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Baghouse Balance-of-Plant Effects at TXU's Big Brown Station During Field Testing of Sorbent Injection for Hg Control

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Project Participants

Acid Gas Solutions

A *Lhoist Group Company*

Big Brown Power Station, Fairfield, Texas

Big Brown Unit Information

Big Brown Station, Freestone County, near Fairfield, Texas

- Plant capacity: Approximately 1200 MW total capacity with two 600-MW units
- Test unit: Tested one-quarter of BB Unit 2, baghouse Module 2-4 (FF 2-4)
- Boiler type: Tangentially fired with eight coal feeders per unit
- Typical fuel: 70% Texas lignite–30% Power River Basin (PRB) blend
- SO_2 control: None
- NO_x control: Low-NO_x burners
- Particulate control: COHPAC™ configuration

Field Testing Objectives

70% Lignite–30% Powder River Basin

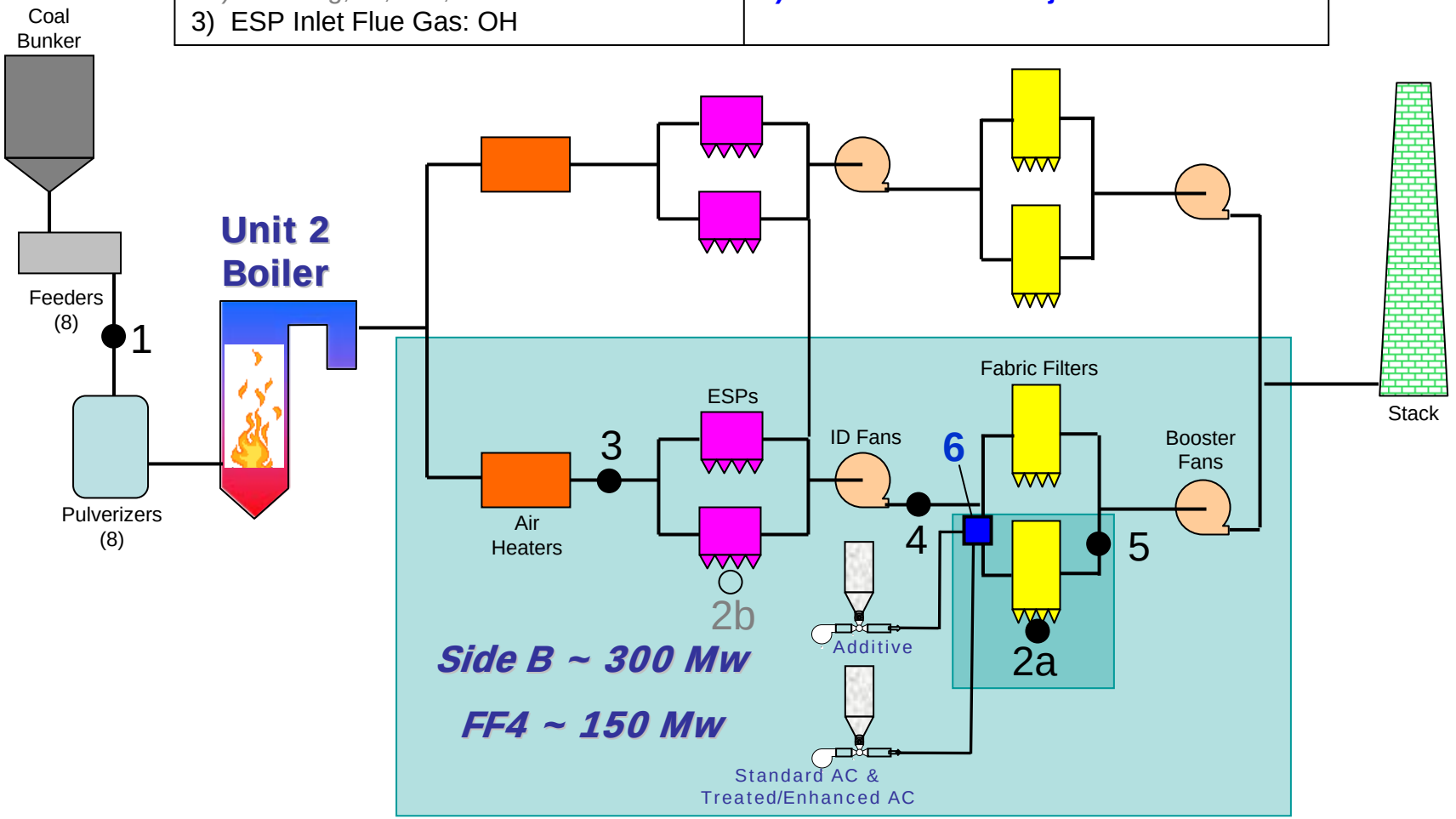
- Establish baseline Hg concentrations and speciation across FF 2-4.
- Screen control technologies with short-duration parametric tests, including ACI-only, enhanced ACI, and ACI plus SEA4.
- Perform a monthlong test with the most promising technology, and evaluate long-term Hg capture and balance-of-plant (BOP) issues.

