

REINHOLD ENVIRONMENTAL Ltd.



**2015 APC Round Table
& Expo Presentation**

July 13 & 14, 2015, in Atlanta, GA / Hosted by Southern Company

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Key Factors Affecting Hg Oxidation & Hg Capture

Reinhold – APC Conference (Atlanta)
July 13, 2015

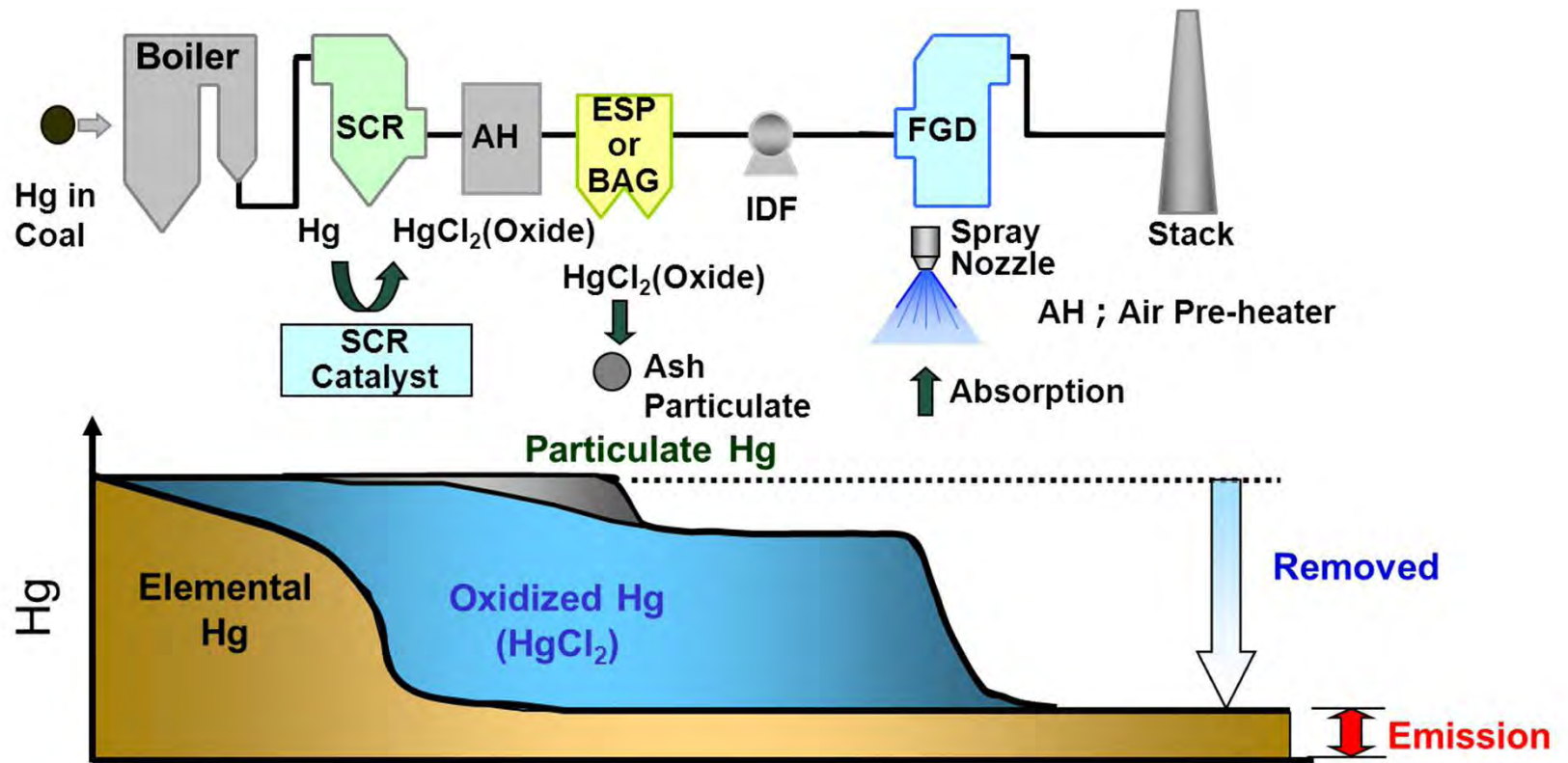
Hal Kruger – Kruger Energy & Environmental Consulting
Don Hromulak - FirstEnergy – Mgr, Environmental

Goals of Workshop

- **Provide understanding of Hg Oxidation & Capture**
- **Review process variables that impact Hg control**
- **Discuss Catalyst Management for combined NOx & Hg Control**
- **Provide knowledge for troubleshooting changing Hg emissions in a power plant**

Mercury Fate Thru Gas Path

Hg-p Particle Bound
 Hg0 Elemental
 Hg+2 Oxidized
 HgT Total
 Hg-vt Total - Hg_p



SCR Catalyst is a key component for mercury oxidation

HITACHI
Inspire the Next

Source: "SCR Effects on Downstream Hg Control"; Favale; Hitachi; Reinhold NOx Conference; 2013

Hg Capture Boiler to Stack

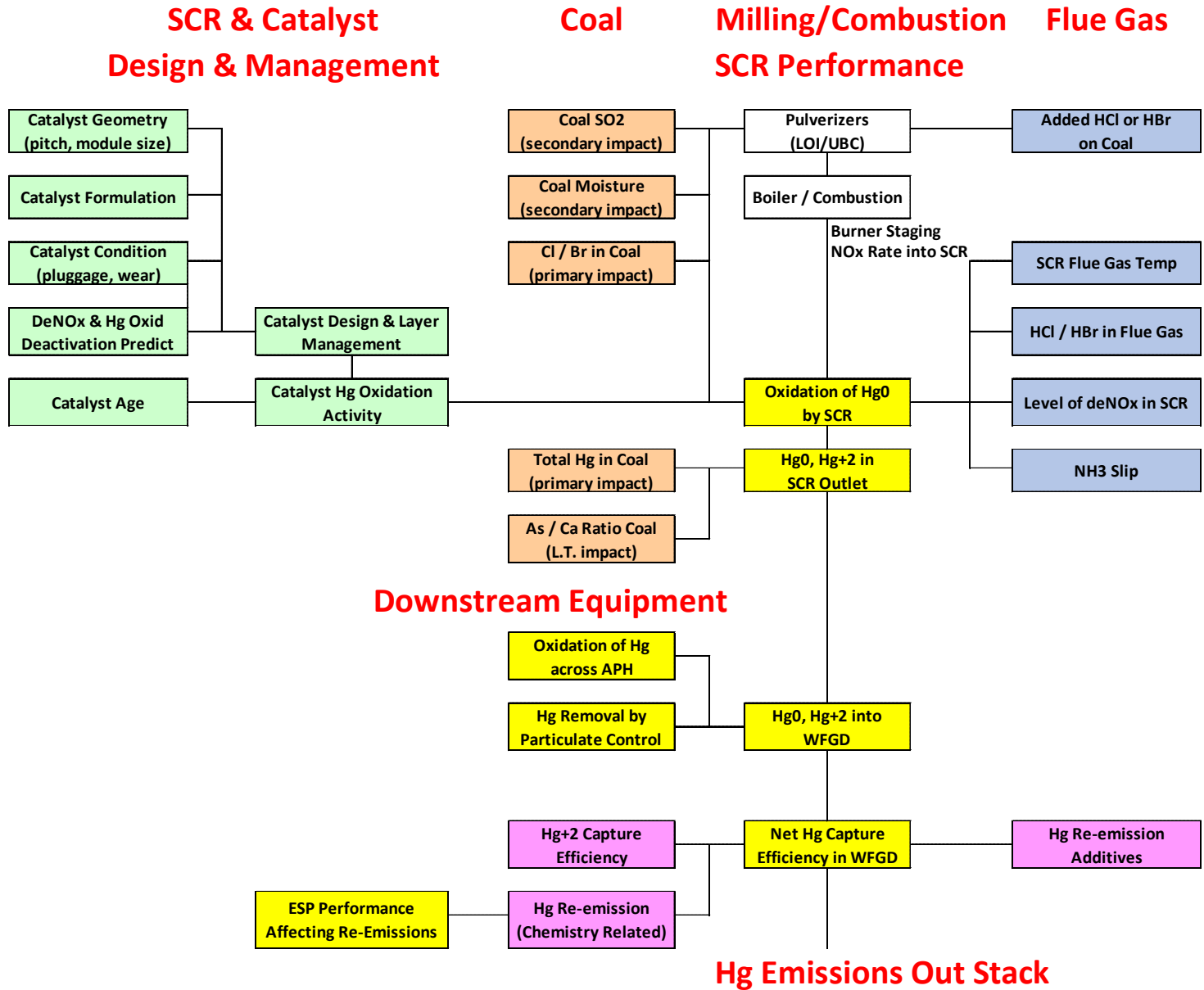
**Manage Coal
Quality Factors**

**Maximize
Hg Oxidation (SCR)**

**Maximize Hg Capture
on Ash**

**Maximize Hg Capture
in WFGD
(Control Re-emission)**

Key Factors Impacting Hg Emissions with Co-Benefits

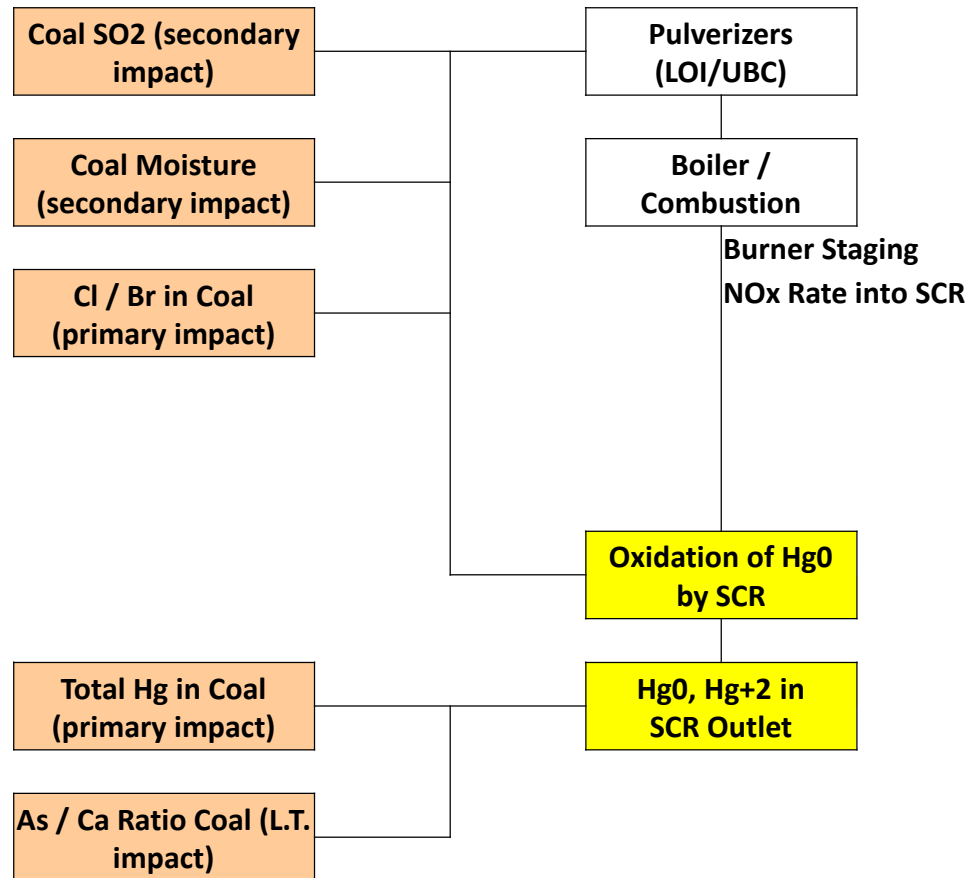


Coal Quality Impacts on Hg Oxidation and Capture

Coal Quality Impacts on Hg Control

Coal

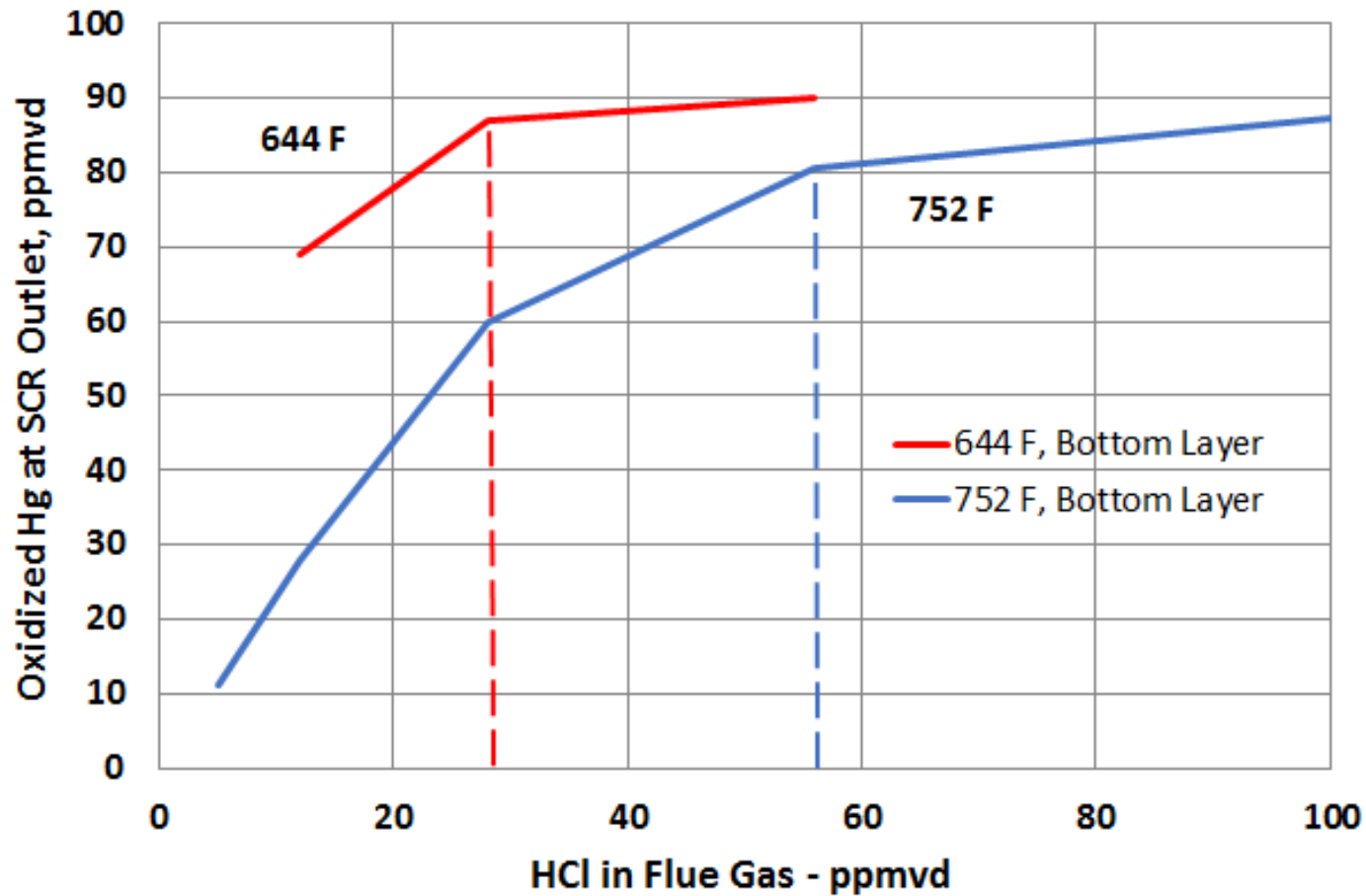
Milling/Combustion SCR Performance



As - Arsenic
Ca - Calcium
L.T. - Long Term

Hg Oxidation vs Flue Gas HCl

Curves are specific to catalyst type. At higher temp, “knee” in curve may be around 50 ppmv HCl. At lower temp, “knee” occurs at lower HCl levels



Plot from Cormetech Data presented at 2013 Reinhold NOx-Combustion Round Table (Salt Lake City, Utah)

Hg Oxidation vs Hydrogen Bromide (HBr)

- Hg Oxidation is very sensitive to HBr, and 1-2 ppmvd in Flue Gas can provide a significant Hg Oxidation benefit.
- If HCl is high, sufficient halogens may be available with HCl to limit HBr's benefits

