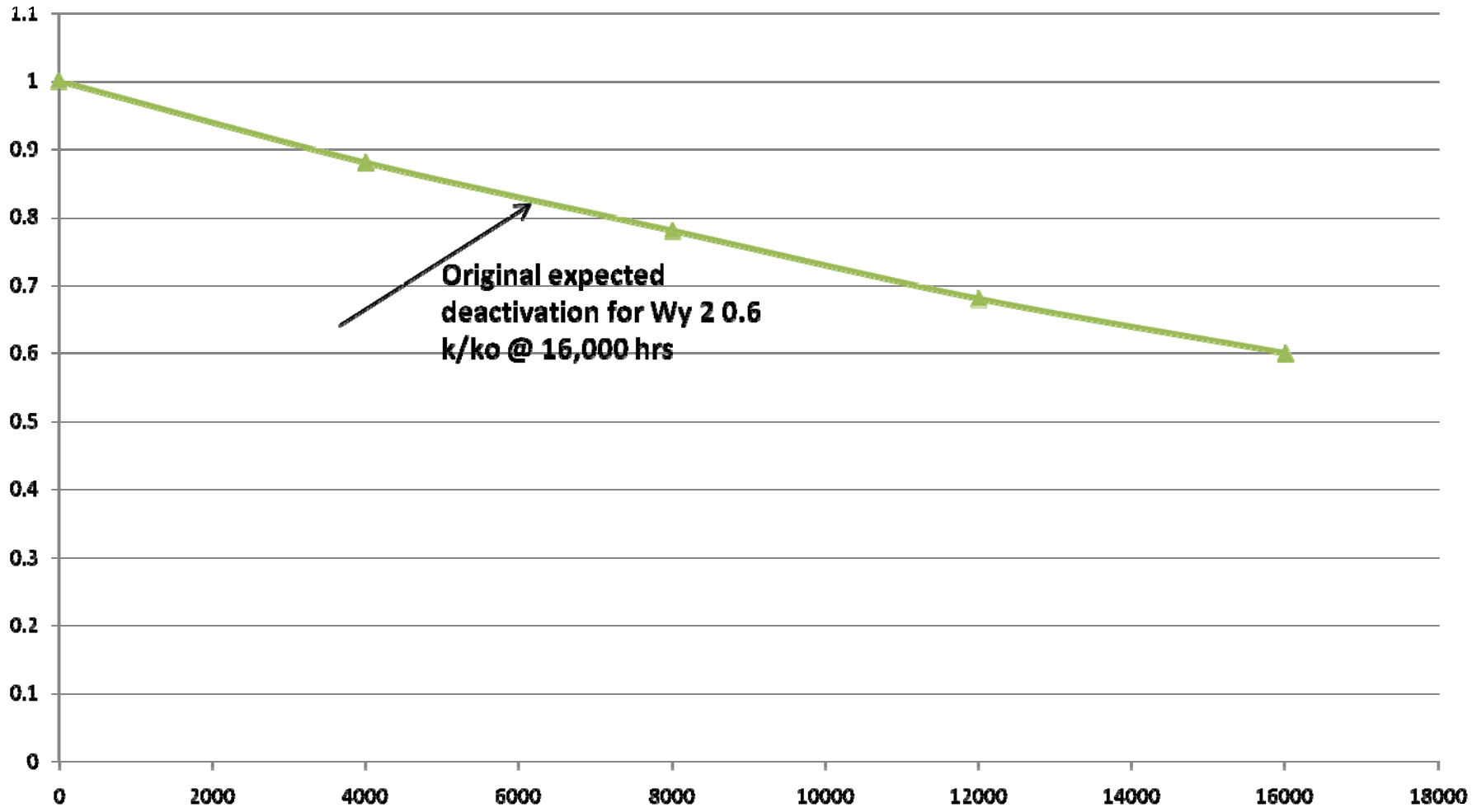
REINHOLD ENVIRONMENTAL Ltd.