100% PRB

- Establish baseline Hg concentrations and speciation across FF 2-4.
- Parametric tests, including ACI-only and enhanced ACI.

Mercury Control Options for TXU Big Brown Configuration

TXU's Big Brown Unit – Sampling Locations	
1) Coal: Hg, Cl, Prox./Ult., Heating Value	4) Baghouse Inlet Flue Gas: OH, Hg CEM
2a) Ash: Hg, Cl, LOI, C	5) Baghouse Outlet Flue Gas: OH, Hg CEM
2b) Ash: Hg, Cl, LOI, C	**6) ACI and Additive Injection**
3) ESP Inlet Flue Gas: OH	

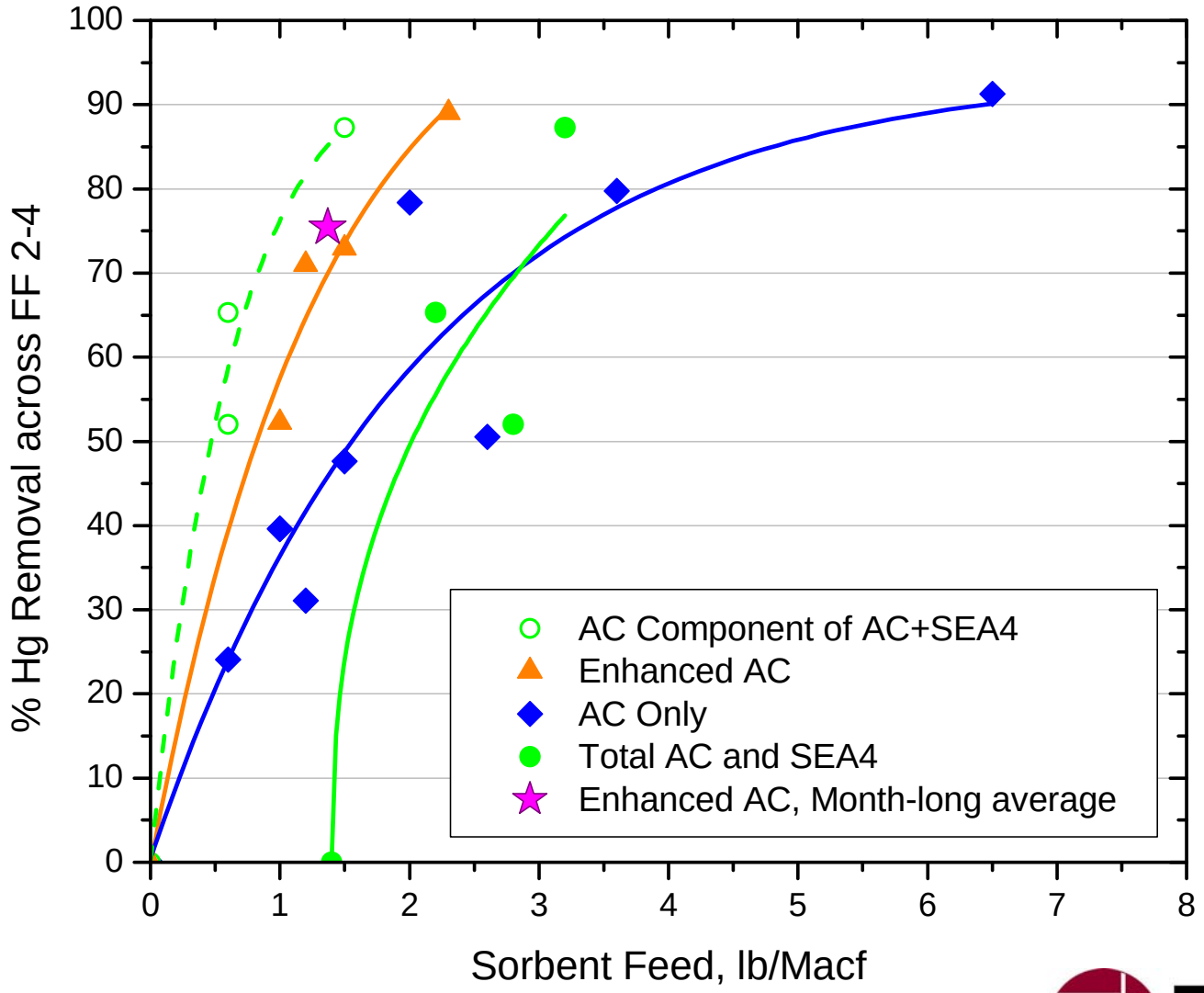


Baseline Coal Comparison
70–30 Blend and 100% PRB Averages

	Nominal 70%–30% Blend *	100% PRB *
Hg, ppm (dry)	0.287	0.102
Cl, ppm (dry)	17**	8**
Moisture, %	31.17	31.17
Ash, %	9.91	4.94
Sulfur, %	0.68	0.39
Heating Value, Btu/lb	7531	8101
Fd, dscf/10^6 Btu	9729	9294
Hg, μg/dNm^3, 3% O_2	37.01	12.80

All values on an as-received basis unless otherwise noted.
* Assumed ratio based on plant information.
** Single value.