Hg Oxidation vs Other Coal Parameters

- **Coal Sulfur (SO₂)**

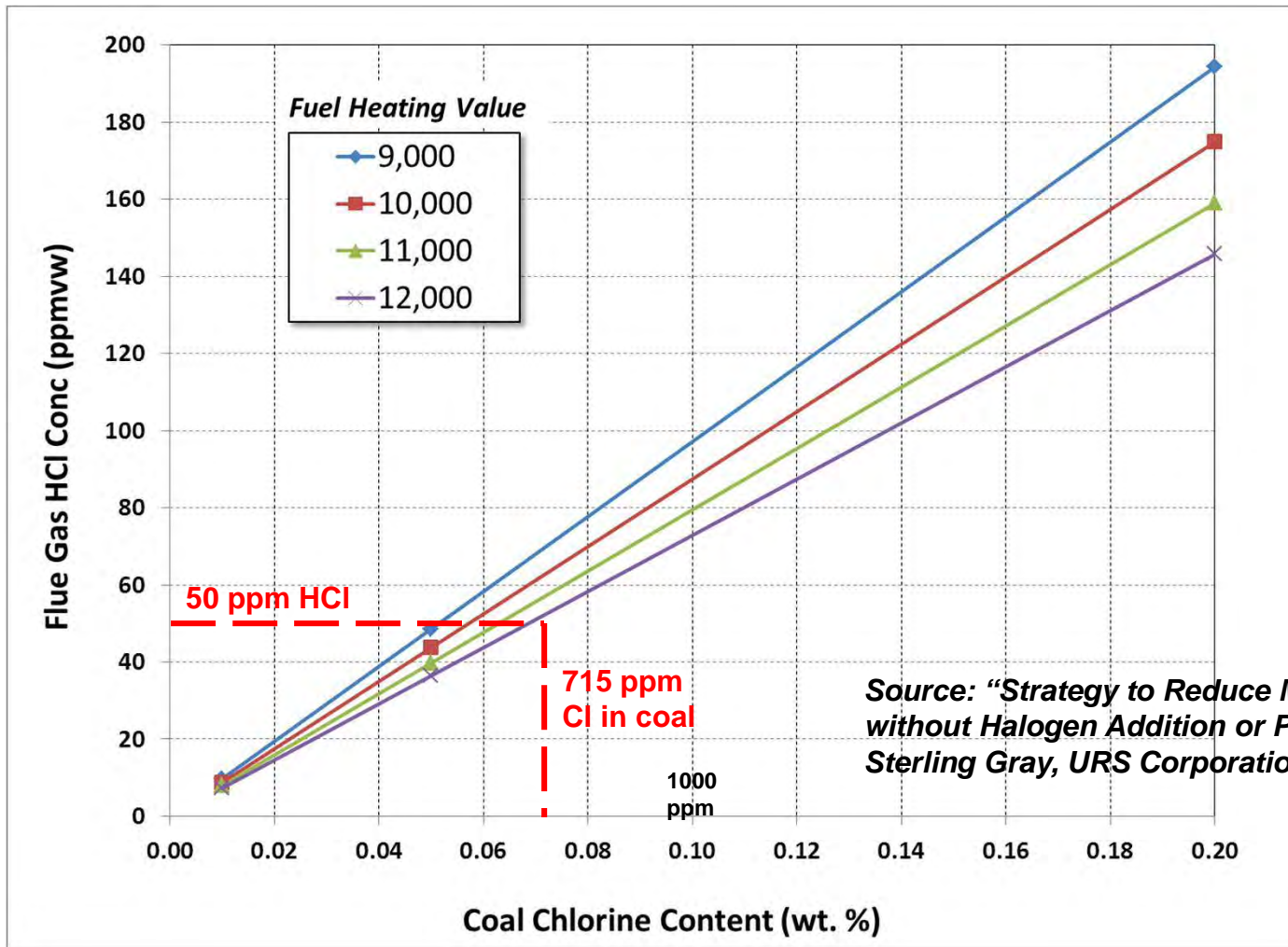
- Increasing SO₂ will reduce Hg Oxidation, but for fairly consistent fuel supplies, the impact is small.

- **Coal Moisture**

- Increasing moisture will reduce Hg Oxidation
- See plot later in presentation

Flue Gas HCl vs Coal Chlorine

General Rule: 500 ppmwd Chlorine = 35 ppm HCl
715 ppmwd Chlorine = 50 ppm HCl



Estimate HBr in Flue Gas from Br in Coal

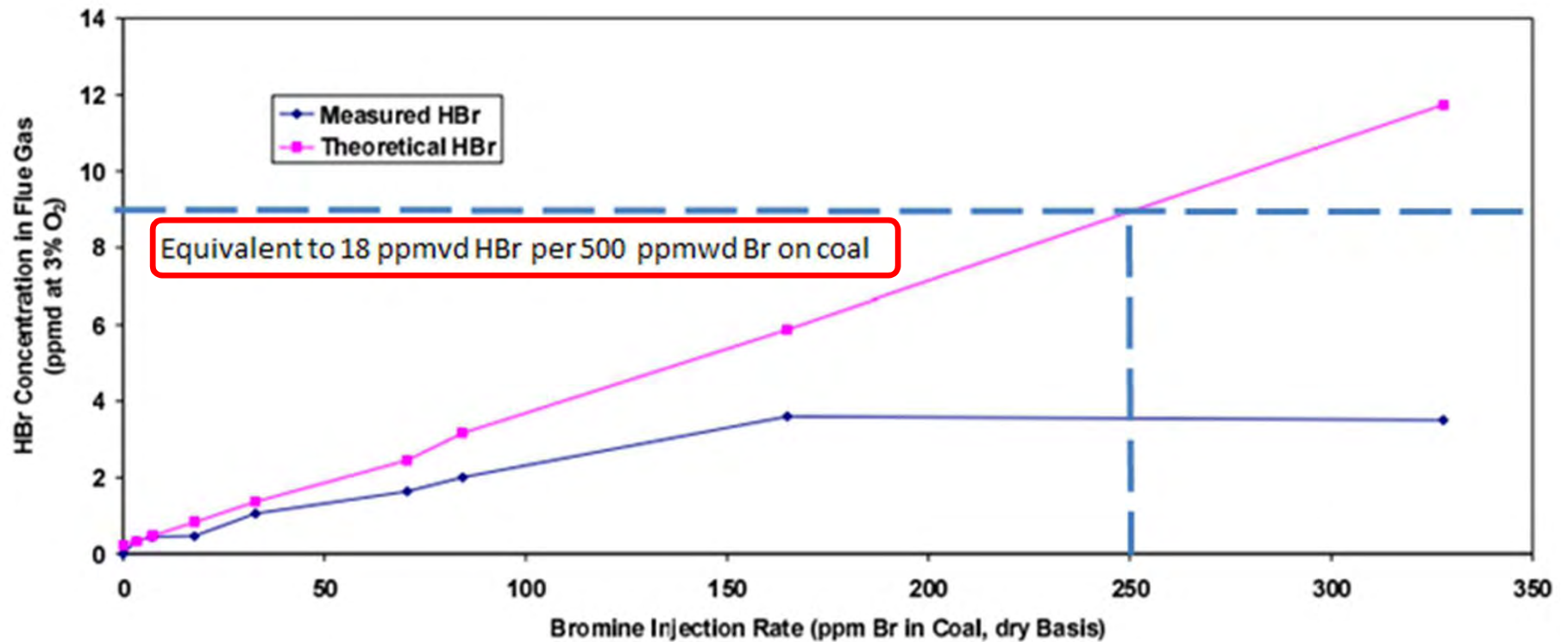


Figure 3. Flue gas HBr enhancement due to boiler injection of calcium bromide.

BOP Impacts of Calcium Bromide Injection as a Mercury Oxidation Technology in Power Plants, Dombrowski, McDowell, Berry, Sibley, Chang, Vosteen (2008)

Coal Impacts

Primary Factors Affecting Hg Capture

- Coal Hg (lower better)
- Coal Halogens - Cl, Br (higher better)

Secondary Factors (Can be significant)

- SO2 potential of fuel
- Moisture

Long Term Factor (catalyst poisons)

- Arsenic / Calcium Oxide ratio
- Other catalyst poisons

COLOR LEGEND

	Good for Hg Capture
	Average
	Potential Limitations for Hg Capture

Typical Coals

Fuel Basis	Hg	Cl	HCl Equiv
	Lb/Tbtu	ppmwd	ppmvd
Plant A	7.0 - 8.0	550-600	39 - 42
Plant B	9.0-10.0	650-750	46 - 53
Plant C	6.0	550	39
Plant D	7.7 - 8.7	600-800	42 - 56
Plant E	9.0 - 10.0	600	42
Plant F	7.5	650	46

Need to determine optimum HCl for good Hg Oxidation. For FE application, best to have at least 50 ppmvd HCl (715 ppm Cl in coal) into SCR. SCR Temp can influence grading

Coal Impacts

Primary Factors Affecting Hg Capture

- Coal Hg (lower better)
- Coal Halogens - Cl. Br (higher better)




Secondary Factors (can be significant)

- SO₂ potential of fuel
- Moisture

Long Term Factor (catalyst poisons)

- Arsenic / Calcium Oxide ratio
- Other catalyst poisons

COLOR LEGEND

	Good for Hg Capture
	Average
	Potential Limitations for Hg Capture

Typical Coals SO₂

Fuel Basis	SO ₂	SO ₂
	Lb/mmBtu	ppmvd
Plant A	6.0	2,900
Plant B	4.3	2,000
Plant C	6.1	2,800
Plant D	6.7	2,300
Plant E	5.3	1,700
Plant F	5.5	2,050

Long Term Factor (catalyst poisons)

■ Catalyst Poisons

- Arsenic
- Potassium
- Phosphorus
- Sodium
- Cadmium
- Lead
- Copper

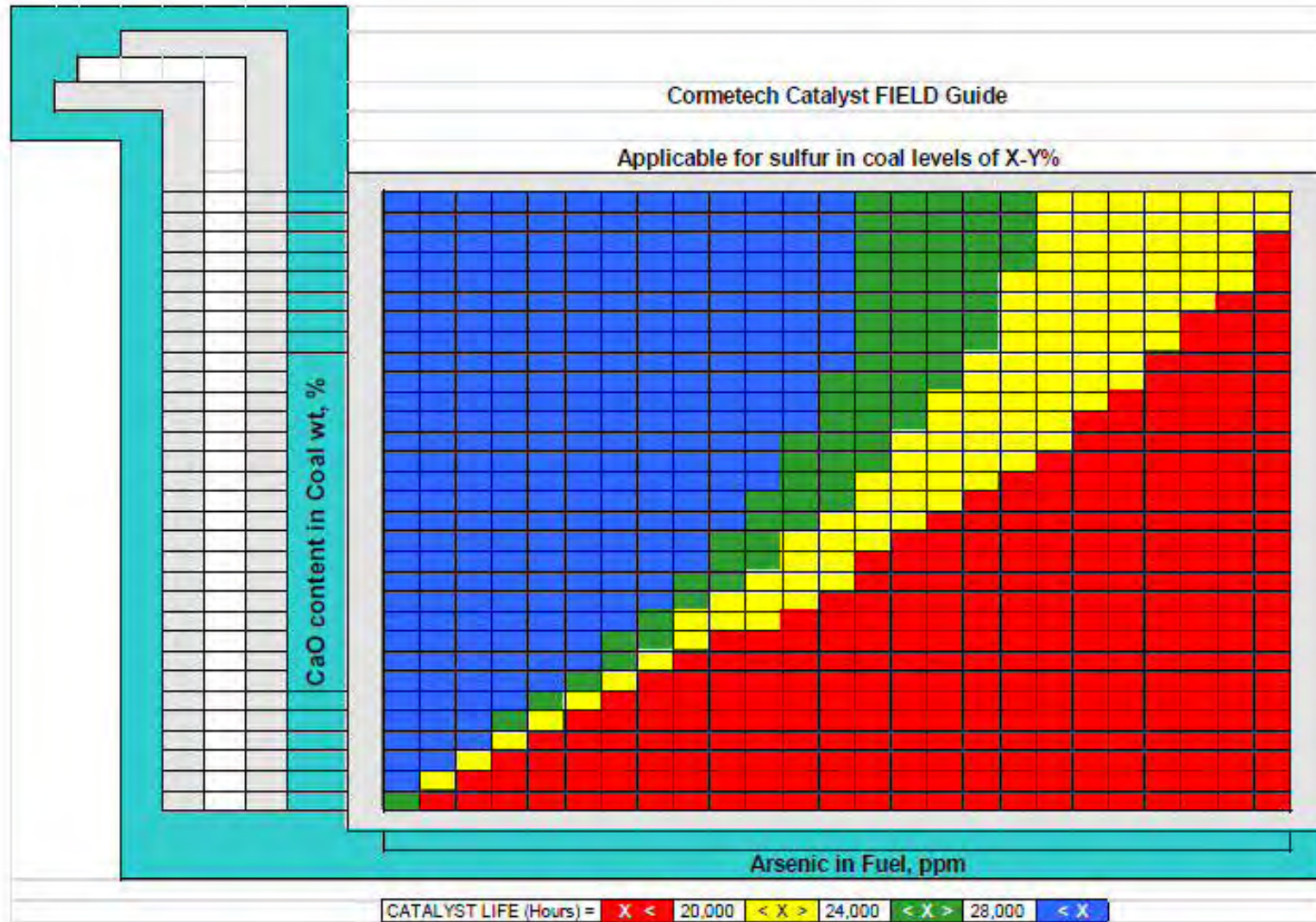
■ Arsenic Poisoning

- As in coal
- CaO in Coal (%CaO in Ash%% Ash)

■ Need Methodology to Evaluate Arsenic Impact on Cat Life

■ Used Cormetech Field Guide to determine a “relative catalyst life”

Arsenic Poisoning Analysis



Cornetech - 2015 Reinhold NOx-Combustion Roundtable, Richmond VA

Application of Curve Evaluating Arsenic & CaO in Fuel

Example of Analysis for a FirstEnergy Plant

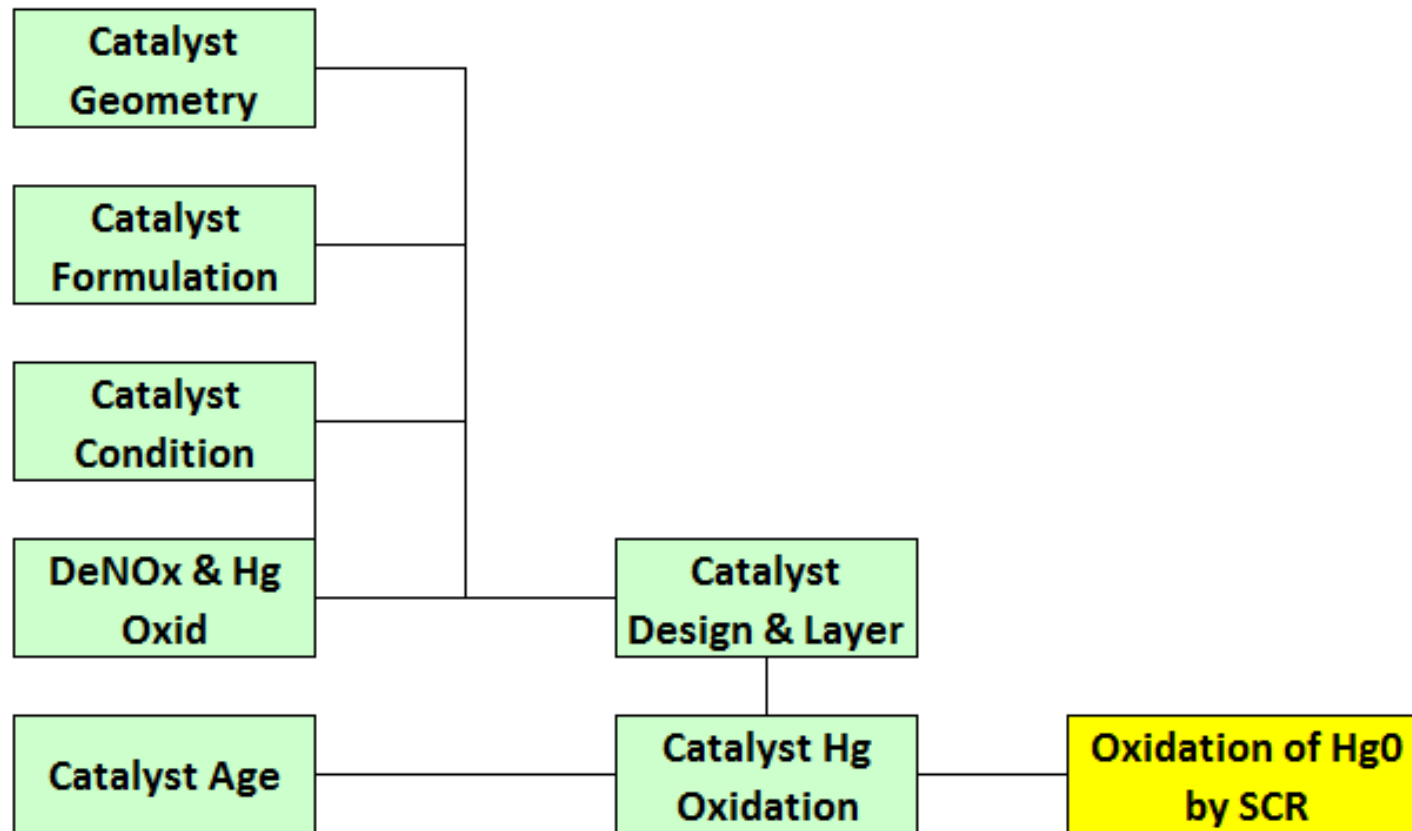
	Coal Mine	SO ₂ lb/mmBtu	As ppm-dry	CaO in Fuel Wt%	Hg lb/Tbtu	Blend 1 %	Blend 2 %	Blend 3 %	Blend 4 %
HS	Coal A	6.2	7	0.3	7.2	33%		14%	20%
	Coal B	5.1	6	0.1	7.5		38%	39%	45%
	Coal C	3.3	50	0.1	25.5		14%		
LS	Coal D	3.7	5	0.3	8.7	40%	38%	24%	32%
	Coal E	3.4	12	0.1	22.2		7%	9%	
Other	Coal F	4.7	26	0.5	23.0		3%	3%	3%
	Coal G	0.7	1	1.0	7.4	27%		11%	
Total						100%	100%	100%	100%
DeNO _x Catalyst Life - K-Hours					K Hrs	57	12	30	17
Average Mercury in Fuel Blend					lb/Tbtu	8.0	12.0	10.8	8.3

