Natural Gas Conversions

Path of Least Resistance

The world's leading sustainability consultancy

ERM

Natural Gas Conversion - Obviously

- Lower Emissions
- Lower Operating Costs
  - I do believe in shale gas – I do, I do, I do
  - Increasing demand will not affect gas prices so long as supply continues to outpace
  - No ash disposal risks/costs
  - Substantially reduced operations staff
  - Reduced parasitic load
  - Minimal ongoing PMS / stack testing
- Avoided Capital Costs
  - No APC upgrade Investment
  - No CEMS
  - EPA and Enviro's off our back

Pitfall #1 – Actual Gas Availability

Cost of needed gas, delivered

- Is needed infrastructure existing today?
- Can you tap into a mainline (and buy at Henry Hub index price)?
- Winter vs. summer vs. shoulders?
- Firm gas vs. interruptible?
- What premium will the LDC charge?

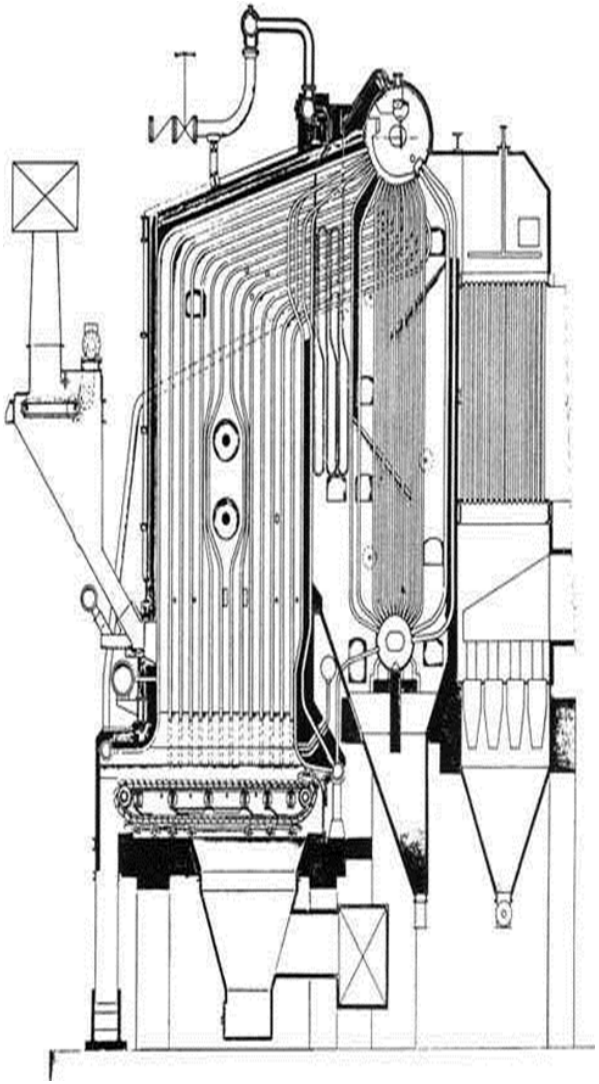
Will the LDC (and/or interstate pipeline) need to upgrade?

- New 9 ppm NOx ULNB's / CTs need high pressure supply
- Who is upstream that might get to it before you?
- Permitting
  - New pipe?
  - Larger diameter pipe?
  - Higher pressure gas?
  - LNG?

On what guaranteed date will your gas arrive – by January 2017?

Engineering Studies

- OEM no longer in business
- Number, size, location of gas burners?
- Pressure part modifications?
- Space for ULNBs?
- Boiler de-rate?
- Block off or remove the grate?
- Heat transfer and circulation
- What about co-firing biomass?



Pitfall #2 – Silk Purse Syndrome

Steam Load A'int What it Used to Be

- 1953 - 450 kpph, 3 shifts
- 2013 - 150 kpph peak, single shift
- Boiler is 60 years old, not very efficient, no longer right sized for our needs
- OEM concerned regarding natural convection in walls/tubes on gas
  - Boiler was designed for radiant heat transfer
  - Recommends tube/surface modifications, modified refractory

Other Costs

- New gas burners, fuel systems
- Improved feedwater treatment needed
- New controls for automated operation on gas
- Condition assessment shows considerable tube wear, cracking, etc.
- Leaky shell, poor condition
- Significant asbestos work

Probably won't need permitting help..