Parametric Results Summary, 70%–30% Blend



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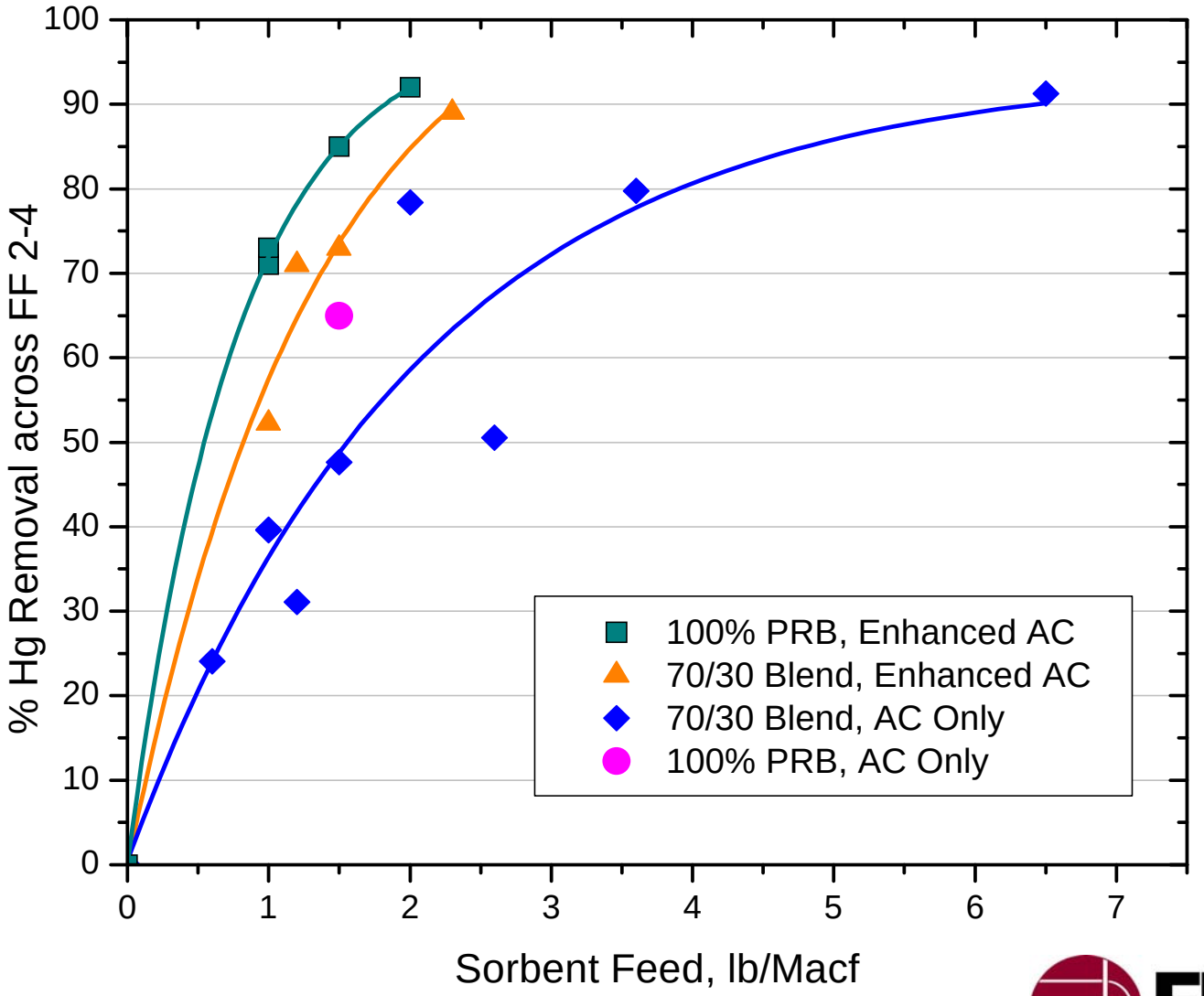
Comparison of Parametric Testing, 70%–30% Blend and 100% PRB