A close working relationship between the catalyst team and Fuel Procurement is vital to optimize the combined catalyst/fuel plans

SCR CATALYST IMPACT & FACTORS AFFECTING CATALYST PERFORMANCE

SCR Catalyst Impact

SCR & Catalyst



Catalyst Design Considerations

Catalyst Design for Optimum Hg Capture in Existing SCRs

- **Use High Reactor Potential**
 - Pack as much reactive catalyst per volume of space
 - Catalyst formulation
 - Limited by catalyst pitch (flue passage openings in catalyst), pressure drop and SO₂ to SO₃ oxidation
- **Use Catalyst Designed Specifically for high Hg Oxidation**
- **Good Ammonia / NO_x distribution into Layer 1**
- **Minimize ash build-up in SCR and catalyst modules (LPA Screens, Ash Sweepers etc.)**
- **Minimal ammonia slip leaving the SCR, and preferable entering the last catalyst layer (ammonia interferes with Hg oxidation)**

Key Differences for Hg vs. NOx



DeNOx

– Key Parameters

- NOx inlet
 - Efficiency
 - Slip
 - Temperature
 - SO₂ conversion (formulation)
 - Fuel → contaminants → K/Ko
 - Reactor condition
 - O₂, H₂O, SO₂ (lower impact)
- } *Performance Threshold*

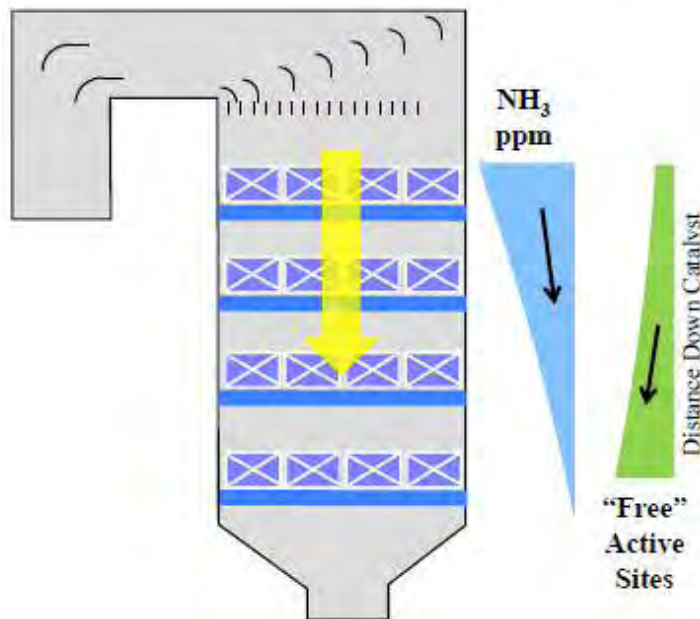
Hg

– Key Parameters

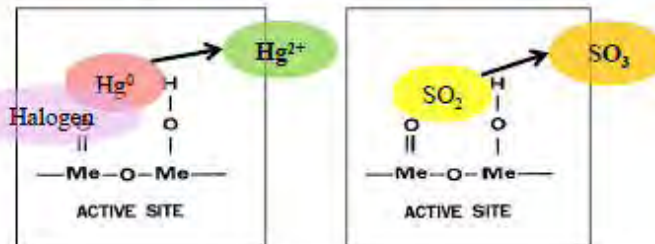
- NOx inlet
 - Efficiency
 - Slip
 - Hg oxidation → Performance Threshold
 - Temperature
 - SO₂ conversion (formulation)
 - Fuel → contaminants → K/Ko
 - Reactor condition
 - Halogen (Fuel or additive)
 - Layer position (NH₃)
 - CO
 - O₂, H₂O, SO₂ (can be larger impact)
- } *NH₃*

Ammonia Impacts on Hg Oxidation

Oxidation Rates Vary Based on Location in the Reactor



- Ammonia Concentration Decreases as Flue Gas Flows Down Through Catalyst Layers
 - Surplus or "Free" Active Sites Increase Down Through Reactor
- Surplus Active Sites Result in Increasing Rate of...
 - SO₂ to SO₃ Oxidation
 - Mercury Oxidation
 - Dependent on Catalyst Aging



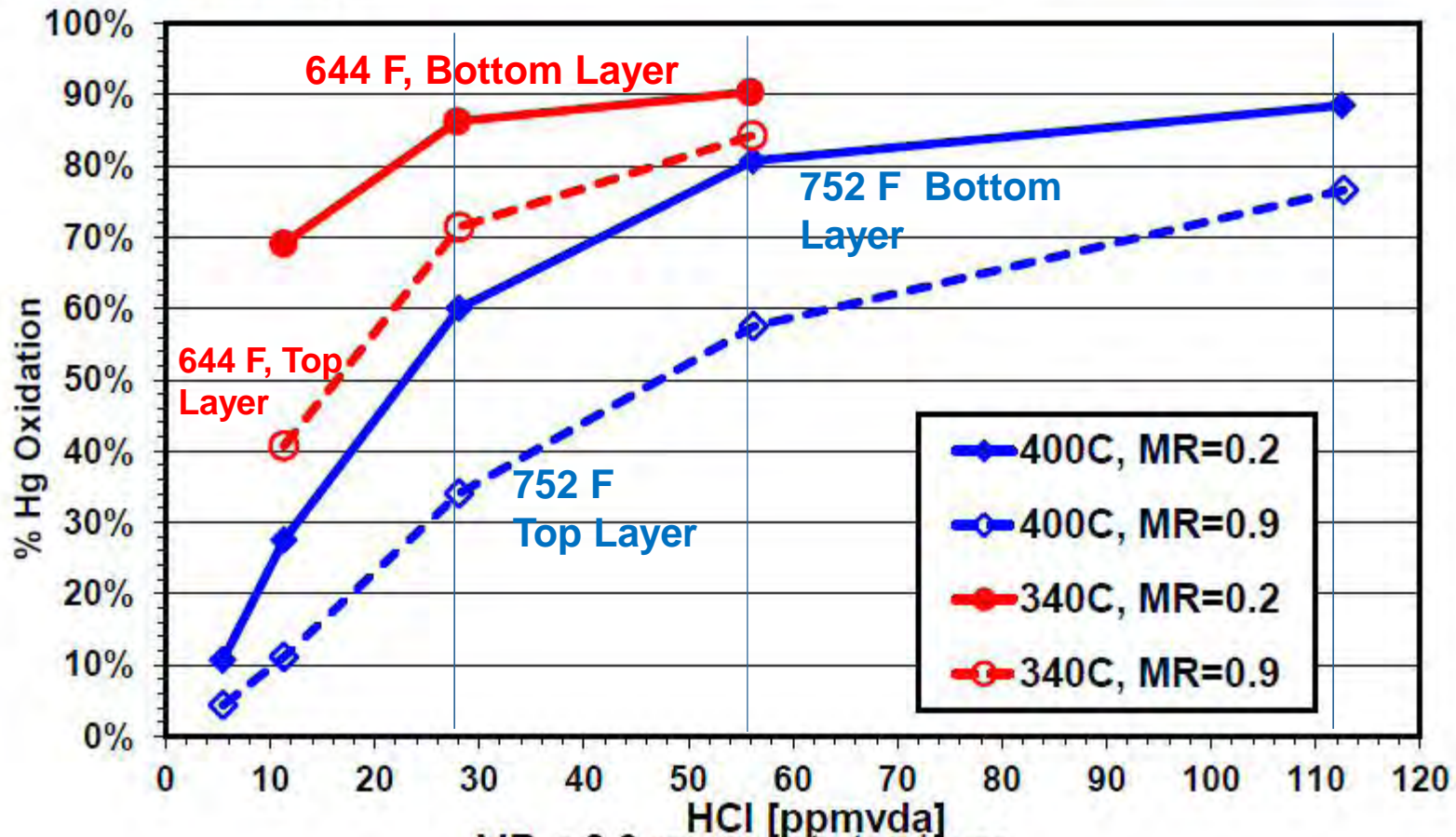
CERAM

Source: "Balancing NO_x Reduction, Ammonia Slip, and Mercury Oxidation"; Cochran; Reinhold Environmental NO_x Conference, Feb 2013

Understanding Parameter Impacts

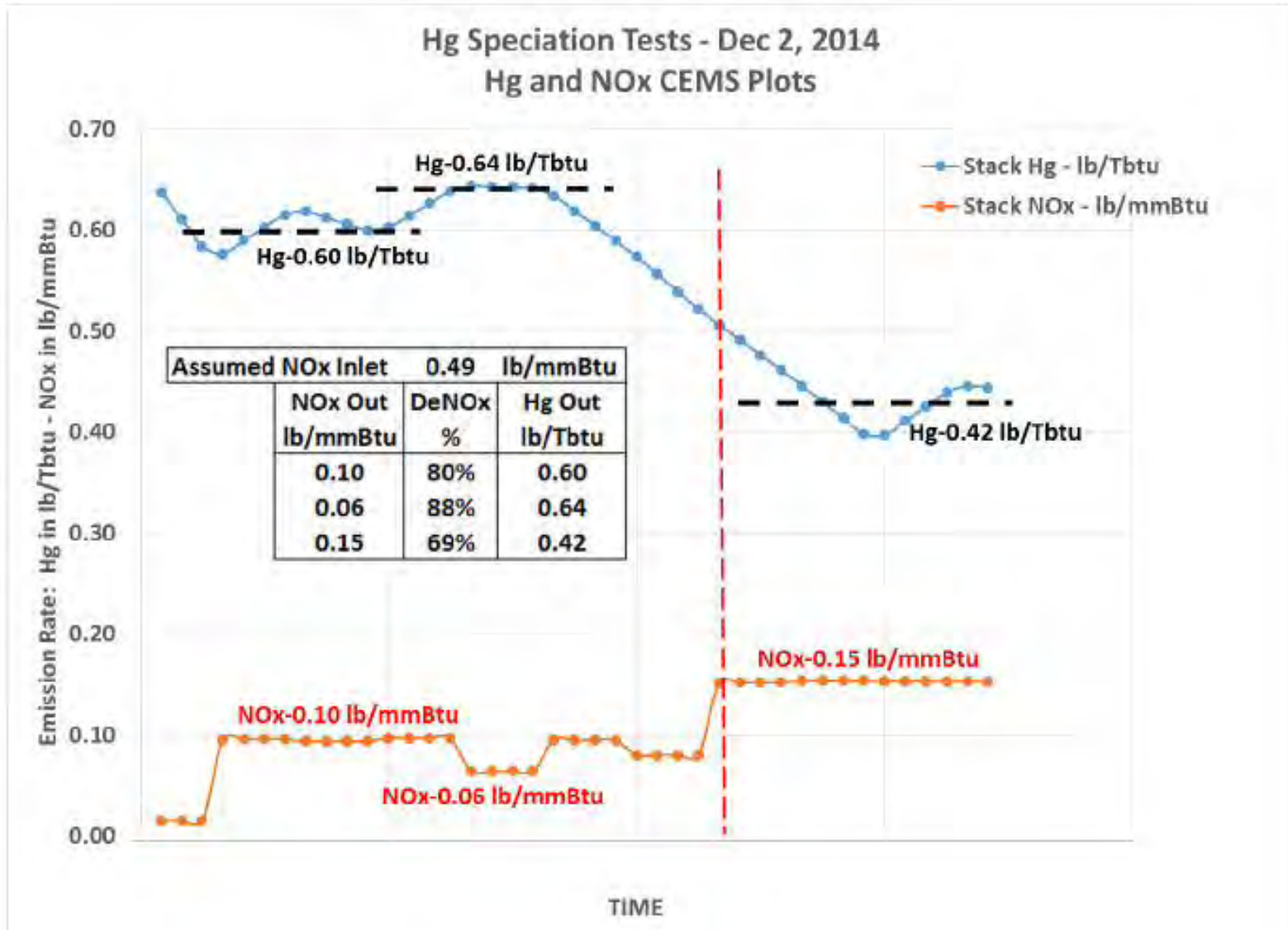


Layer Dependency **Less Hg Oxidation Top Layer – Greater Effect at Higher Temps**

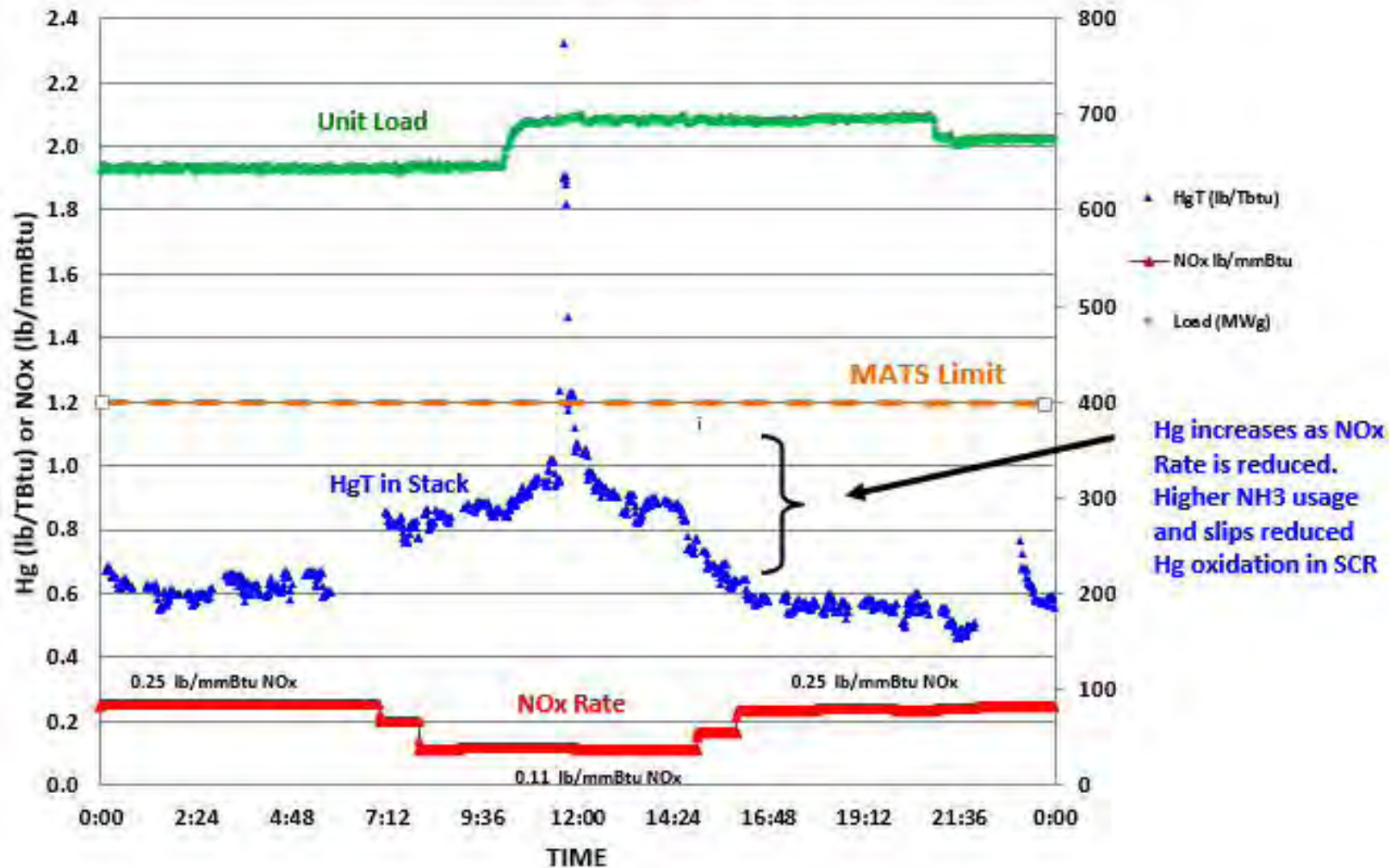


MR = 0.9 represents top layer
MR = 0.2 represents a lower layer

%deNOx Impact on Hg Emission (newer cat.)