We will be replacing coal with gas

State said they will expedite the approval

Neighbors are highly supportive

Will help the mill (and local employment) to remain viable

Permitting will be a piece of cake

What could possibly go wrong?

Pitfall #3 – Air Permitting

(Assuming gas/distillate not already permitted)

- NSR/PSD applicability (avoidance)
  - Modification to an existing major source
  - Net emissions increases vs. PSD significance thresholds
  - Low operation last five years vs. permitting for 100% CF
  - CO, VOC on gas may trigger PSD; if so, lower thresholds for everything else
  - $PM_{2.5}$ “paper trigger” (+10 tpy) since no guarantee for sulfur in gas
- Non-major permit to construct; 6-12 Months?
- Approval to remove air pollution control equipment
- Change in flue gas flow rate, velocity, temperature, modeling?

Minor Source Permitting

Avoid BACT in most states..

Modeling may be requested by state

- Especially if stacks are suspicious or parameters changing
- Discretionary – any time, any reason
- One less SIP source to worry about
- Screening level (source + background)?
- Data availability for modeling

- Biomass and/or oil?

PSD Permit Triggers

Facility PSD Threshold

- 100 ton/year of any pollutant at “listed sources”
- 250 ton/year of any pollutant at other sources
- 100,000 ton/year of greenhouse gases
  - (CO_2 + 21methane + 310N_2O = CO_2e)
- Lower thresholds for existing major sources (40 tpy NOx)

PSD Review by Pollutant

- 40 ton/year NOX, SO_2, VOC
- 100 ton/year CO
- 75,000 ton/year greenhouse gases (CO_2e)
- 10 ton/year $PM_{2.5}$, 15 ton/year PM_{10}
- Other thresholds for reduced sulfur etc.