2011 NOx-Combustion Round Table & Expo Presentation

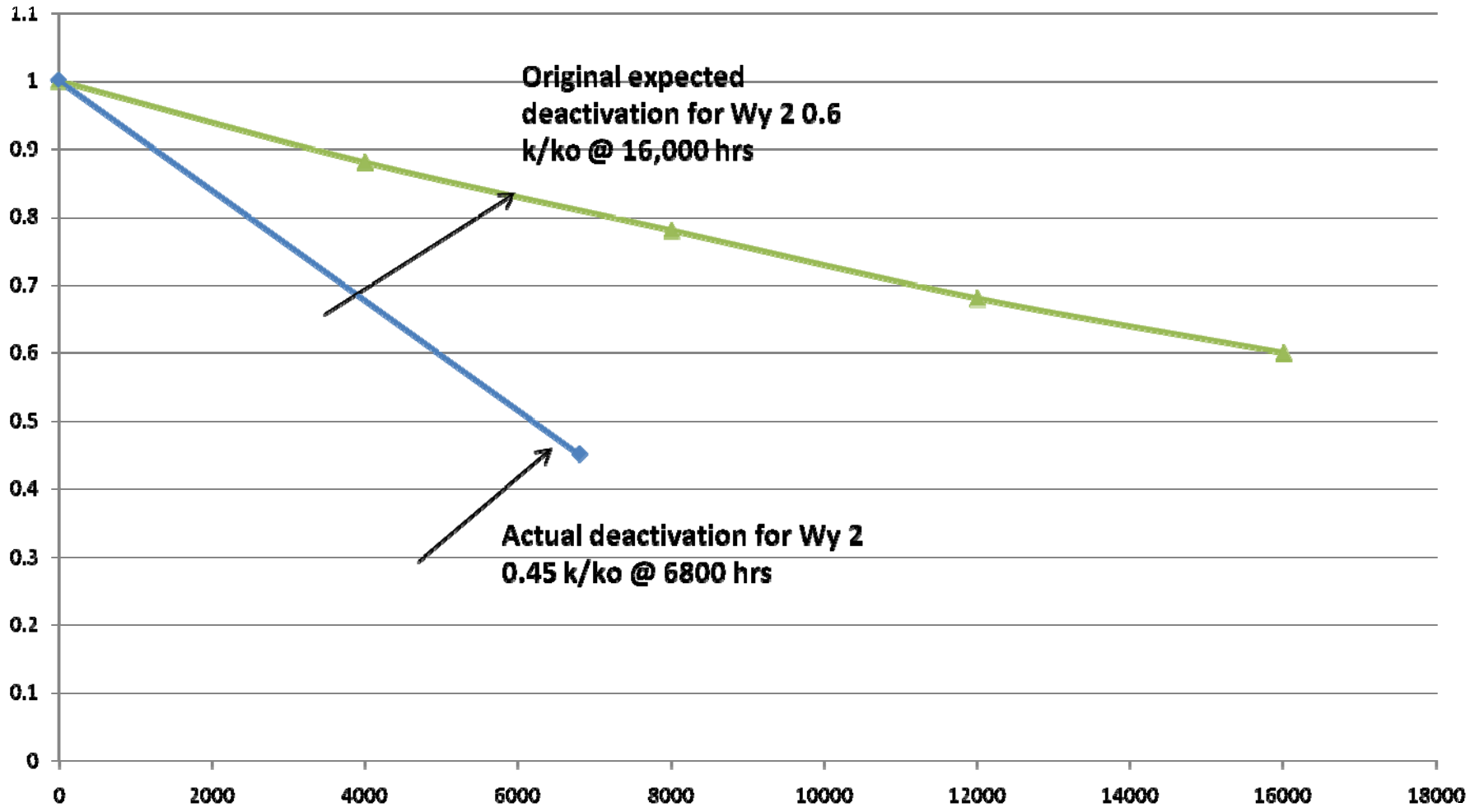
February 7-8, 2011, in Birmingham, AL / Hosted by Southern Company