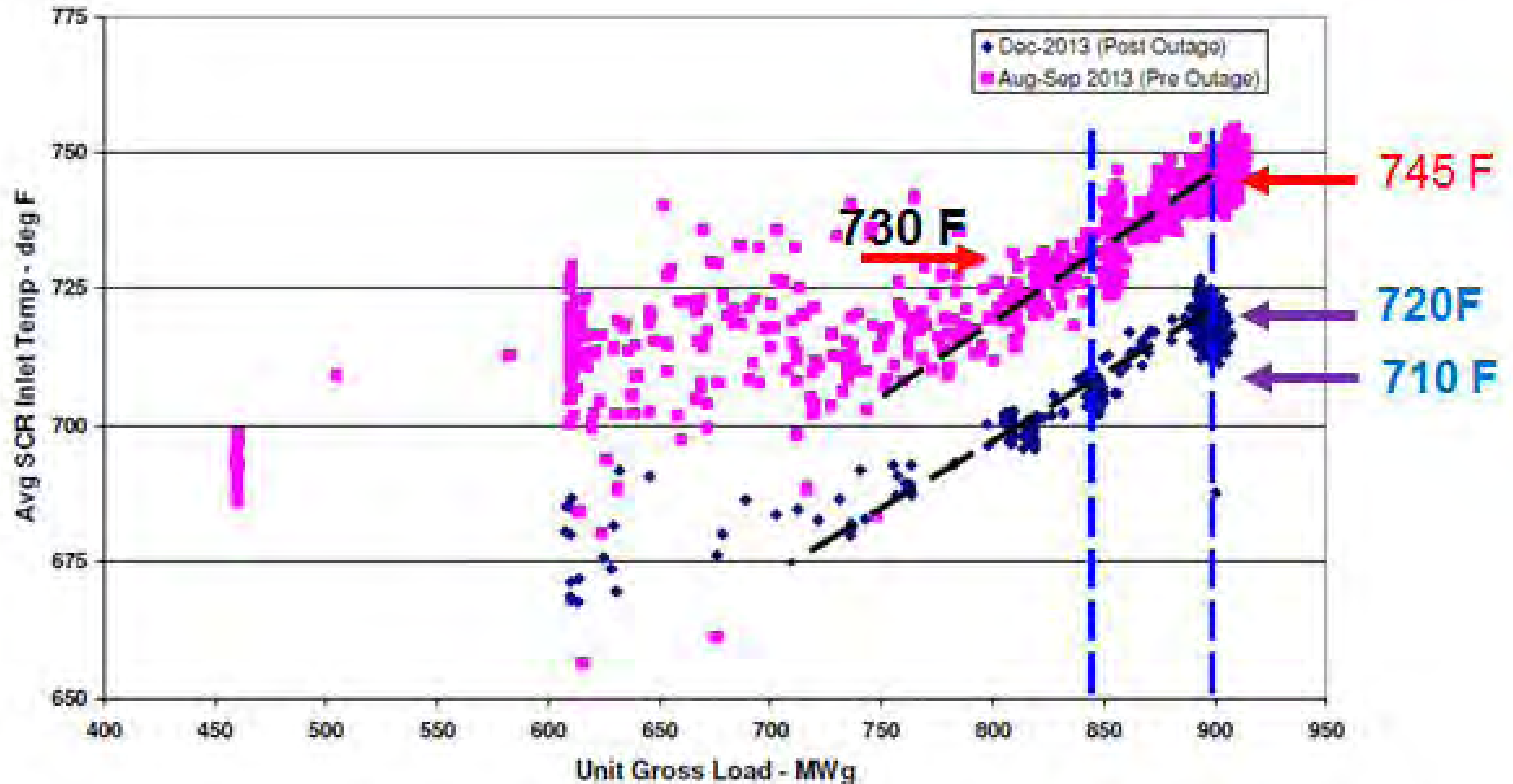


%deNOx Impact on Hg Emission (older cat.)



Flue Gas Temp Impact of Cleaning & Derates

SCR Inlet Temp Dropped 25 F by Cleaning Backpass;
Get another 10 F decrease with 50 MW derate



Primary Influences on Hg Oxidation in SCR

Many Factors Impact Hg Oxidation in SCR, but 3 major factors are Flue Gas Temp into SCR, HCl in Flue Gas and NOx Reduction

	NOx in lb/mmBtu	NOx out lb/mmBtu	deNOx %
Plant A	0.45	0.06	87%
Plant B	0.50	0.08	84%
Plant C	0.50	0.10	80%
Plant D	0.50	0.15	70%
Plant E	0.50	0.25	50%
Plant F	0.50	0.35	30%

Level of
deNOx



HCl ppmvd
in Flue
Gas

Flue Gas Temp
into SCR

	HCl Equiv ppmvd
Plant A	39 - 42
Plant B	46 - 53
Plant C	39
Plant D	42 - 56
Plant E	42
Plant F	46

	SCR Inlet Temp deg F	Impact on Temp After Outage
Plant A	730-750	Decreased 30 F (cleaned backpass)
Plant B	na	
Plant C	640-660	One Unit Increased 30 F
Plant D	660-700	One Unit Increased 30 F; other 10 F
Plant E	na	
Plant F	660-680	Only slight Increase, 5-10 F

Other Methods for Oxidizing Hg in Flue Gas

- **Calcium Bromide (CaBr₂) solution sprayed on coal**
 - Higher halogen levels boost oxidation
 - Very effective for coals with very low chlorine (PRB)
 - Less effective with high chlorine coals
 - FE Experience: In general have seen higher Hg oxidation with E-Bit coal, but not always. Sometimes saw no benefit for Hg in stack (due to higher Hg re-emissions in FGD)
 - Common MATS Strategy: Replace sufficient catalyst so CaBr₂ is not required when catalyst is new; Add CaBr₂ injection systems in the future as a secondary Hg control for when catalyst ages
- **Other options: Injection of iodine & ammonia chloride via ammonia supply to SCR**

Understanding Parameter Impacts

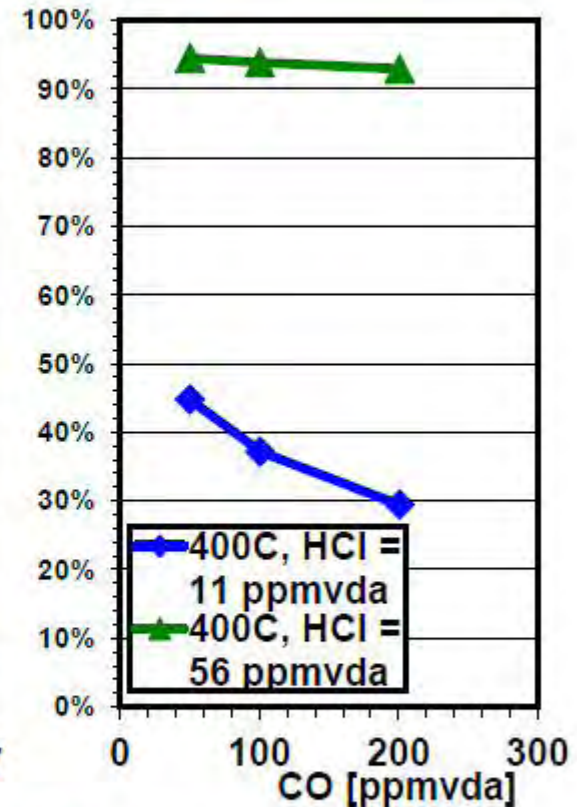
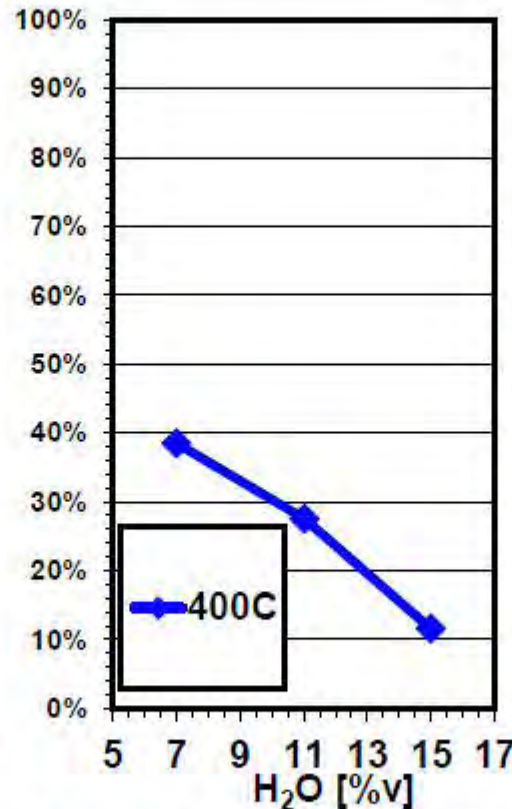
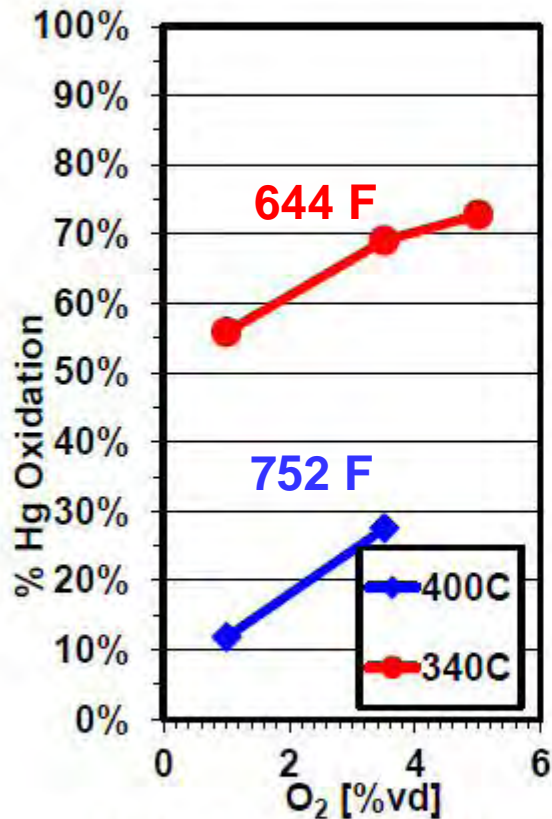
(O₂, H₂O, CO)



CORMETECH

400 C = 752 F

340 C = 644 F



- O₂, H₂O and CO have significant impact (minimal impact on DeNO_x);
- Impact is condition dependent (CO for example)
- Distribution of these parameters should be considered in setting design conditions.

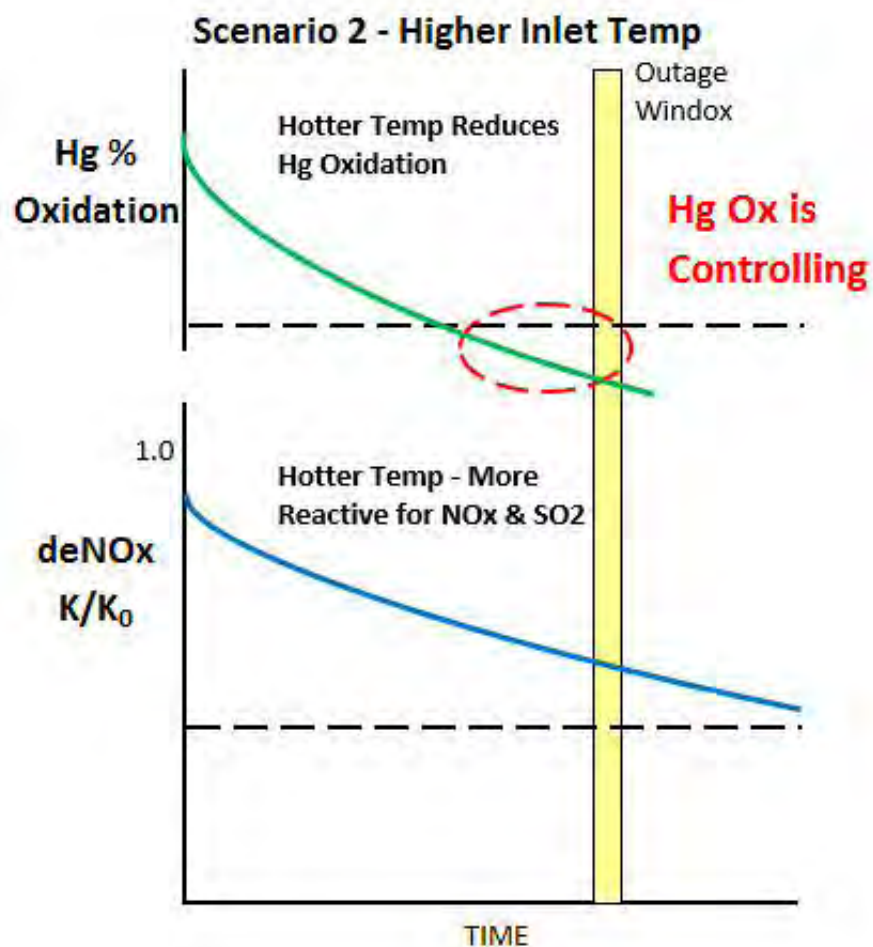
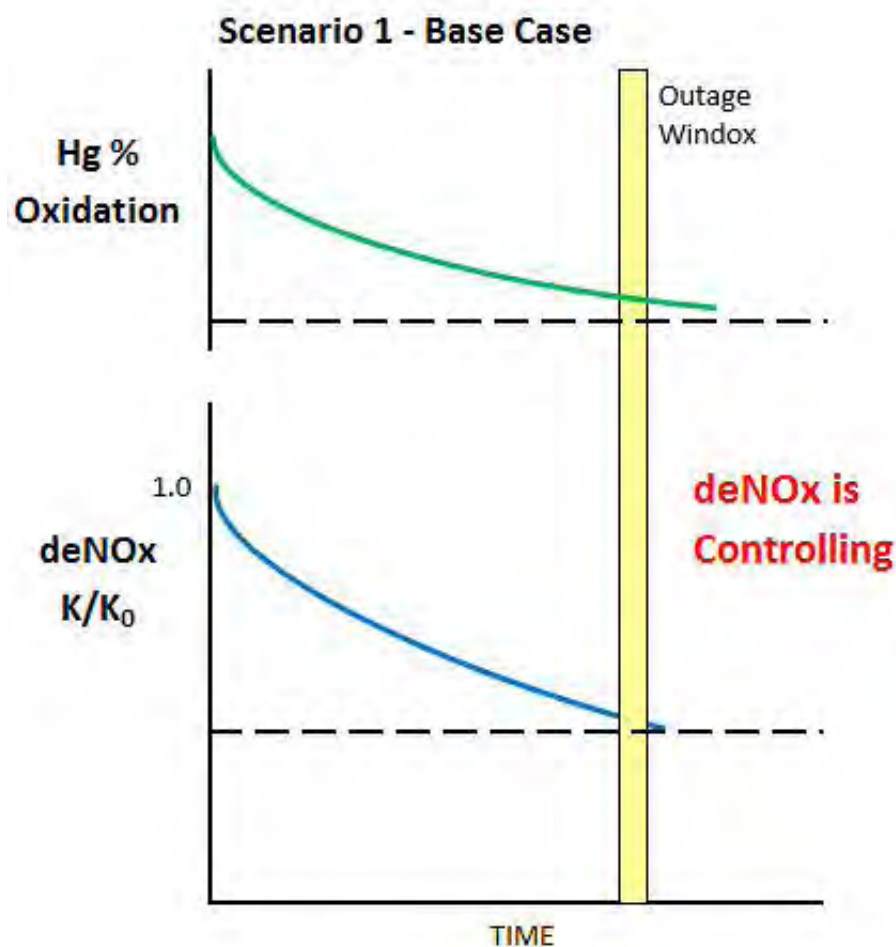
2013 Reinhold NO_x-Combustion Round Table
Salt Lake City, Utah

