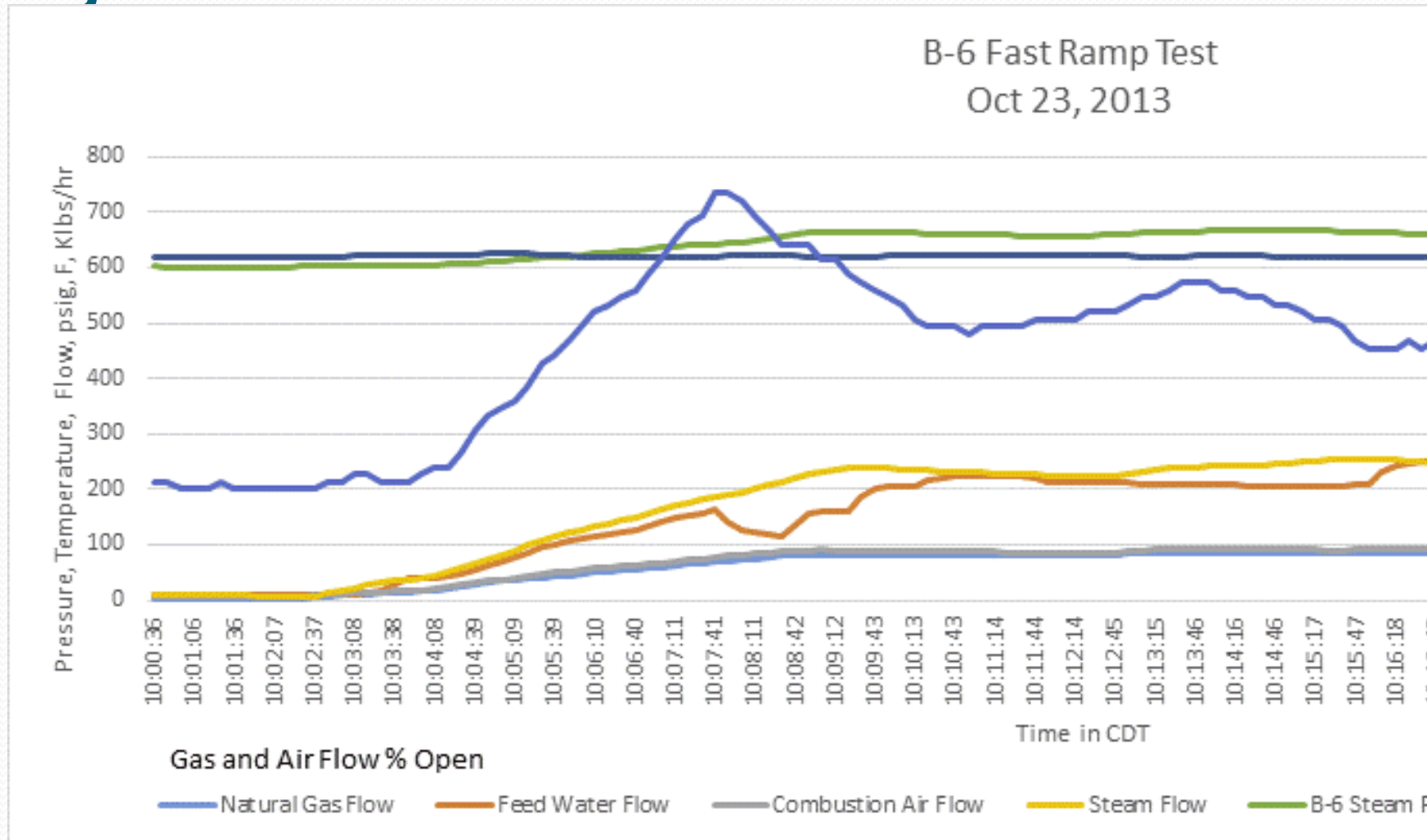
- Removed Inlet Duct and Outlet Bypass
- Specified 2300VAC Variable Frequency Drive
 - Drive was 6 to 8 months out.
 - Found Used Drive EBAY
 - 600hp but 2300VAC
 - Calculated HP based “wc x CFM 580 HP needed.
- Inlet Vanes Welded Full Open.

2300vac Drive





Project Results



Boiler Ramp Test

- 4.4klb/hour consistent low fire output
- 4.4klb/hour to 240klb/hour in 360 Seconds.
- Efficiency > 80% throughout range
- NOx emissions Less than 0.036lb/hour

Lessons Learned

- Never Assume Existing Instrumentation is Correct
 - Fuel Flow Off in both CEMS and Boiler
 - Fuel Flow Restricted
 - Boiler was never able to fire more than 180klb/hour.
- Boiler Drum Level isn't what it appears to be