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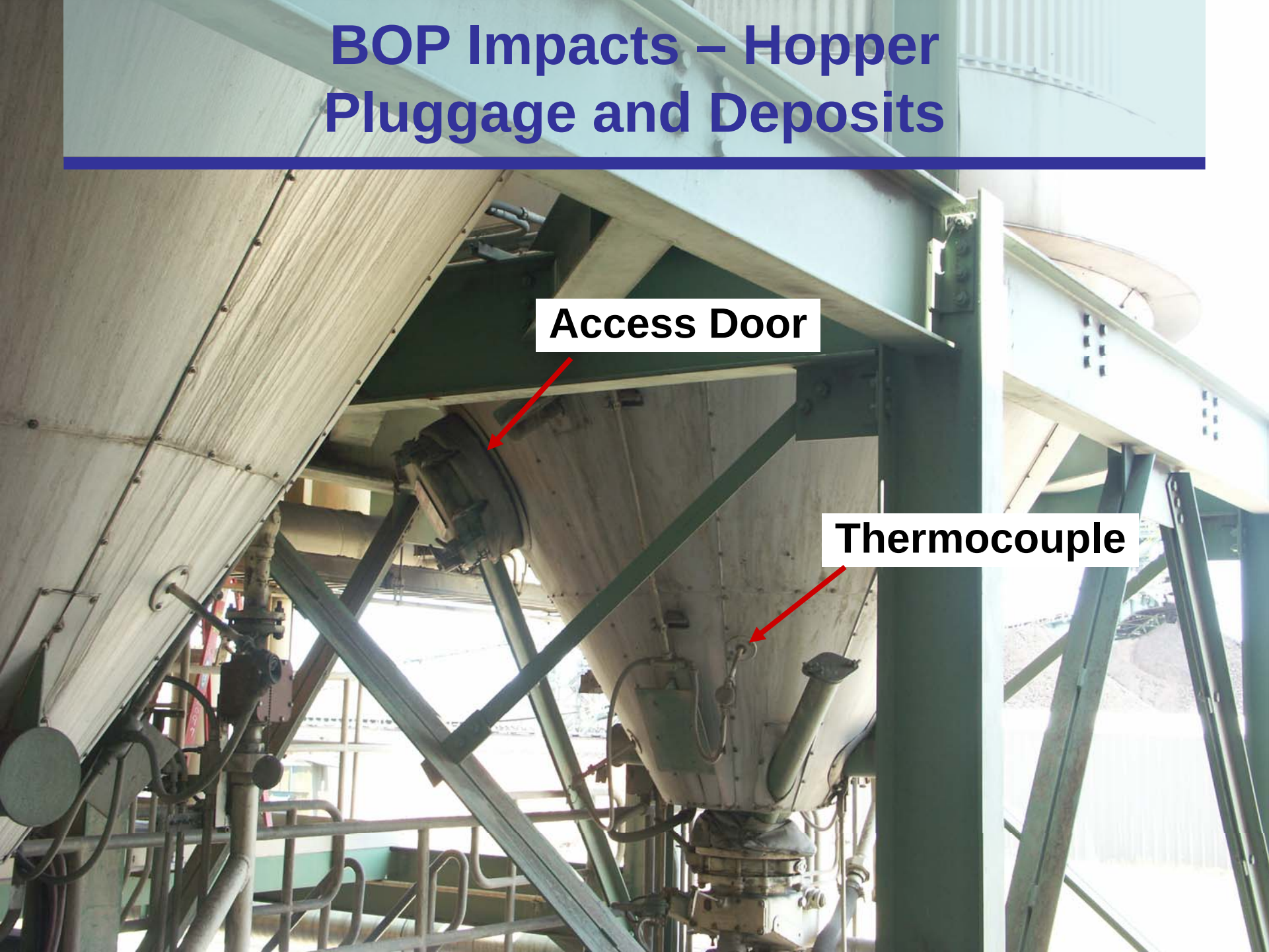
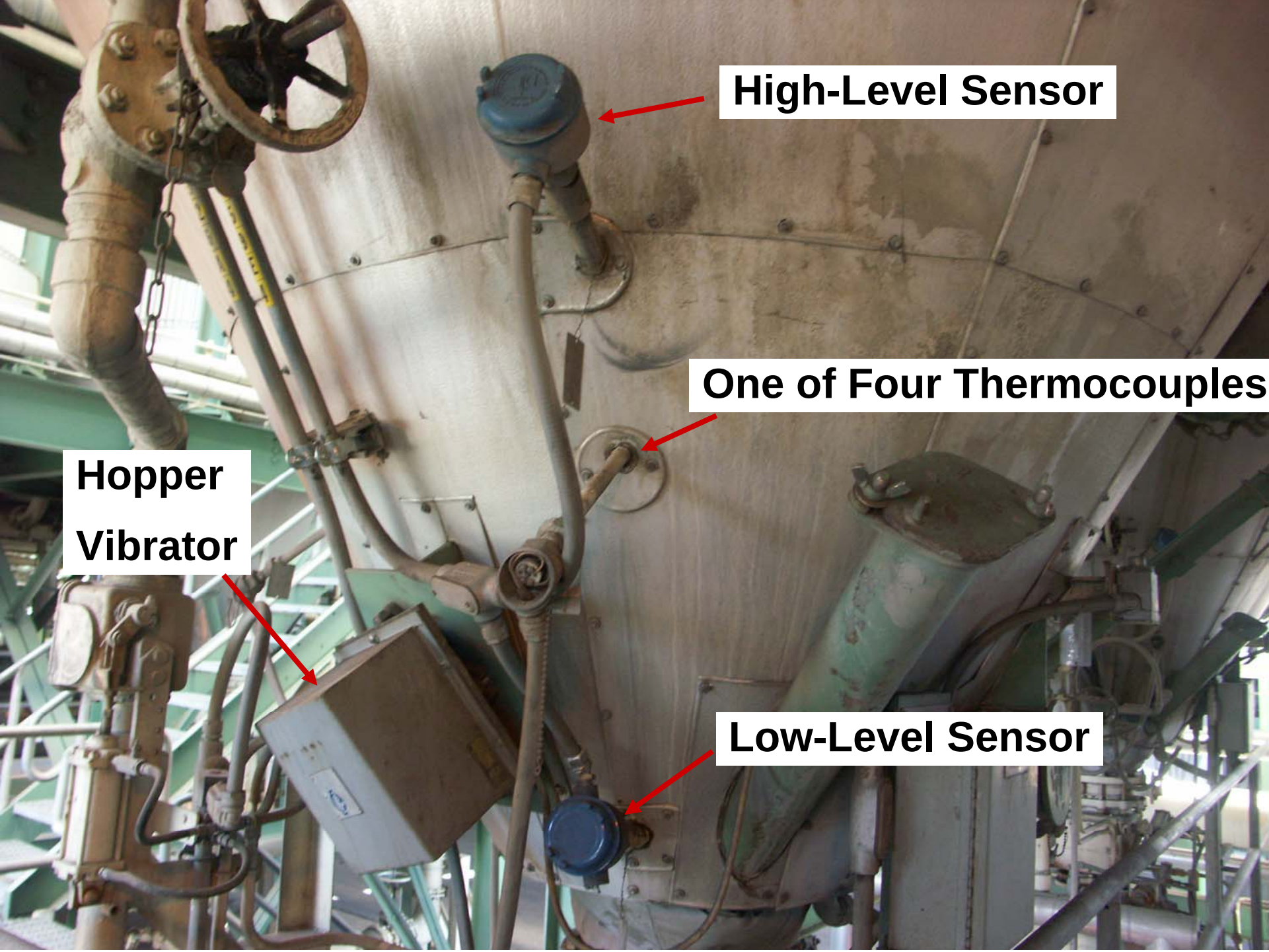
Big Brown Field Testing
BOP Issues