Page 16

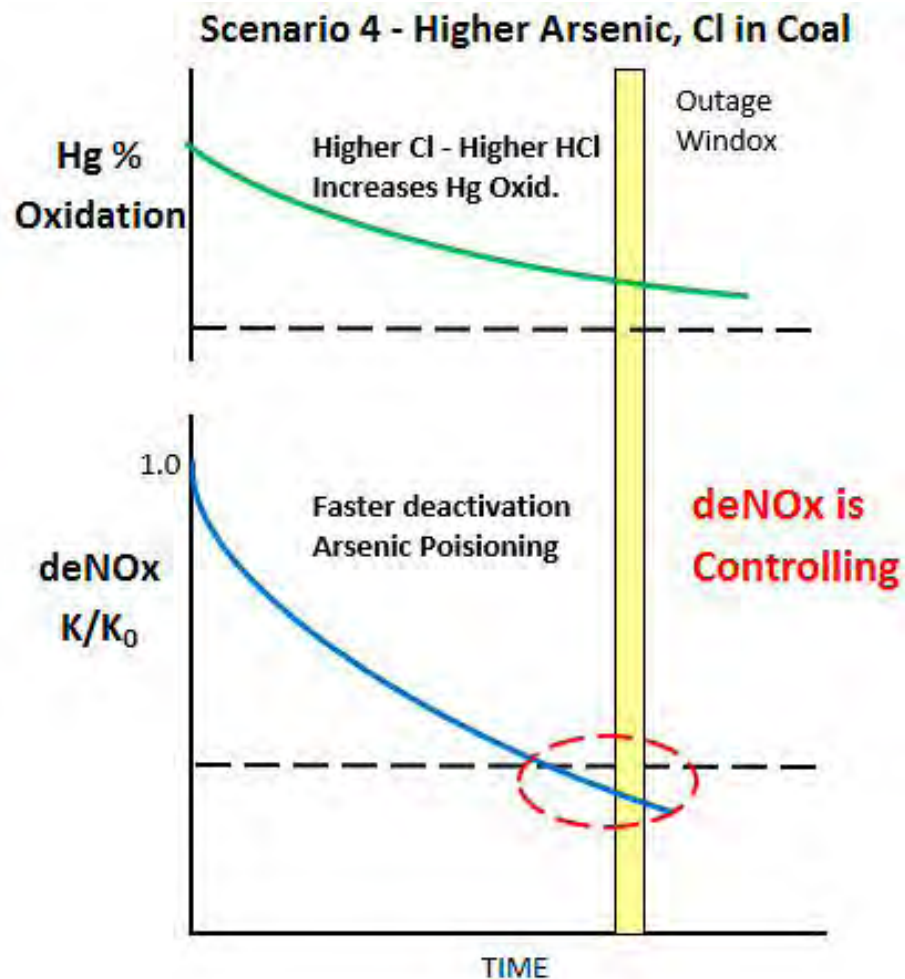
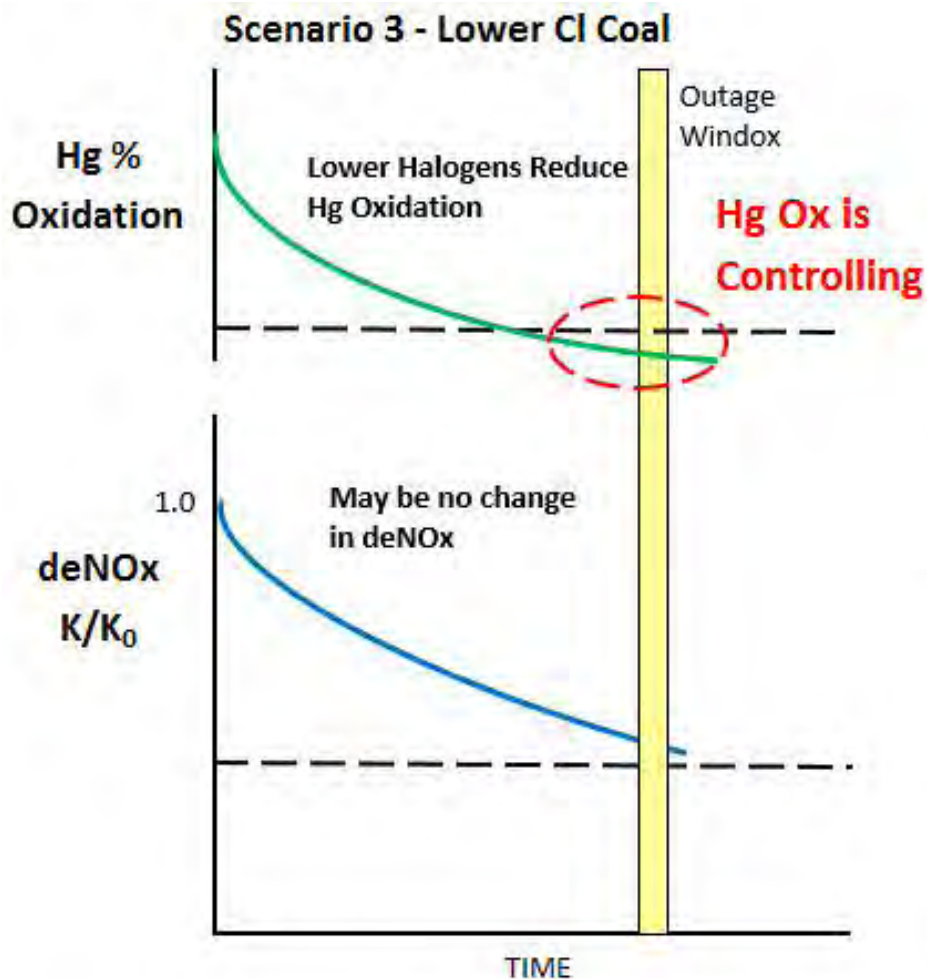
Quiz Time

Applying What You Have Learned About Changing Process Variables

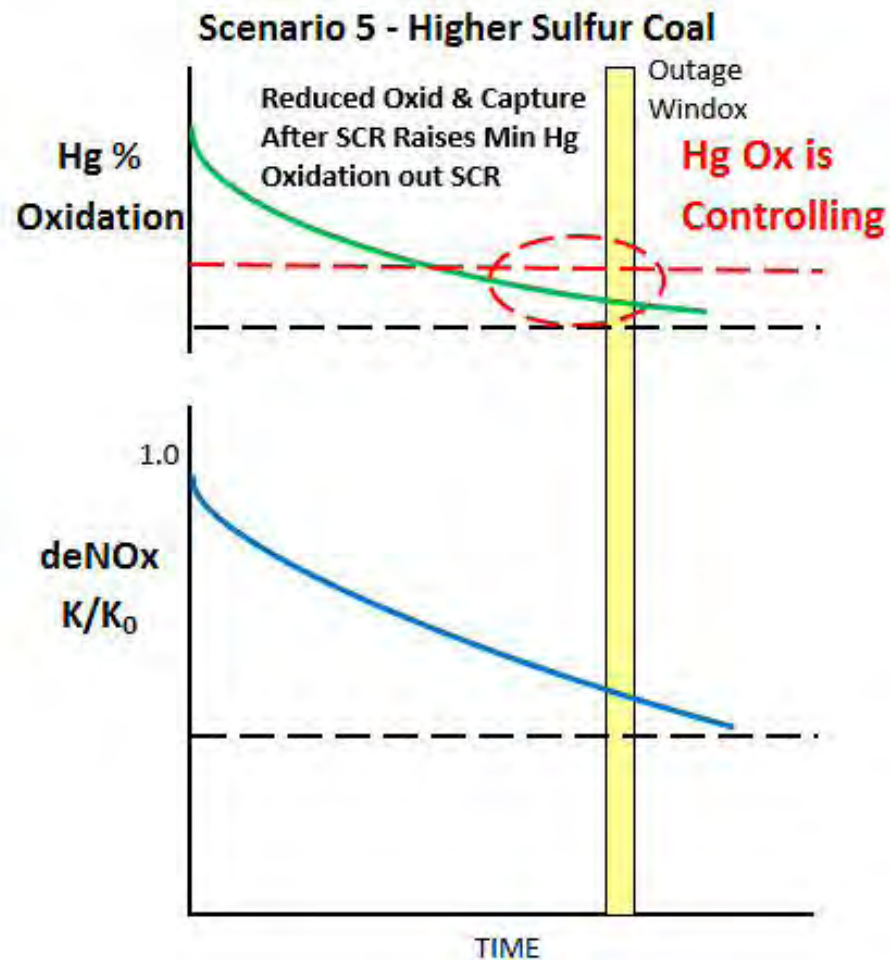
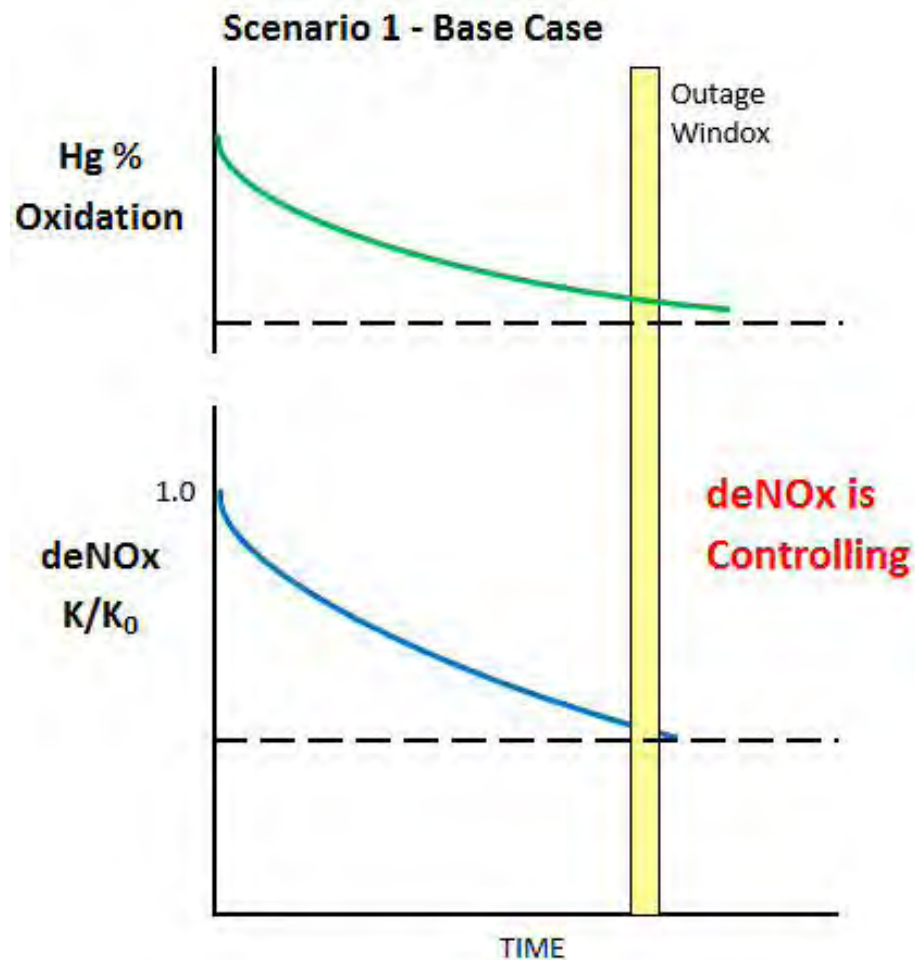
Changing Process Conditions can switch SCR Catalyst Plan between %deNOx Driven & Hg Oxidation Driven



Changing Process Conditions can switch SCR Catalyst Plan between %deNOx Driven & Hg Oxidation Driven



Changing Process Conditions can switch SCR Catalyst Plan between %deNOx Driven & Hg Oxidation Driven



Factors Affecting Hg Capture Air Heater-ESP

Combustion Tuning and Flue Gas Impacts

- **Staging Combustion for Lower Burner NOx**
 - Lower NOx
 - Higher CO
 - Higher LOI/UBC
- **Impacts on SCR Oxidation of Staging for Lower NOx**
 - Lower NOx can mean lower deNOx in SCR (Good)
 - Higher CO, lower Hg Oxidation (Bad)
 - Higher LOI/UBC which can help (Good)
 - reduce Hg by increasing capture of Hg from flue gas

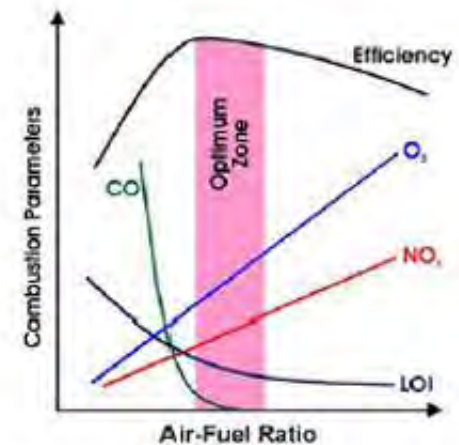


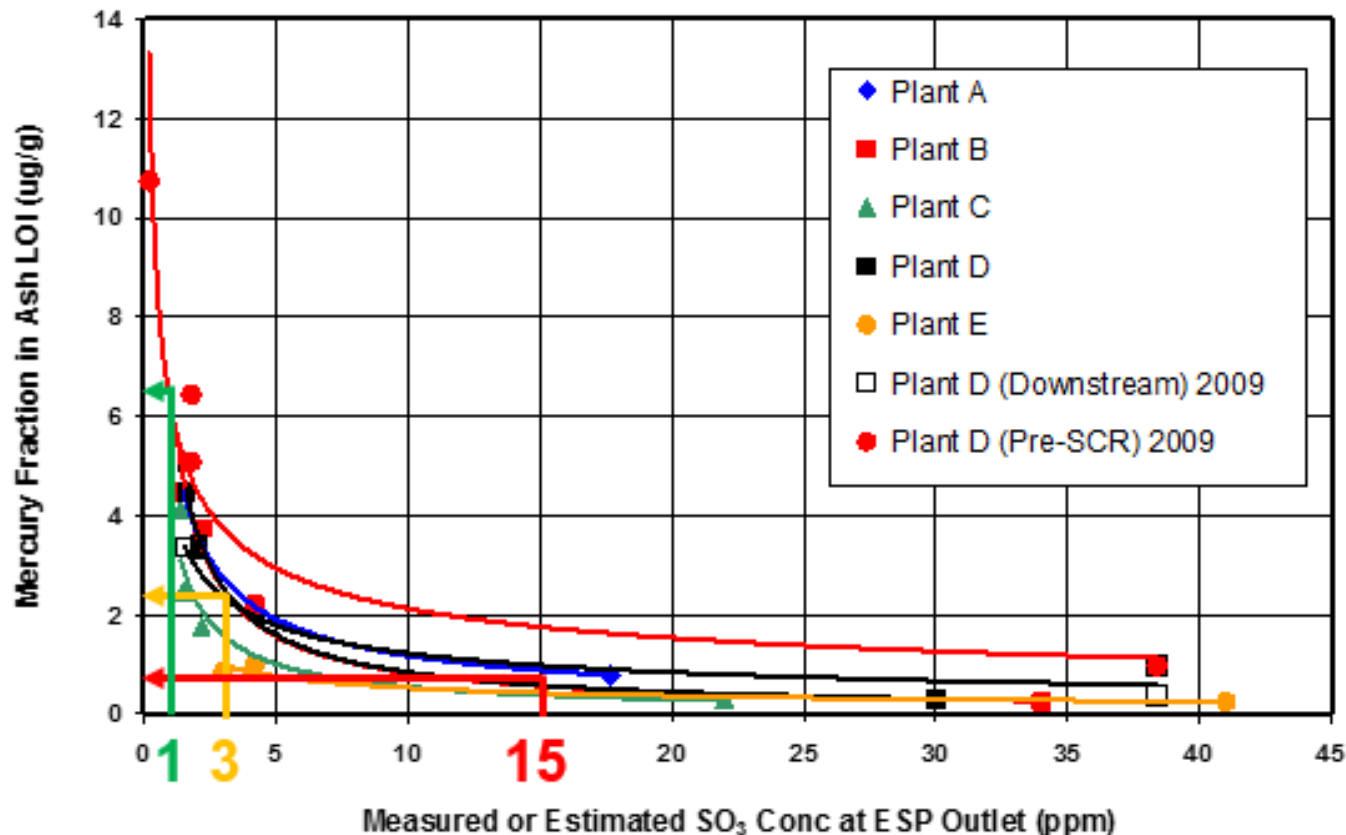
Figure 4-5
Relationships Between Combustion Parameters and Air-Fuel Ratio