Using Combustion Additive for SCR Deactivation Mitigation

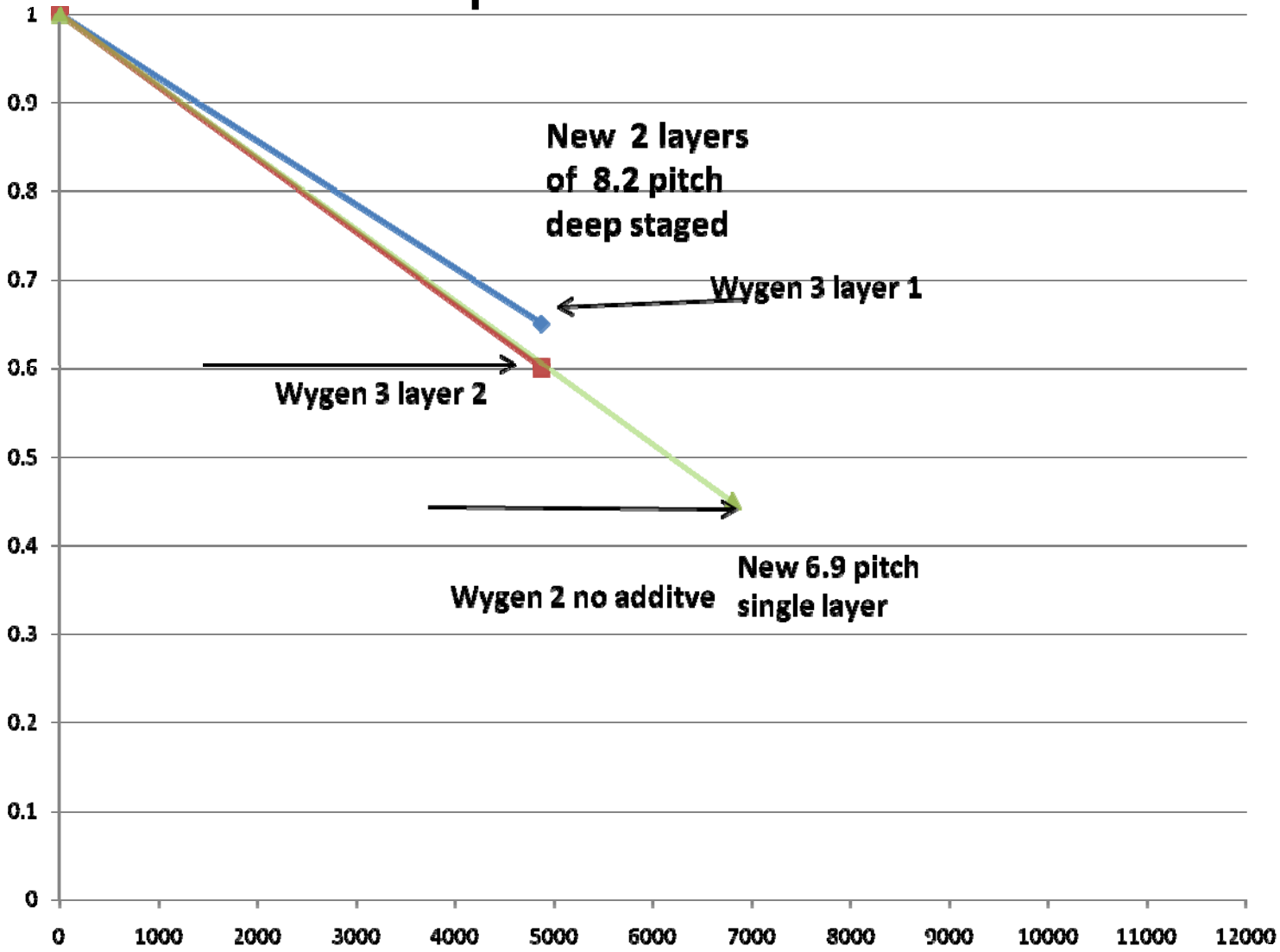
Catalyst Performance Trend



Actual Catalyst Performance

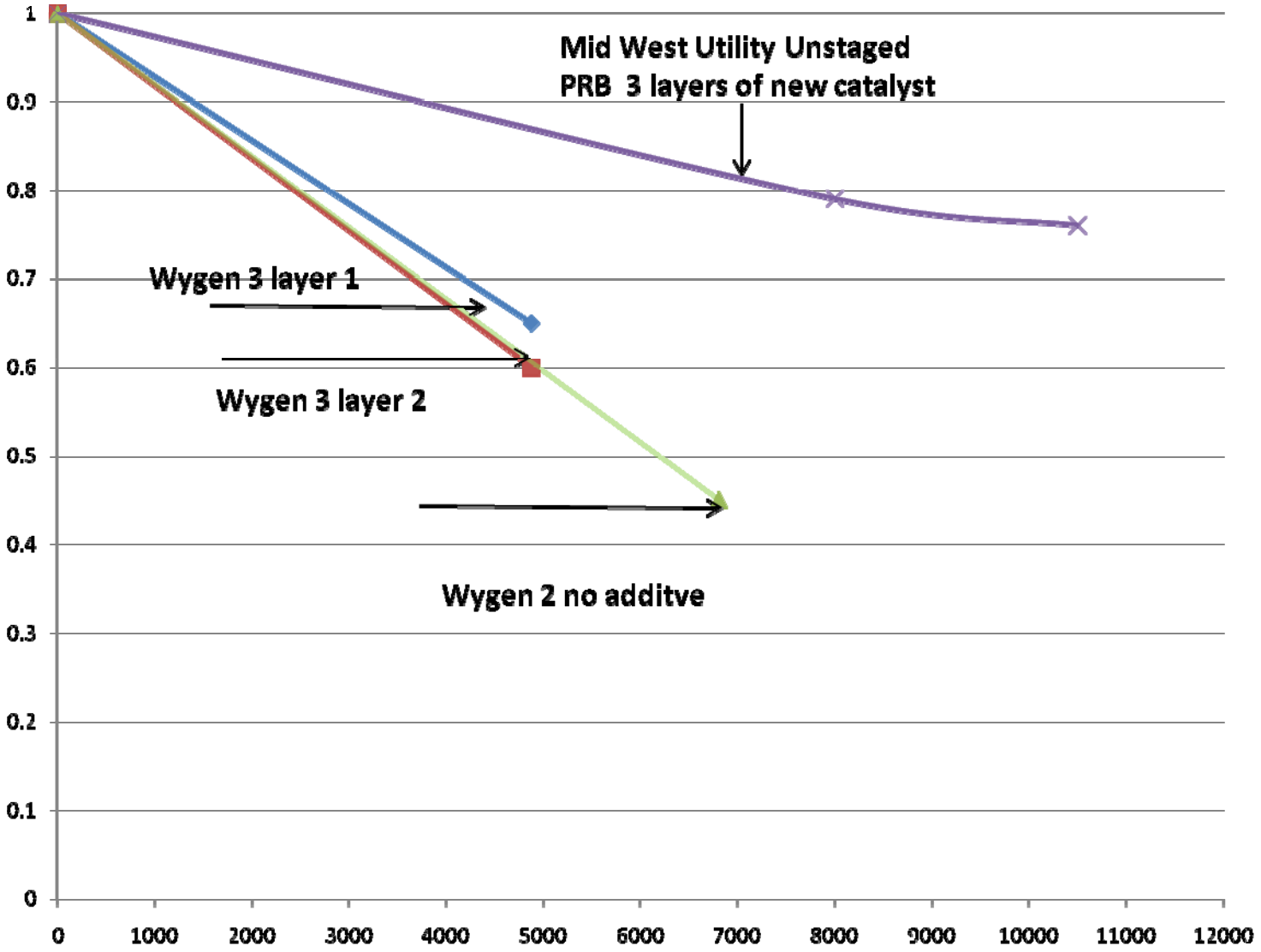


Comparison of Similar Units



