Full Scale Evaluations of Mercury Control Technologies with PRB Coals

EUEC
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Hg Removal with Existing Equipment

ICR Data

Controls	Bituminous	Subbituminous (PRB)
CSESP	46%	16%
FF	83%	72%
SDA + FF	98%	25%

Example: Sunflower Electric Holcomb Station PRB Coal SDA/FF

Inlet Hg: 10.5 μg/dncm

Outlet Hg: 11.2 μg/dncm

Hg Removal: 0%

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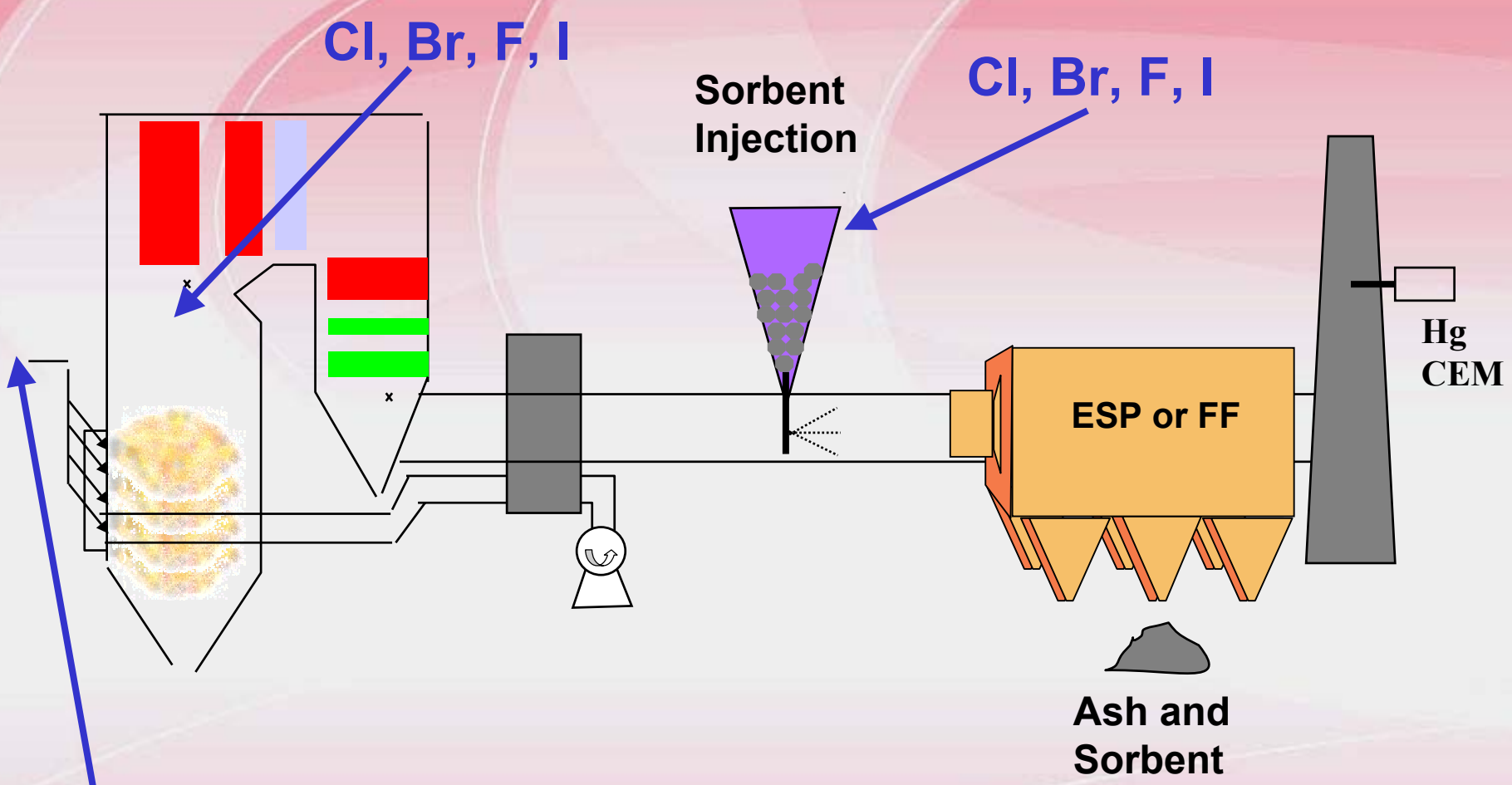
Enhancing Mercury Removal for Western Coals