- **Bag blinding**—Following Hg field testing, the residual drag across FF 2-4 had reached a point where TXU was not confident in its performance for the upcoming summer season; therefore, the plant initiated a full bag replacement of FF 2-4 in May 2006. Because of many confounding factors, the exact cause is still under investigation.
- **Plugged hoppers/deposits**—During the bag change, it was discovered that two of the eight hoppers (Hoppers C and H) on FF 2-4 were plugged and filled with ash. In these two hoppers, unusual deposits were found mixed with the loose ash, which was reported to be very hot and smoldering.

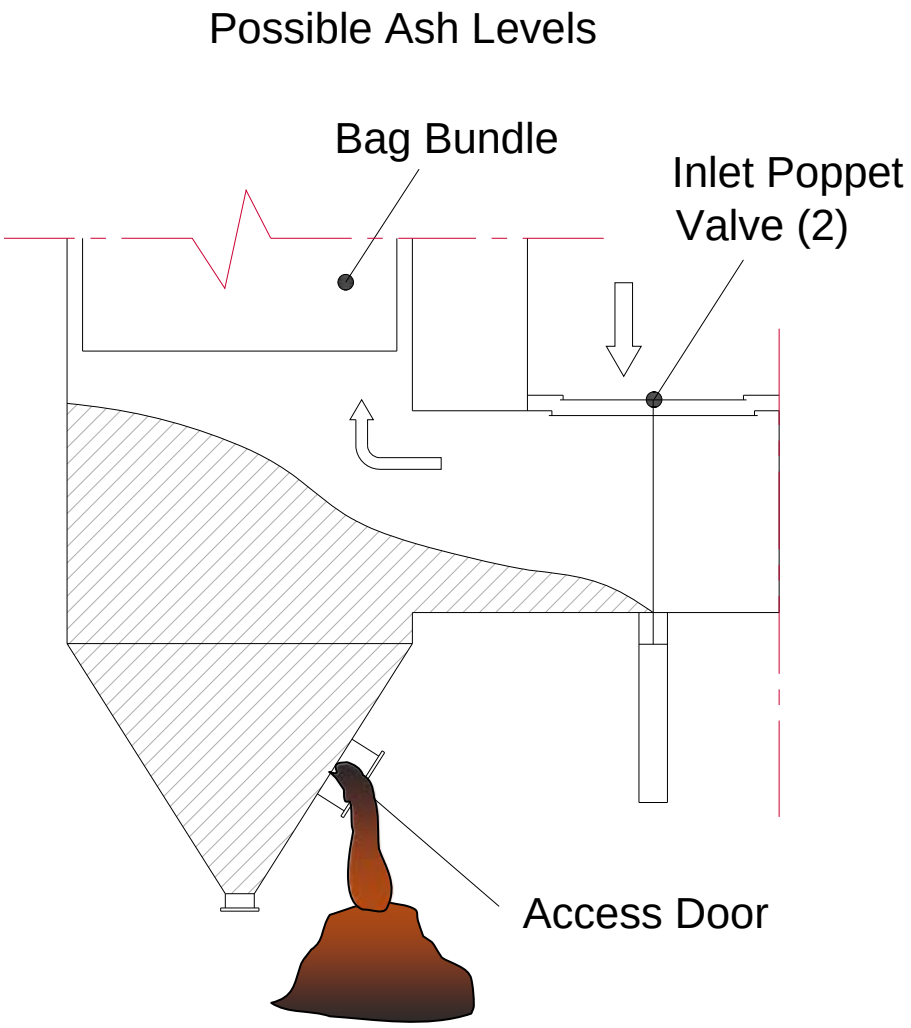
BOP Impacts – Hopper Pluggage and Deposits