Hg Oxidation Across Air Preheater

- **The Air Heaters typically reduce the Flue Gas Temp from > 600F to 290-325 F depending on the Design and Condition**
- **As the flue gas cools, the following happens in the flue gas**
 - SO₃ is converted to H₂SO₄ and some is captured on the fly ash
 - Total Hg is reduced as Hg adsorbs on to fly ash
- **Factors affecting Hg capture on the fly ash**
 - **Need SO₃ < 5 ppm at Air Heater Outlet** - the lower SO₃ can give greater capture of Hg on the ash
 - **Need Gas Temps < 350 F** - lower temps can give greater capture of Hg on ash
 - **Need higher levels of LOI or Unburned Carbon** – “poor man’s ACI”
 - **Volume of fly ash**
 - **Halogens (HCl, HBr) in Flue Gas**

Impact of Hg Capture on Ash

Hg capture improves below 5 ppm SO₃ and is significant at 1-2 ppm SO₃

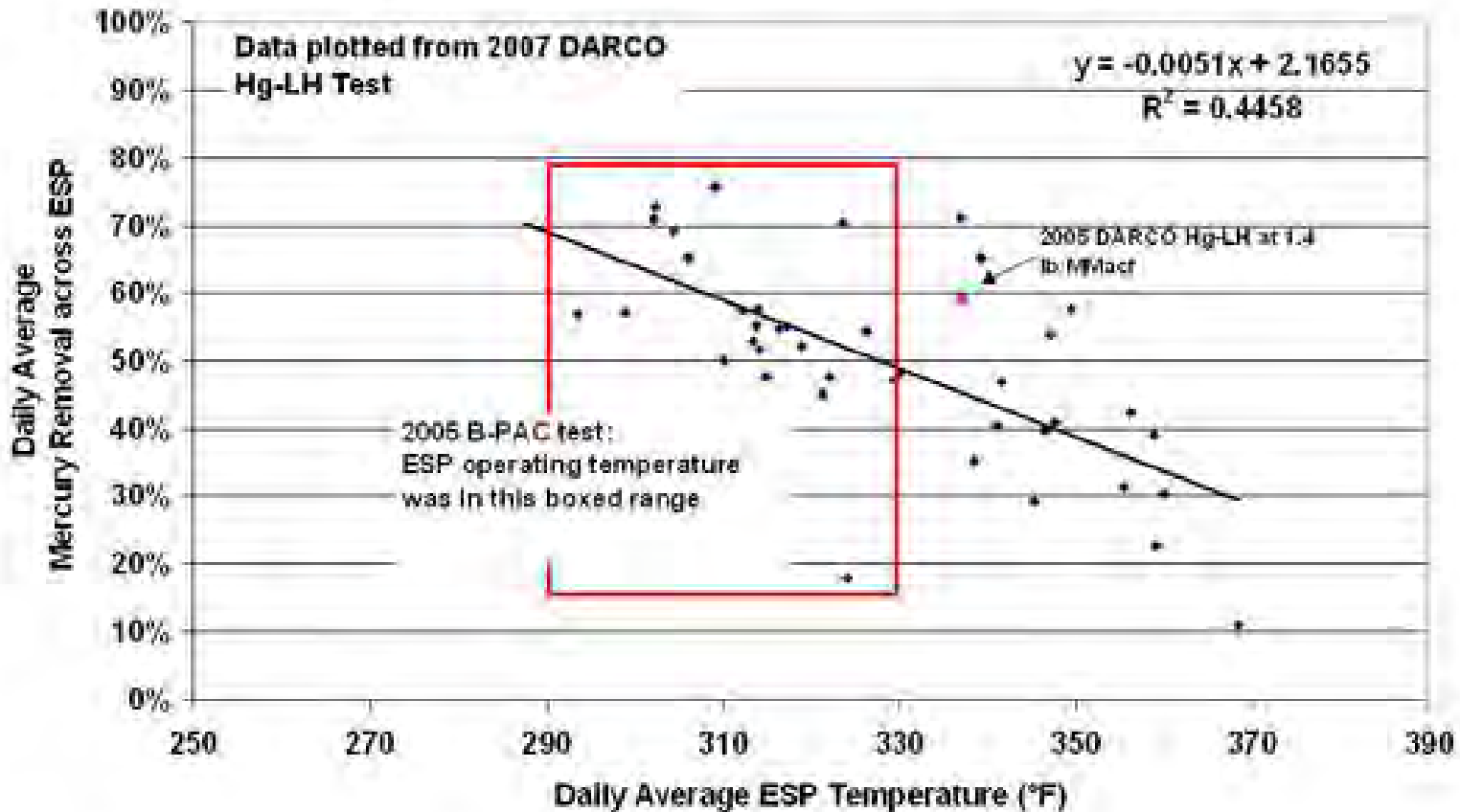


Source: "Strategy to Reduce Mercury Emissions without Halogen Addition or PAC Injection", Sterling Gray, URS Corporation, March 2013

PAC Performance vs Temp

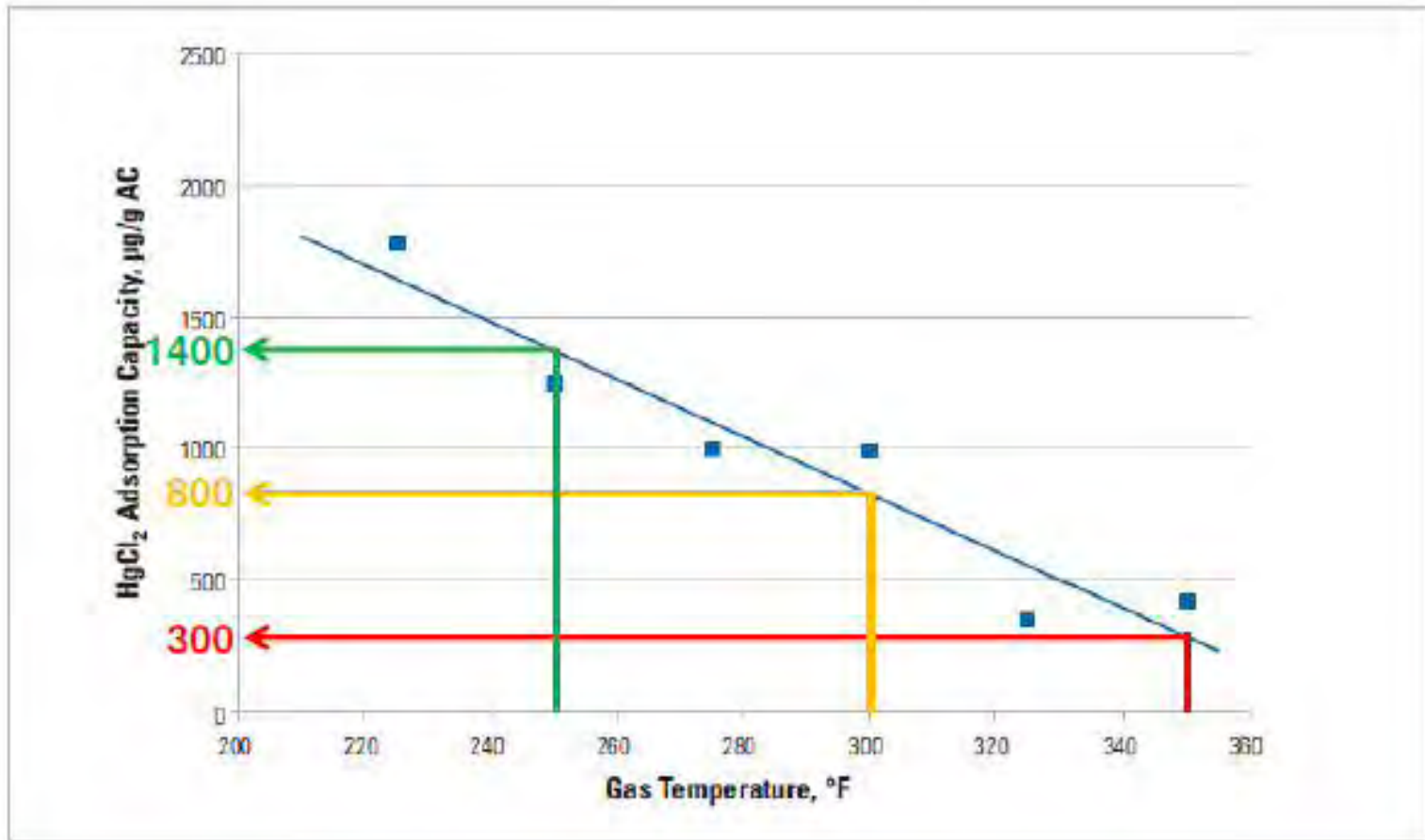
Looking at Powdered Activated Carbon as a Surrogate for Unburned Carbon on Ash

PAC Injection Upstream of ESP



Source: "Activated Carbon Injection at Stanton Station Unit 1"; Richardson; URS; DOE Report, 2008

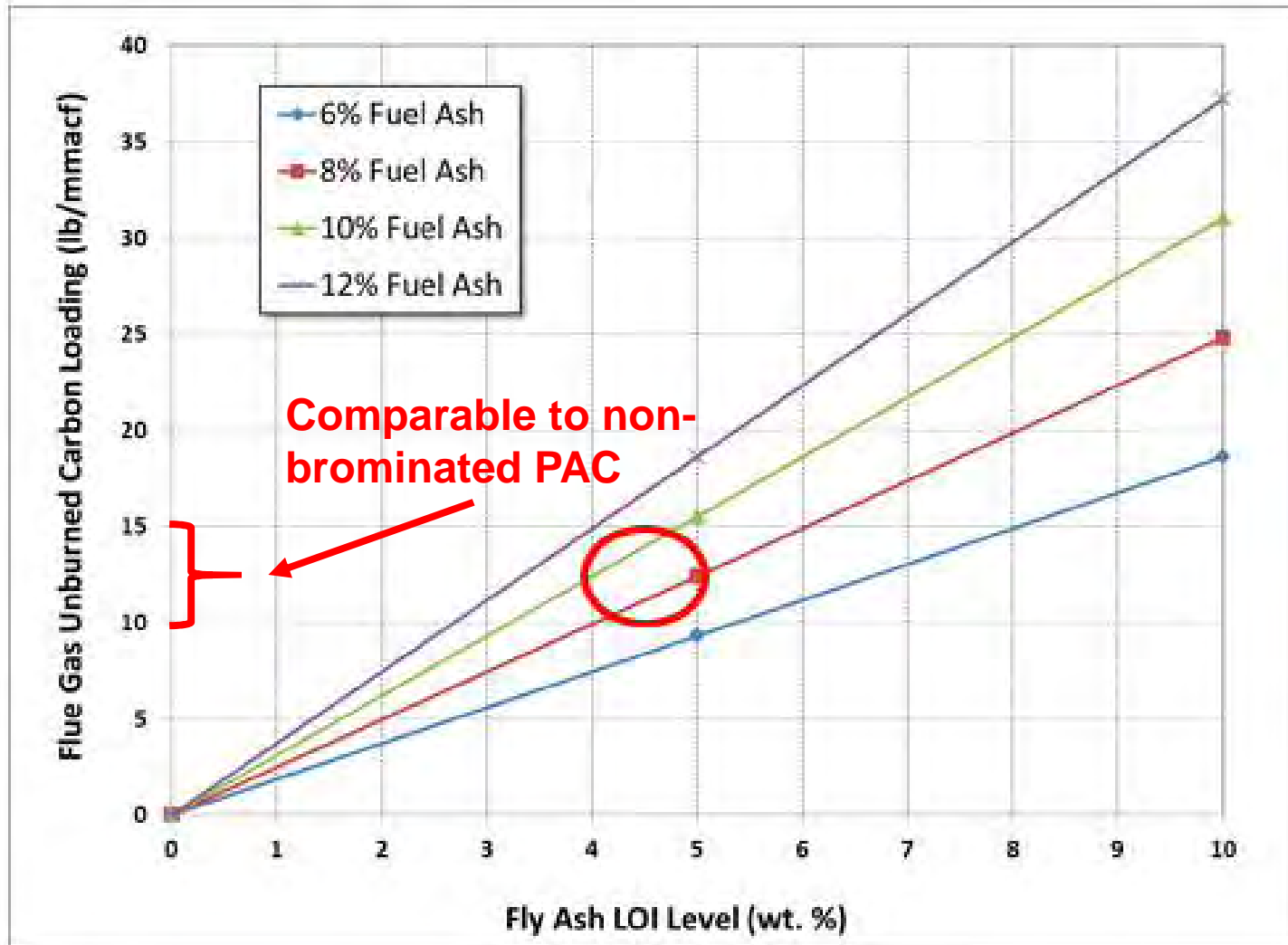
PAC Performance vs Temp



Adsorption capacity of PAC increases at lower temperature

Source: "Strategy to Reduce Mercury Emissions without Halogen Addition or PAC Injection", Sterling Gray, URS Corporation, March 2013

UBC Loading vs Fly Ash LOI



Source: "Strategy to Reduce Mercury Emissions without Halogen Addition or PAC Injection", Sterling Gray, URS Corporation, March 2013

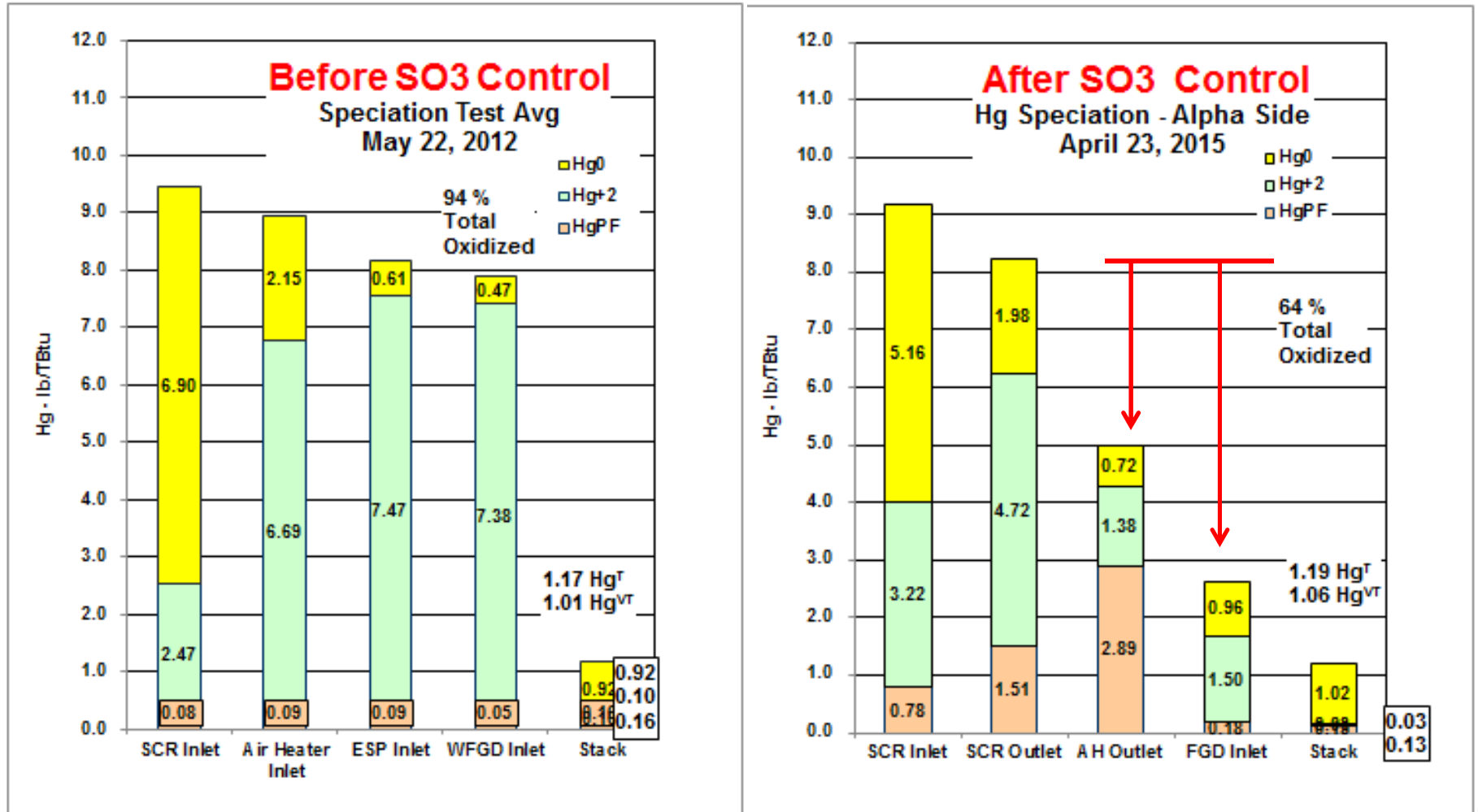
Hg Capture Across Air Preheater

Air Heater Outlet Conditions

	AH Outlet Temp deg F	AH Outlet SO3 ppmwd	AH Outlet LOI or UBC	Ash Loading in Coal lb/mmBtu	Carbon Loading lb/mmACF	Halogens HCl in Flue Gas ppmvd	Net Effect
Plant A	300-340	<5	3-5%	6.6-7.4	8	38-41	Cannot get to 1-2 ppm SO3
Plant B	290-320	> 5	2-6%	9.0-10.0	11	46 - 53	SO3 Limiting
Plant C	290-300	>> 5	5-10%	9.7	20	39	Low HCl-High SO3
Plant D	320-325	<< 5 *	4-7%	7.3-7.5	12	42 - 56	Winter, 1-2 ppm SO3
Plant E	290-300	< 5	3-25%	9.0-10.0	>30	38-43	High LOI, Moderate SO3
Plant F	290-300	< 5	3%	9.0-10.0	8	30-45	Cannot get to 1-2 ppm SO3