Both Wy 2 & Wy 3 are deep staged unit Coal from same Wodak mine

Comparison of Staged Vs Unstaged



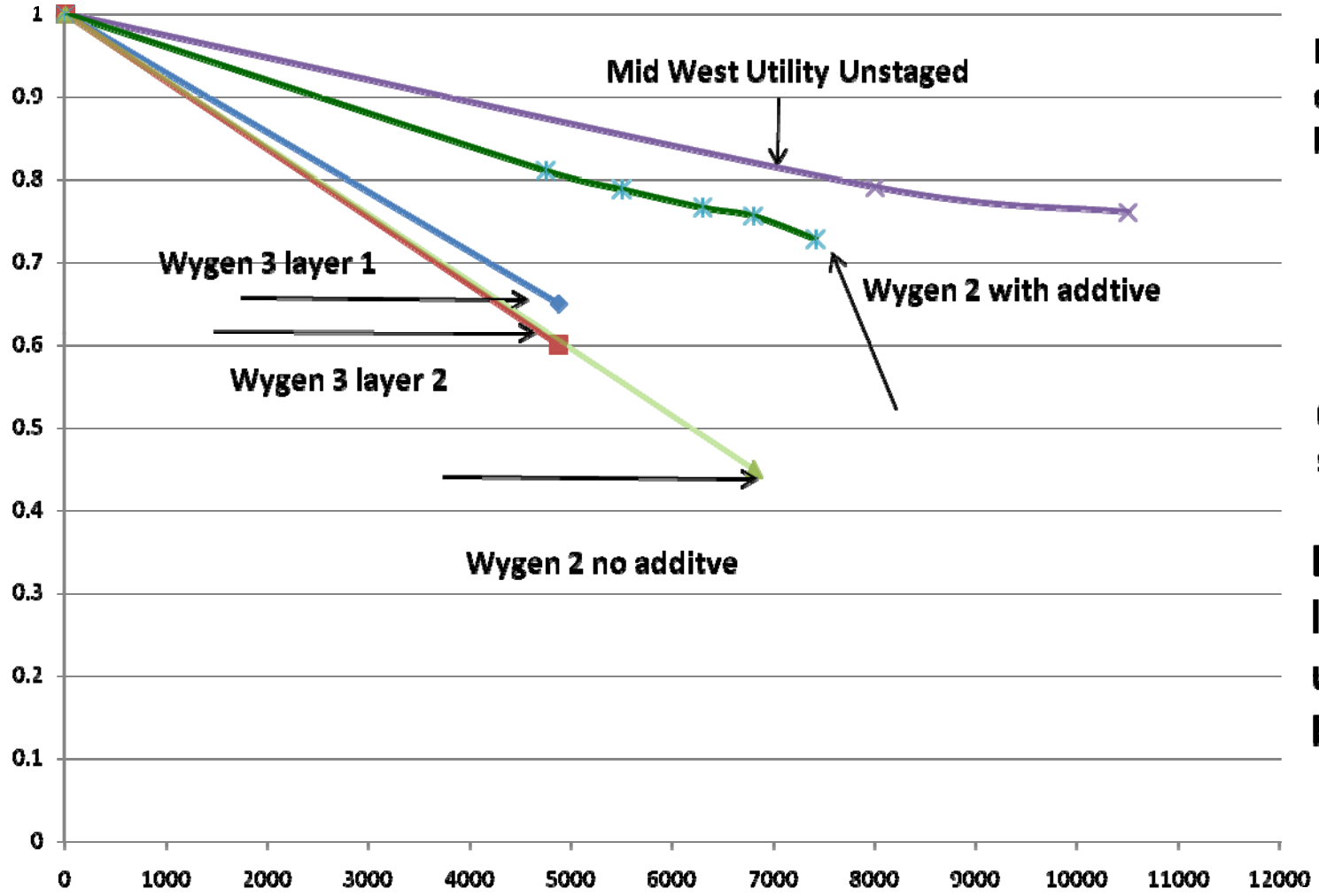
FERCo Catalyst Activity Test

- As an alternate to catalyst log, the activity of the catalyst can also be measured while the unit is online by method developed by Fossil Energy Research Corporation (FERCo)
- The reactor potential (RP) is measured based on max $DeNO_x$.
- $RP= -\ln (1-DeNO_x)$
- $RP= k/AV$
- AV based on actual plugging
- Activity expressed as k/K_o