High-Level Sensor
One of Four Thermocouples
Hopper Vibrator
Low-Level Sensor

BOP Impacts – Hoppers Ash Level

- When opened for the bag change, both Hoppers C and H were completely full of ash to a height above the access door.
- The operators did note that ash had collected in the inlet duct and was probably at least to that level and, therefore, completely filling the bottom cone.
- They did not think ash contacted the bags since that would require the entire inlet duct to become blocked.
- When emptied, smoldering ash was observed.



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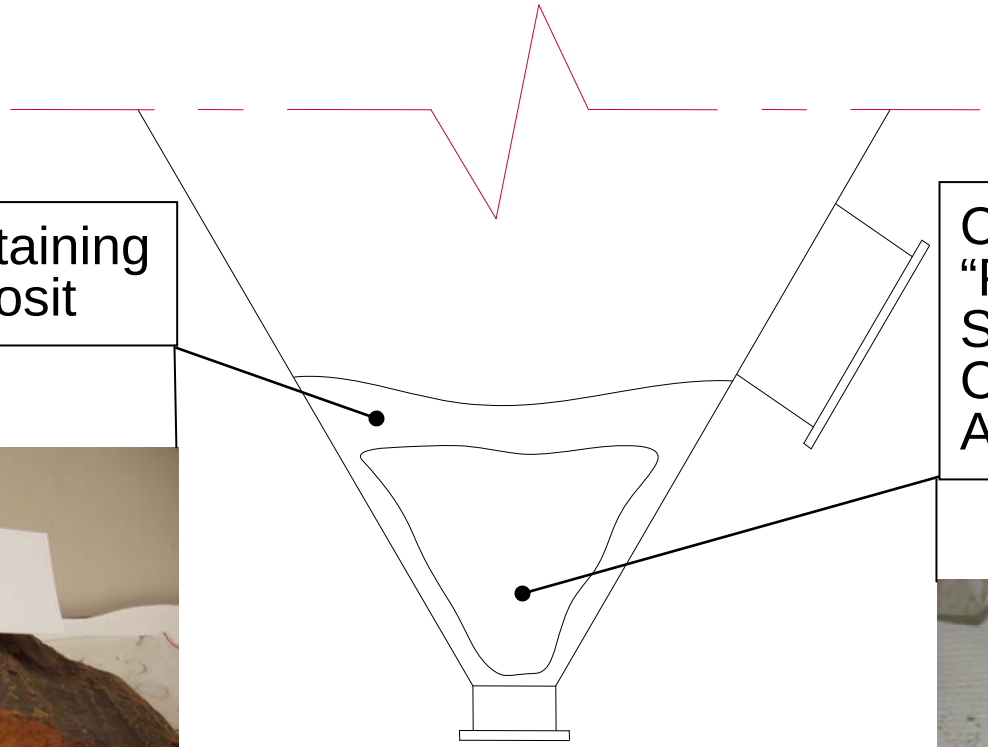
Hopper C Layering
As Observed by Plant Contractors

Ash Layer Containing Monolithic Deposit



Central Core of Hard "Popcorn" Deposits Surrounded Completely by Ash/AC

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BOP Impacts – Hopper Deposits