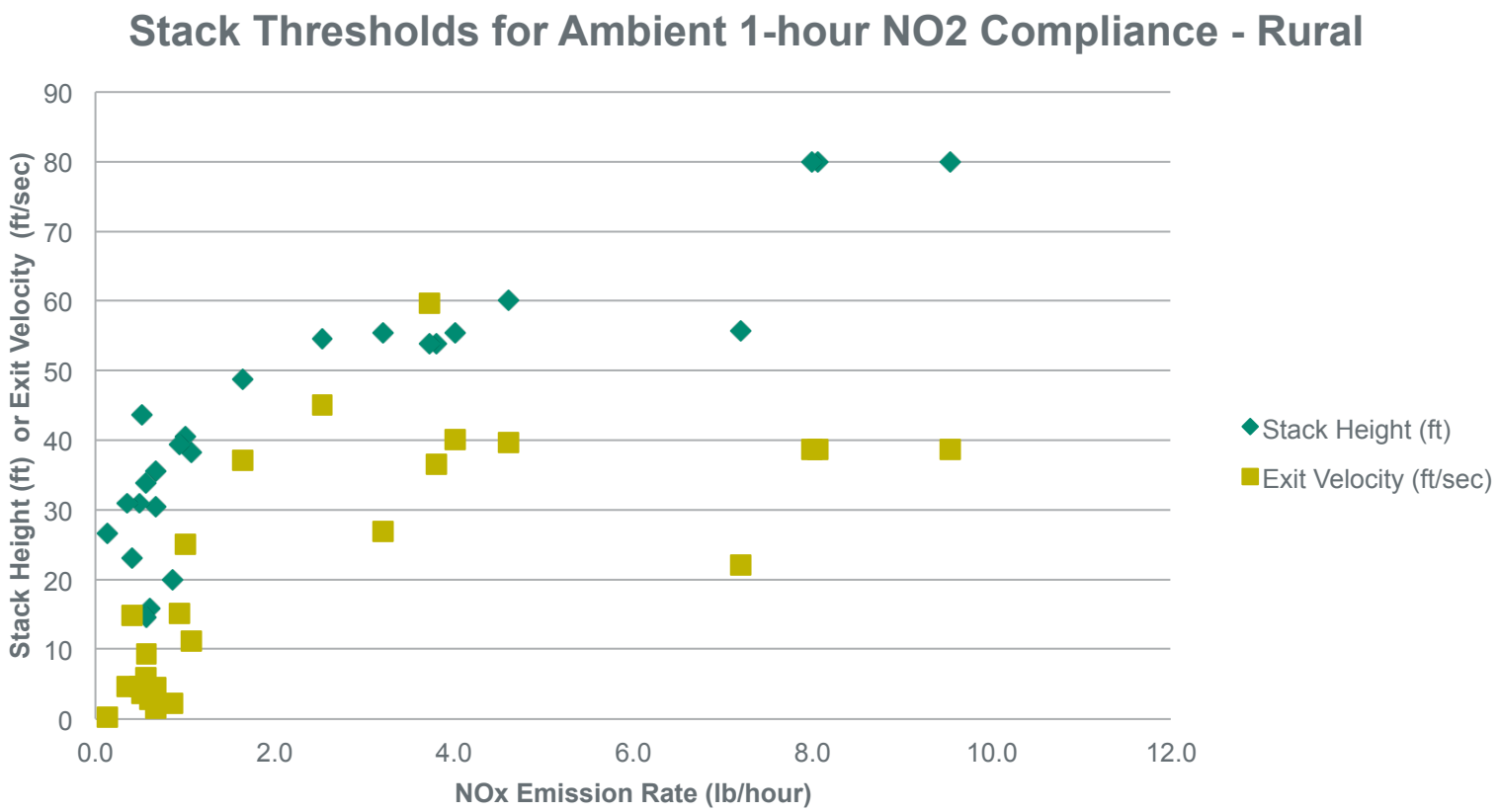
Net Emissions at Existing Facilities

Modeling

AERMOD

- 1-Hour NO_2 standard may be constraining (Tier 1, 2, or 3 methods)
- Local current meteorology and air quality data should be evaluated
- Consider installation of pre-construction monitoring (AQ and met)
  - Prepare permit with less than 1 year data
  - Gather one year's data for application
  - Ozone and background NO_2 monitored levels can be critical to success
- $PM_{2.5}$ modeling – limited to filterable and condensable, not precursors
  - Vendor data can be a problem
  - SILs were remanded by the Courts
- Backup engines for 1-hour standards
- Other standards generally not a problem
- Significant Impact Area (nearby sources) could be a schedule/problem
- Modeling for startup and shutdown

Modeling 1-hour NO_2 Impacts



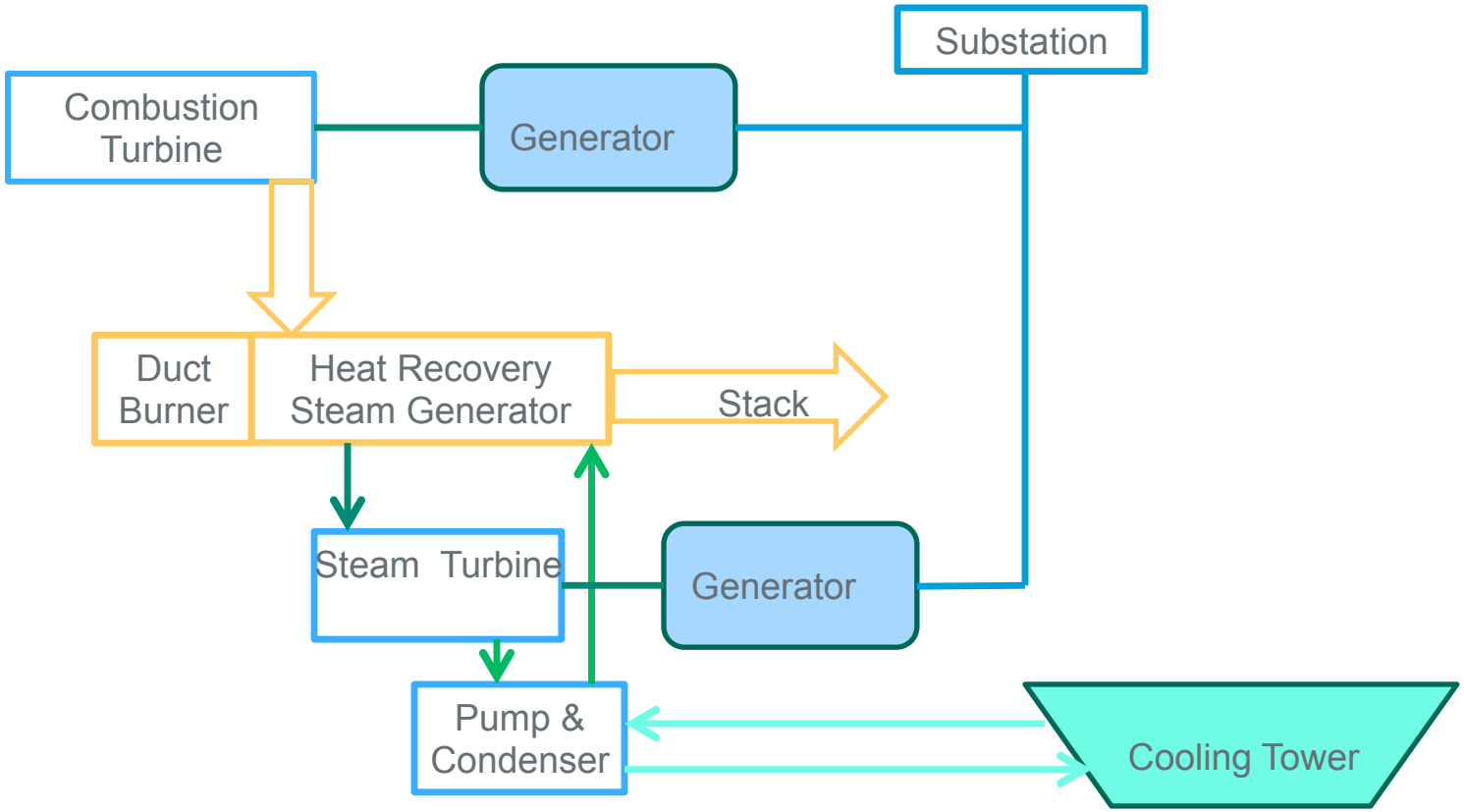
Pitfall #4 – New Boiler(s)