Combustion Additive

Can We achieve slower rate of deactivation for a deep staged PRB SCR Catalyst

Wy 2 Catalyst Activity



Regenerated catalyst with lower initial Ko

5 % plugged at time of install

6.9 mm pitch single layer

Deactivating like an unstaged PRB

Observations

- Completed 7950 hours of continuous injection of additive to date
- With additive injection, the rate of deactivation appears to have slowed significantly on a deep staged combustion unit
- On Wy 3 with same coal and same deep staged combustion, the deactivation seems to follow the typical initial rapid deactivation trend
- No negative impact observed on furnace or any back-end equipment
- Working well even with regenerated catalyst
- Universal applicability independent of catalyst type & pitch
- First published long term demonstration for staged PRB proving slower deactivation

Alternatives to Address Gas Phase Phosphorus

- If firing PRB fuel, do not operate under staged combustion conditions
  - Do not upgrade combustion system
  - If possible, “de-stage” the unit

COST IMPACTS:

- Larger catalyst volume due to higher inlet N
- Larger reactor/more structural steel/ more foundations
- Larger ammonia system components/ higher ammonia usage

Alternatives to Address Gas Phase Phosphorus

- If firing PRB fuel, operate under staged combustion conditions without additive

COST IMPACTS:

- Larger catalyst volume than would otherwise be needed for lower inlet NO_x
- Larger reactor/more structural steel/ more foundations
- Smaller ammonia system components/ lower ammonia usage than without staging
- Possible early replacement of some or all of catalyst

Alternatives to Address Gas Phase Phosphorus

- If firing PRB fuel, operate under staged combustion conditions with additive

COST IMPACTS:

- Smaller catalyst volume than without additiv
- Smaller reactor/less structural steel/ less foundations
- Smaller ammonia system components/ lower ammonia usage that without staging
- Additive injection equipment/additive usage

Cost Comparison for 750 MWe Unit

Parameter	Staged	Un staged
Inlet NOx Outlet NOx	0.19 lb/mbtu 0.05 lb/mbtu	0.41 lb/mbtu 0.05 lb/mbtu
Ammonia consumption	375 lb/hr	952 lb/hr
16,000 life consumption of ammonia	3000 Tons	7616 Tons
Assumed Price @ $700/ ton delivered for 16,000 hrs	$ 2,100,000	$ 5,330,000
Catalyst cost for 16,000 hours life initial charge	$2,425,000 with 485 m^3 volume	$ 2,550,000 with 510 m^3 volume
Total cost for first 16,000 hour of life	$4,525,000	$ 7,881,200
Differential cost for first charge	$ -3,356,200	

Blended Additives

- No demonstrated SCR catalyst formulation with simultaneous P resistant & enhanced mercury oxidation capabilities
- The existing enhanced mercury oxidation SCR catalysts will also deactivate as normal DeNOx catalyst under staged combustion or with poor combustion
- Need for a blended additive to achieve simultaneous phosphorus reduction & Hg oxidation
- Additive injected pneumatically at the same injection location
- Reduction in stack Hg emissions of about 30% along with less gas phase P entering SCR were observed
- Expecting to test on bigger units

Blended Additives

- Another blended additive under development for mitigating potassium, sodium and P deactivation of SCR.
- Particularly beneficial for coal biomass co combustion situation.
- Field Test to be completed soon.

Questions

mgadgil@babcock.com


B&W
power generation group
1-800-BABCOCK
www.babcock.com