- Plant D – with higher SBS injection rate, can go << 5 ppm SO3
- Plants E,F – based on current coal; considering use of higher sulfur coal

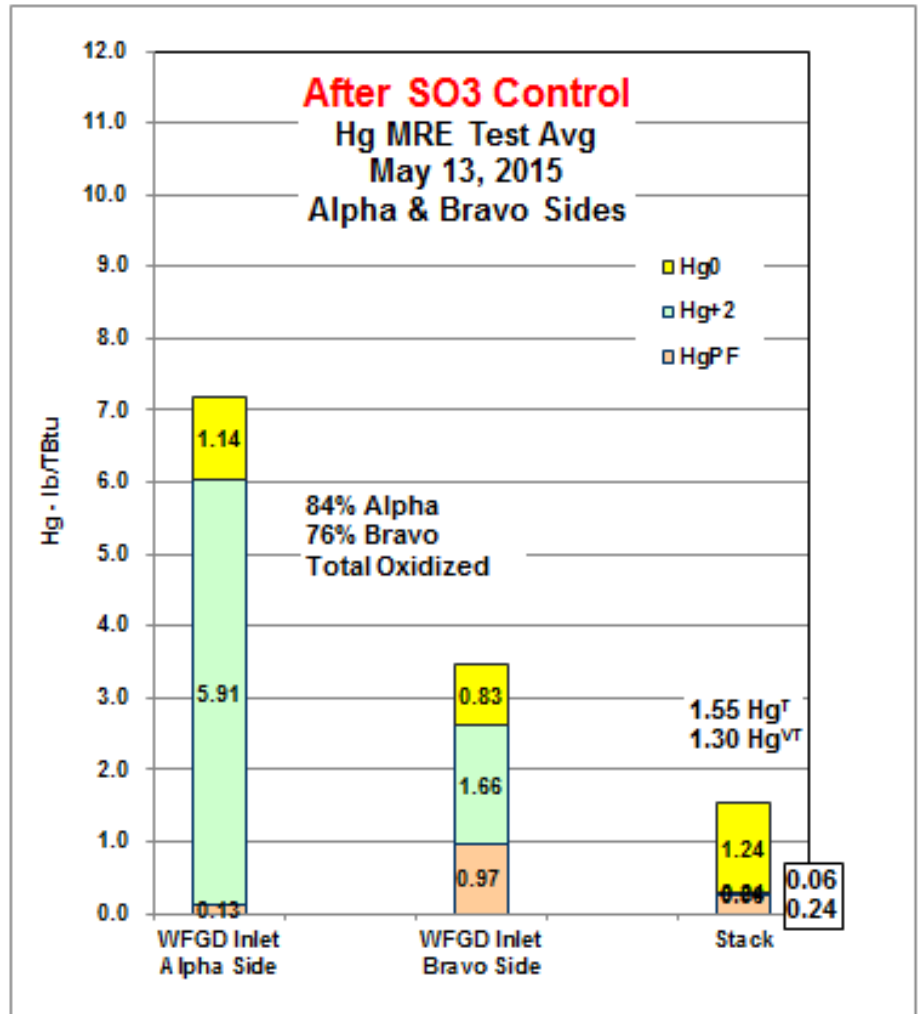
Hg Speciation: Before & After SO3 Control



Greater Hg Capture on fly ash AFTER SO3 Control in operation

Evaluation of Changing Conditions

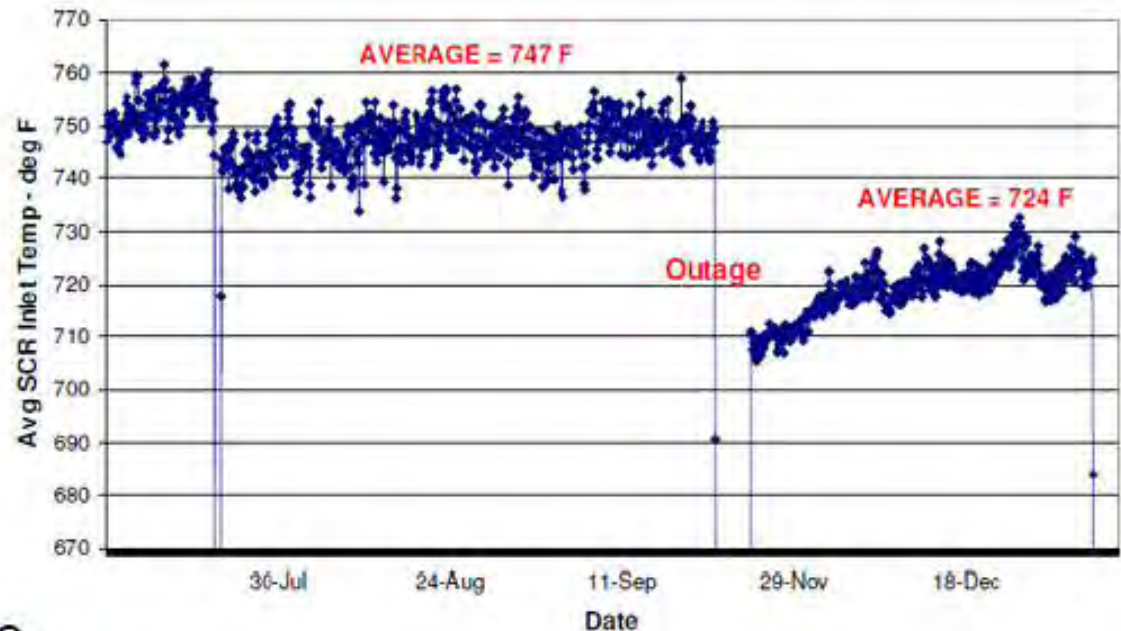
- Recently, Unit saw unexpected increase in Hg emissions
- Emissions on “sister” unit did not change
- ORP on both units showed no changes
- Hg Speciation Testing shows less Hg capture on flyash on Alpha side
- Root Cause Analysis for less Hg capture on Alpha Side in progress. Potential causes:
 - Higher flue gas temp
 - Higher SO₃ after AH
 - Less LOI on ash



Evaluate Changing Process Conditions

- Plant conditions change over time affecting Hg capture. Examples:

- **Flue Gas Temp into SCR** – cleanliness of convection back pass
- **Correction of air Inleakage** - raises flue gas temp, reducing Hg capture
- **Combustion Tuning** – may reduce LOI and reduce Hg capture on fly ash



Maximizing Hg Capture in WFGD

Hg Capture In Wet FGD

- Oxidized Hg (Hg+2) is soluble – WFGD will scrub out
- Elemental Hg (Hg0) has very low solubility – passes through WFGD to Stack
- Hg Re-emissions
 - Occurs when oxidized mercury captured in the scrubber liquor converts back to elemental mercury, Hg0.
 - Hg0 has low solubility in the scrubber liquor and is re-emitted.
 - Observed when Hg0 Stack > Hg0 into FGD

Example:

Hg in Lb/mmBtu	No Re-emission		With Re-emission	
	Into FGD	Stack	Into FGD	Stack
Hg0 (Elemental)	1.0	1.0	1.0	2.0
Hg+2 (Oxidized)	9.0	0.1	9.0	0.1
HgT (Total)	10.0	1.1	10.0	2.1

Hg Capture in wFGD

- **Step 1: Scrub Oxidized Mercury (Hg+2) from flue gas and collect Hg in scrubber liquor**
 - Need good spray coverage & L/G (SO₂ Removal)
 - Maximize % Oxidized Hg entering WFGD
- **Step 2: If re-emissions occur,**
 - Use additives (sorbents, chemicals) into scrubber to reduce re-emissions (better understood due to field testing)
 - Adjust process conditions to mitigate or reduce re-emissions (less understood)

ORP or Oxidation Reduction Potential

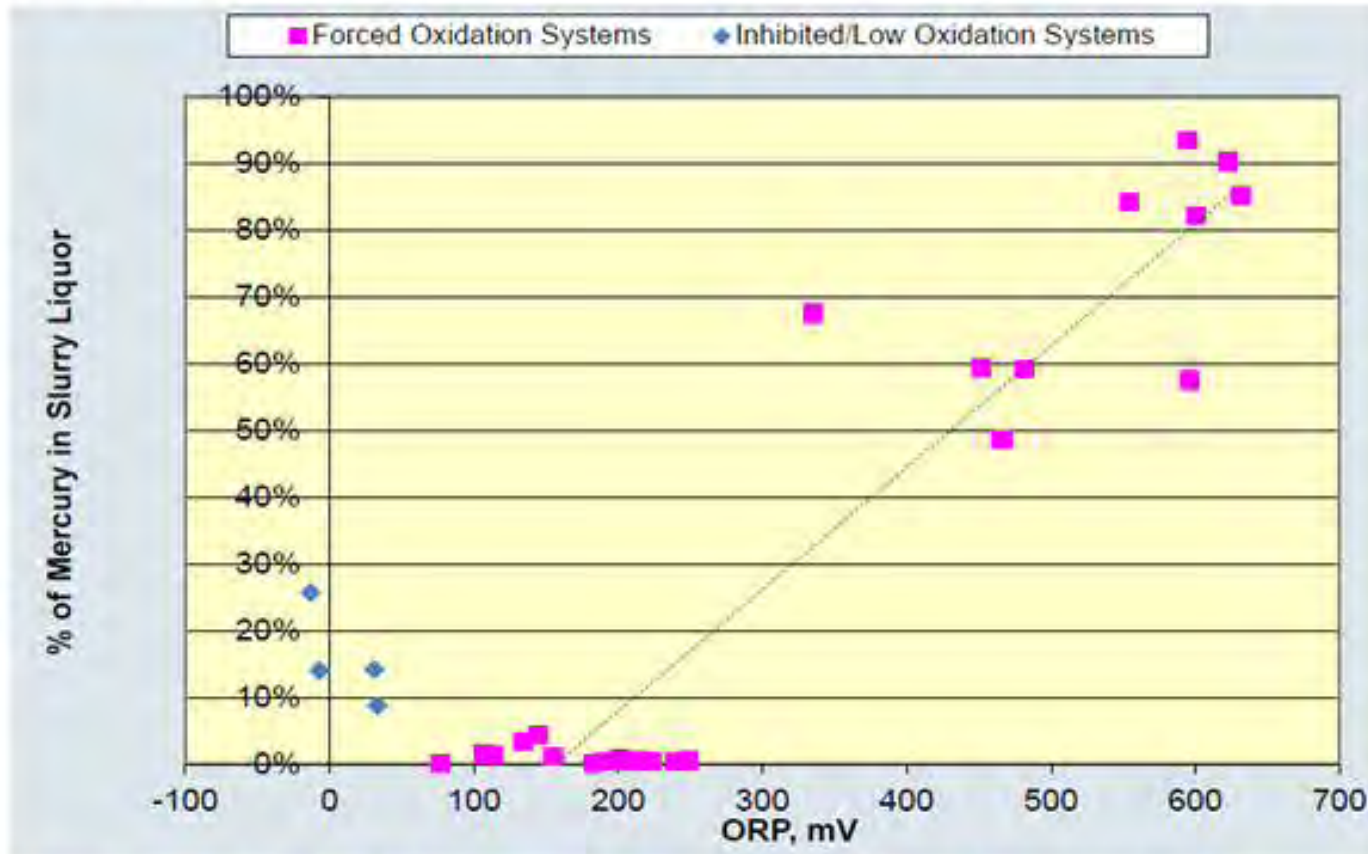
- **ORP is a measure of a solution's potential to oxidize or reduce anything in contact with it**
- **ORP indicates oxidation state and phase partitioning in FGD Slurry**
 - Hg in slurry: Partitions to liquid phase for high ORP, solids for low ORP
 - Selenium:
 - For ORP < 300 mv, Se at Selenite, Se(IV) which can be captured in WWT systems
 - For ORP > 300mv, Se forms as Selenate, Se(VI), a dissolved ion that is more difficult to treat
 - Manganese Corrosion
 - High ORP > 500 mv has been shown to cause MnO₂ to precipitate from solution leading to potential for severe and accelerated allow corrosion
 - In Limestone Forced Oxidation scrubbers, ORP typically 100 – 800 mv
 - In Mag-Lime scrubbers, ORP typically 50 to slightly negative

Source: Optimization and Process Control of Air Quality Control Systems for Improved WFGD Oxid Chemistry and Effluent Composition for WWT", Power-Gen, Nov-2013, B&W, DTE, SRI

Common Indicators of Re-emissions

- **ORP (Oxidative Reduction Potential)**

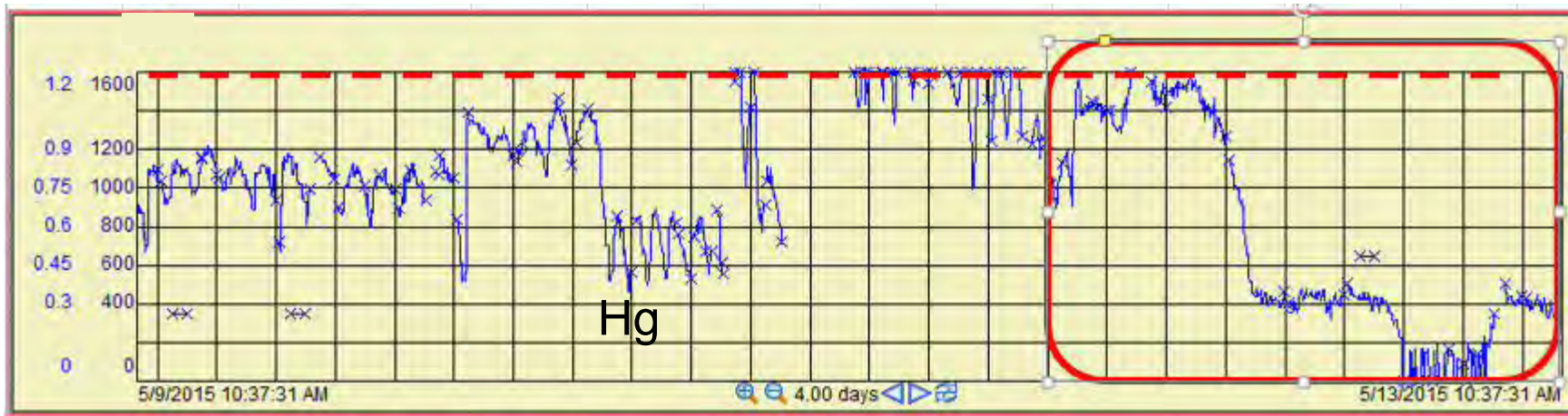
For LSFO WFGD – ORP 100-300 mv Recommended