Hopper C

Hopper H

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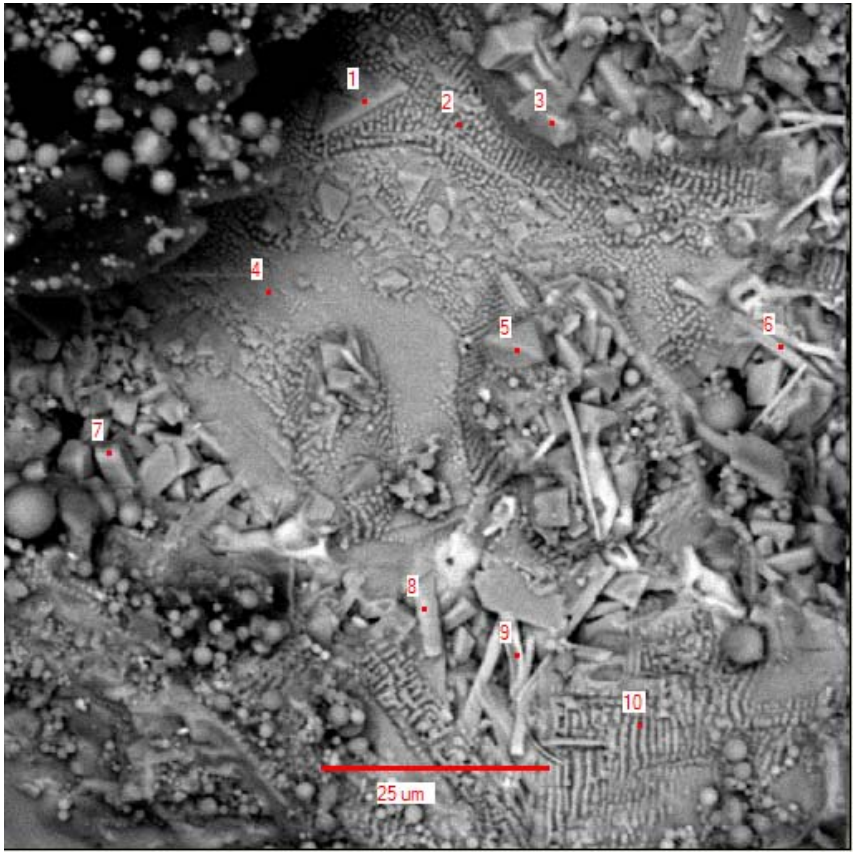
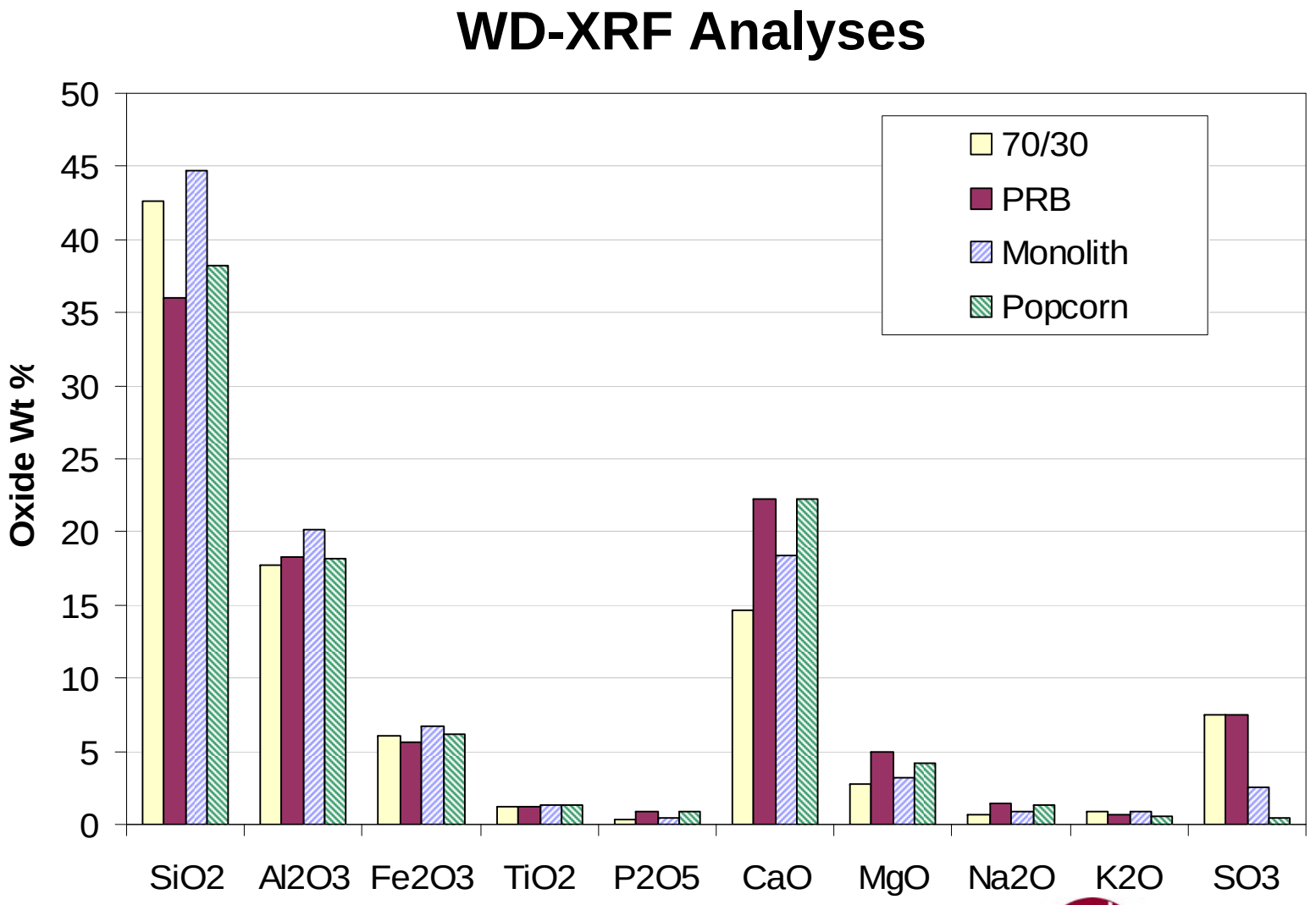
Hopper C – Popcorn Deposit