For the same cost, we could buy two state-of-the-art 200 kpph packaged boilers, retire old boiler in place

- Time bandits
  - One large boiler or two smaller ones? One now, one future?
  - Gas only or dual fuel?
  - Perhaps we should specify high pressure boilers and add CHP?
  - Combined cycle would be more efficient..
  - Which burner- 9 ppm? 30 ppm?
  - Engineering and economic studies
  - Management authorization
  - Technical specifications, RFP, formal bids, negotiations
- Air permitting – 6-12 Months?
- Vendor production schedule
  - “early finish” 2/1/2017; guaranteed delivery 10/1/2017
  - 3 Months for commissioning

Cogeneration / Combined Cycle Alternative

- Size HRSG to steam needs or produce surplus electricity
- Combines Brayton/Rankine Cycle
- 55% + Efficiency
- Backup on distillate



Example GHG Threshold

GE S106B – Combined Cycle Gas Fired

- 64 MW output
- 6960 Btu/kwh heat rate
- 53 kg CO_2/MMBtu Natural Gas
- 8760 Hours/year
- 227,000 ton/year of CO_2 => PSD
- Heat rate increases at partial load (140% increase at 50% load)

Pitfall #5 – Temporary Rental Boilers

As a bridge, while waiting for the permanent boilers / gas

- How long a bridge?
  - States have various rules regarding temporary boilers
  - Permit as an alternative operating scenario?
- What will be available when you need them?
  - What NO_x emission rate?
  - What sizes, pressures, fuels?
  - Oil firing until gas arrives? (see permitting)
  - Will you need Agency approvals?
  - Stub stacks
    - Air dispersion modeling?
    - > SIL for 1-hr NO_2
    - Multi-source > NAAQS?
    - Build dedicated tall stacks for temporary boilers?

Pitfall #6 – Fuel Flexibility

- LNG virtual pipeline?
- ULSD for emergency backup
  - Tanks?
  - Delivery?
  - BACT?
- Existing Boiler
  - Biomass?
  - Coal future?
    - <10% CF for now
    - Deal with MACT later?
    - Contingency Plan?

What is the project?

Timing and Alternative Operating Scenarios

- Consent Orders to Mitigate Schedule?
- PSD Triggers
  - Size
  - Hours of operation
  - Peaking vs. base load vs. intermediates
  - Netting threshold for triggering PSD at a major source – may be adverse
  - Resolve BACT/emission limits
- Modeling and Site layout
  - Proximity to fence line, stack heights, downwash, nearby terrain
  - 1-hour NO_2 and $PM_{2.5}$ – Tight ambient standards
  - PSD Increments and nearby sources
  - Vendor emission and control data
  - Availability of meteorological and air quality data
  - Startup operations and emissions

Questions

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