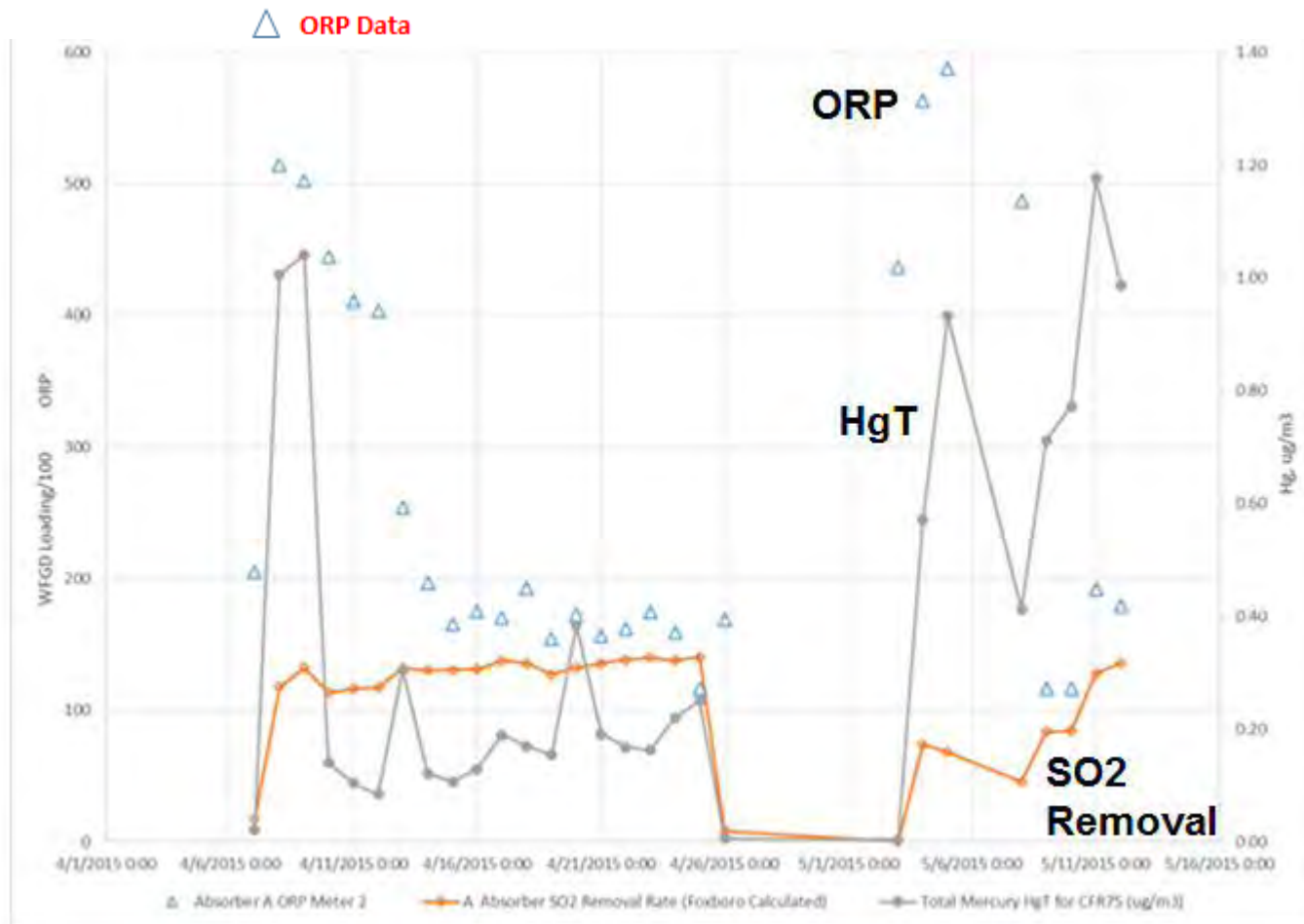
Source: "Impacts of Current Coal Unit Operations and Environmental Regulations on Wet FGD Systems", URS Corp & EPRI (Mega Symposium 2015)

Example of FE Plant with Sudden Hg Drop

- On May, 13 – within a few hours, Hg dropped from 1.2 to 0.3 lb/Tbtu. ORP dropped during the same time
- Hg Plot



FE Plant Example – ORP vs Hg



Common Indicators of Re-emissions

- **Dissolved Hg levels in scrubber slurry** (Source 1)
 - Studies have shown that re-emissions from some WFGD tend to increase with Higher dissolved Hg levels in scrubber liquor - but not always.
 - Increasing Hg oxidation via halogen addition to coal or new catalyst will increase Hg dissolved in WFGD liquor and may result in re-emissions

Source 1: "Bench-scale Kinetics Study of Hg Reactions in FGD Liquors", Aug-2008, Blythe, Curry, DeBerry (URS, now AECOM)

Process Conditions that Impact Re-emissions (Source 1)

- **Conditions for good wallboard gypsum quality in LSFO is counter to desired conditions for Hg re-emission control.**
- **Advantageous Operating Mode for gypsum quality**
 - Use high Oxidation Air rates to minimize liquor sulfite in reaction tank
 - Set pH as low as possible and still achieve desired SO₂ removal
 - Use high blowdown to keep chloride levels down
- **Optimum Conditions for controlling Hg re-emissions**
 - Reduce Oxidation Air Rates
 - Increased sulfite levels
 - Increase halogen levels (chlorides, bromides) in slurry
 - Dissolved halogens form stable complexes with oxidized Hg
 - Higher dissolved halogen levels – less likely to re-emit.
 - Increased Slurry pH

Other Process Conditions that Impact Re-emissions

- **Sulfites in liquor – At higher sulfites, get less re-emissions with increasing pH**
- **Sulfur–Nitrogen species dissolved in WFGD liquor form over time due to NOx in scrubbed gas. They tend to increase re-emissions**
- **Thiosulfate**
 - Inhibits re-emission at low pH (e.g. pH <6 for LS FGD), but
 - Can accelerate re-emissions at higher pH (e.g. pH > 6 for lime FGD)

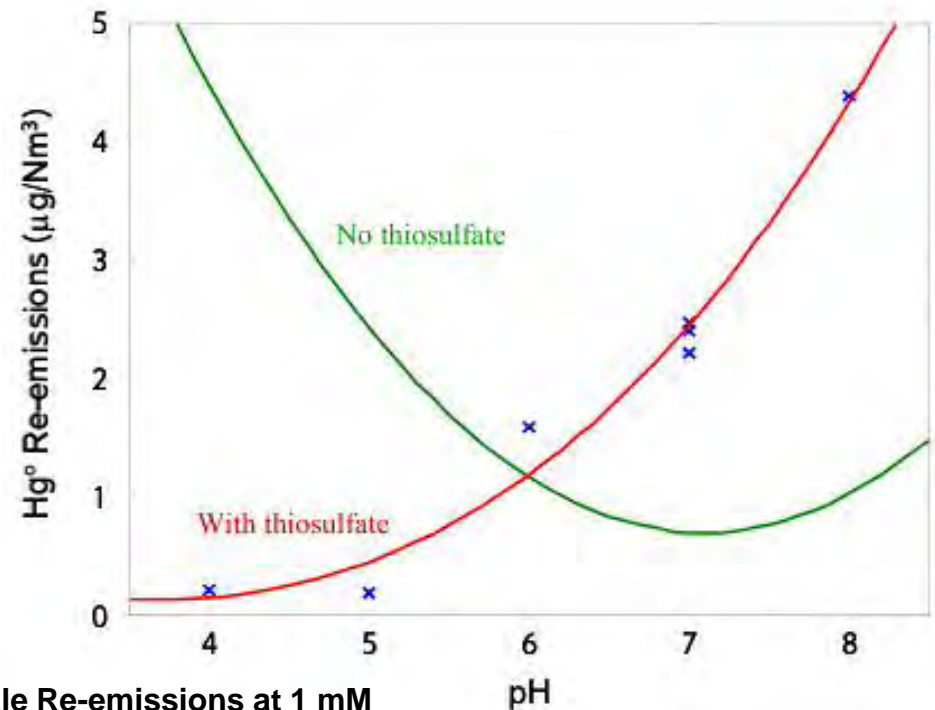


Figure 46. Bench-scale Re-emissions at 1 mM Thiosulfate, as a Function of pH

Other Process Conditions that Impact Re-emissions

- **Slurry temp – re-emission increases with higher slurry temp**
- **Limestone trace impurities (iron, manganese)**
 - Precipitated iron hydroxide fines in FGD slurry improve Hg adsorption / co-precipitation of Hg from FGD liquors
 - Higher % of MN in liquor – more reducing – more likely to re-emit
- **ESP Performance**
 - Some H₂S is formed in flue gas and can help precipitate Hg as solid in FGD, reducing Hg re-emissions
 - Higher ozone can destroy H₂S in flue gas

Mercury Re-emissions Control Options

- **Common Technology Options FirstEnergy will have tested all of the above by late Summer, 2015. Testing has shown varying levels of success.**
 - Add “KleenScrub” chemical to WFGD Slurry (EES)
 - Add MerControl 8034 to WFGD Slurry (Nalco)
 - Add Ferrous Sulfide to WFGD Slurry (Redox Solutions)
 - Add Powdered Activated Carbon to WFGD Slurry (Steag)
 - Add Sodium Hydrosulfide to WFGD Slurry (TDC/Joe Stuart/B&W)
 - Add Calcium Bromide to WFGD Slurry
- **Other options not tested by FE (not a complete list)**
 - Addition of TMT-15
 - EMO (HBr addition to Flue Gas)
- **Other Options**
 - Automated control of oxidation air to scrubber (Advatech)

GENERAL STRATEGY FOR MERCURY CONTROL

General Strategy for Hg Control

■ Maximize Mercury Oxidation

- Replace SCR Catalyst optimizing for Hg oxidation and reducing ammonia slip
- Reduce deNOx level (if possible) to Reduce Ammonia Slip
- Mitigate Catalyst Pluggage of Fly Ash: Proper Catalyst Pitch Size, Capture Large Particle Ash (Ash Hopper / LPA Screens), use of Ash Sweepers to keep ash off catalyst
- Reduce SO₃ before & after APH (if practical)
- Provide adequate halogens (chlorine, bromine or iodine) in flue gas
- Reduce Flue Gas Temp into SCR if high: Clean backpass or derate unit if necessary to achieve Lower SCR Inlet temperature to meet Hg Oxidation targets

General Strategy for Hg Control - continued

■ Increase Native Capture on Ash

- Lower SO₃ and flue gas temperature out APH (if practical)
- Use “unburned” carbon on ash to adsorb Hg (MATS tuning may negate this benefit)

■ Maximize Hg Capture in WFGD

- Assure good spray coverage in scrubber
- Mitigate FGD Re-emissions (if it occurs)
 - Add chemicals or sorbents to reduce dissolved mercury in FGD liquor or wastewater

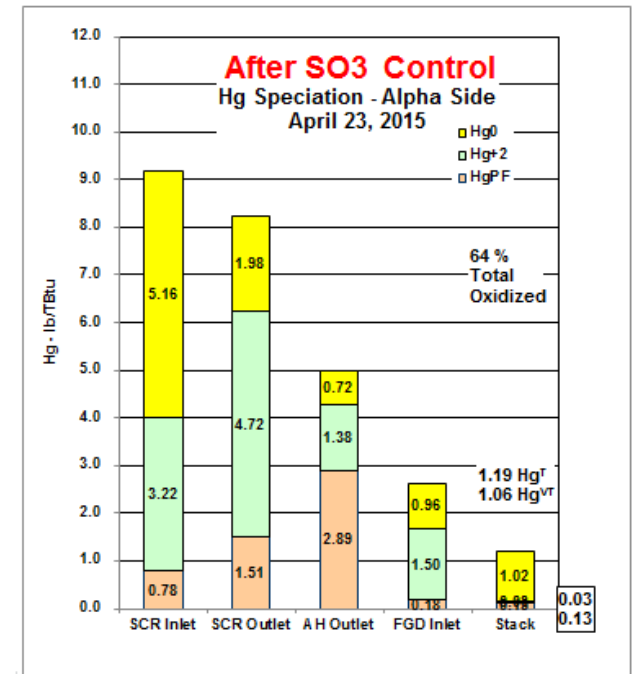
Need Predictive Hg Control Models

■ SCR Model

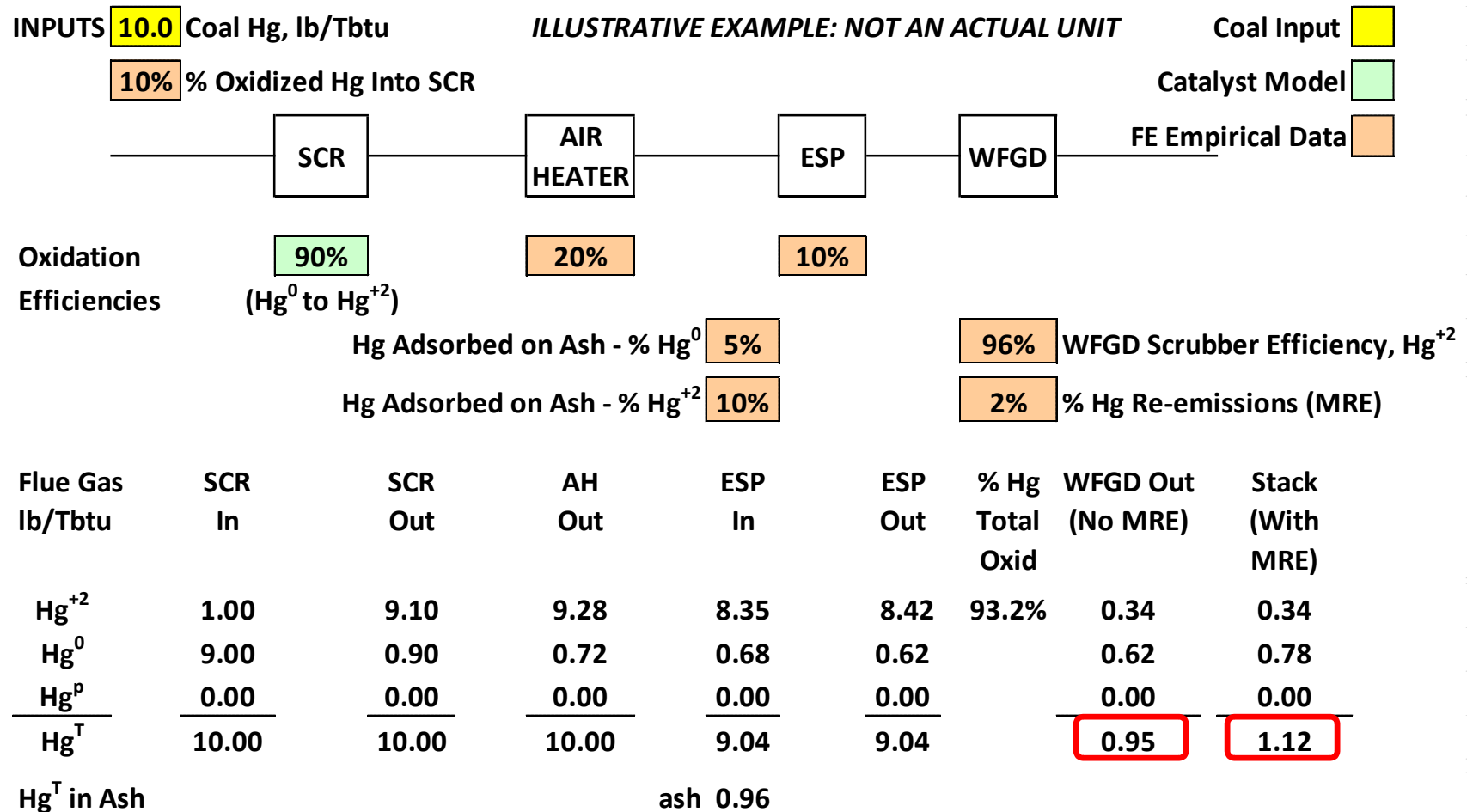
- Predicts Hg Oxidation for varying conditions (%deNO_x, flue gas temp, halogens) for varying ages of the catalyst
- Based on Lab Testing & catalyst vendors expertise

■ Back-End Hg Oxidation & Capture Model

- Predicts Hg capture on Ash and WFGD Hg Capture
- Based on Field Testing & Engineering Predictions



FirstEnergy's Mercury Oxidation Model



FirstEnergy's Approach to Catalyst Management for Combined NOx/& Hg

1. **Coalogix conducts regular internal SCR inspection**
2. **Lab Testing of Catalyst Samples for NOx / Hg**
3. **Perform Field Hg Speciation Testing SCR to Stack (FE)**
4. **FE does fuel plan review with Fuels Procurement to optimize fuel vs catalyst life**
5. **Coalogix develops NOx catalyst plan**
6. **Cormetech uses NH3 from NOx Plan to develop Hg Oxidation estimate**
7. **Evaluate Alternate Conditions (SCR Inlet Temp, Halogen, deNOx) and determine if plan driven by deNOx or Hg Oxidation**



Thank You
Questions ?