- The popcorn and “monolith” deposits are sintered, with the popcorn deposit having reached higher temperatures.
- Apatite, $Ca_5(PO_4)_3(OH)$, was identified which starts to crystallize at temperatures around 1000°C.
- Significant phosphorus was available in the melt.

Composition Comparison of Hopper C Deposits, 70%–30% Blend, and 100% PRB Ashes



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Deposit Composition
CHN Analysis

Sample	C, %	H, %	N, %
Baseline, 70%–30% FF Ash	0.30	0.18	0.12
C Popcorn	0.130	0.035	0
C Monolith Surface*	0.650	0.125	0.010
C Monolith Interior	0.065	0.105	0
H Red–Orange Surface*	3.085	0.085	0.110
H Red–Orange Interior	0.115	0.270	0
H Soft Grey	0.265	0.135	0.105

*Surface differences were very thin, sampled approximately 1–3 mm deep.

Conclusions, Hopper Deposits

- Both deposits from Hopper C appear to have been sintered by heat, as they appear to have some structure and strength. The monolith deposit is not as well sintered as the popcorn deposit. Hopper H deposits do not appear to have been sintered together by heat.
- Hopper C deposits were very strong, with the popcorn deposit being the strongest. Crystalline structures indicate the popcorn deposit may have formed at temperatures above 1000°C.
- The high-temperature minerals are not as well developed in the monolith deposit as in the popcorn deposit (did not reach as high a temperature).
- The monolith deposit from Hopper C and the other deposits from Hopper H appear closer in composition to the 70%–30% blend ash, suggesting a longer time of formation, likely due to reactions with moisture. The popcorn deposit characteristics are more similar to the 100% PRB ash, suggesting formation during combustion of 100% PRB followed by self-heating prior to removal.

Conclusions
Big Brown Hg Field Testing

- Under baseline test conditions, mercury capture across the baghouse is effectively zero for both the 70%–30% blend and 100% PRB.
- Both the AC + SEA4 and enhanced AC options performed better than AC alone. Testing showed that >70% capture could be achieved with rates lower than 2 lb/Macf.
- Hg removal efficiencies were similar for the 70%–30% blend and 100% PRB, but emissions were much lower with the PRB because of the lower Hg-in-coal content.
- Monthlong testing with the enhanced AC showed an average removal greater than 70%; however, there were fluctuations due to interruptions in the ACI feed and the ACI equipment settings. At steady-state conditions with the target ACI rate of 1.5 lb/Macf, average removals were greater than 80%.
- The narrow and limited operating margin of the COHPAC differential pressure proved to be the limiting factor for applying sorbent injection at Big Brown. Short-term tests were successful, but for long-term sustainable ACI operation, substantial modifications to the plant are required to provide a greater operating margin.

Conclusions
Big Brown BOP Effects

- The residual drag across FF 2-4 appears to have increased by an amount that was unexpected based on past experience. The investigation into the root cause is still under way and includes plant operating conditions as well as the effects of sorbent injection.
- The plugged hoppers and the associated deposits appear to be a result of the hopper heaters being off for Compartments C and H. The heaters being off likely led to formation of deposits that eventually grew to a size large enough and strong enough to plug Hopper C and H discharge. Subsequently, this led to accumulation of ash and AC of adequate quantity to promote self-heating and eventual ignition. The deposits are a mix of hydration products, heated to varying degrees, and ash sintered with heat from the smoldering ash or AC mixture. More work is being done to define the self-heating potential of the Big Brown TOXECON ash and the risks associated with storing it.