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Coal Blending to Improve Mercury Control

Sunflower Electric, Holcomb Station	**Completed 2004**
Detroit Edison, Monroe Station	**2005**

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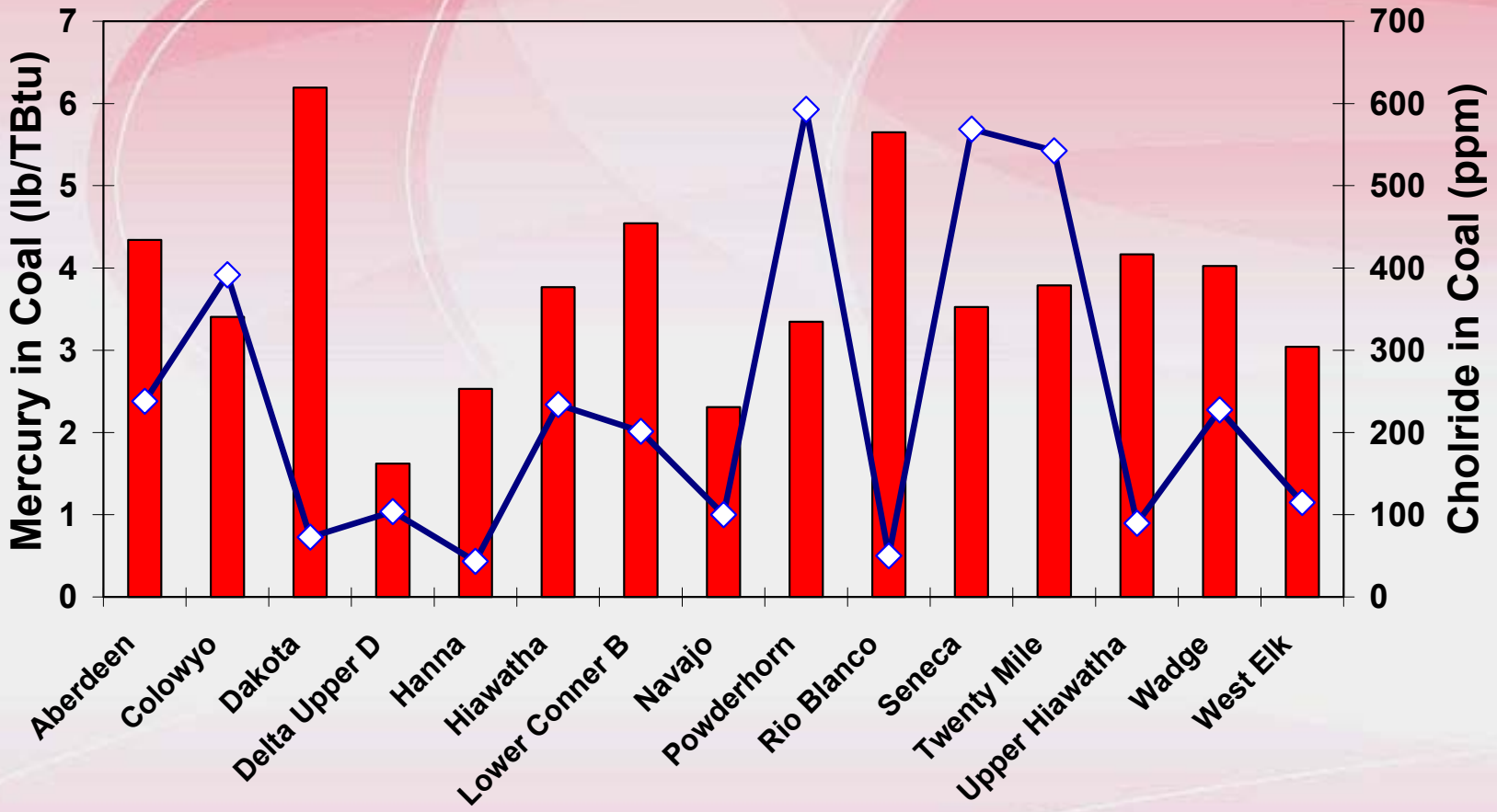
Mercury and Chlorine in Western Bituminous Coals



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Native Mercury Removal by Western Bituminous Coals

Plant	APC	Coal	Mercury Removal
Cherokee 3	FF	Colowyo	98%
Intermountain	FGD	Utah Bit	74%
Valmont	FF	20 Mile Colowyo	86%

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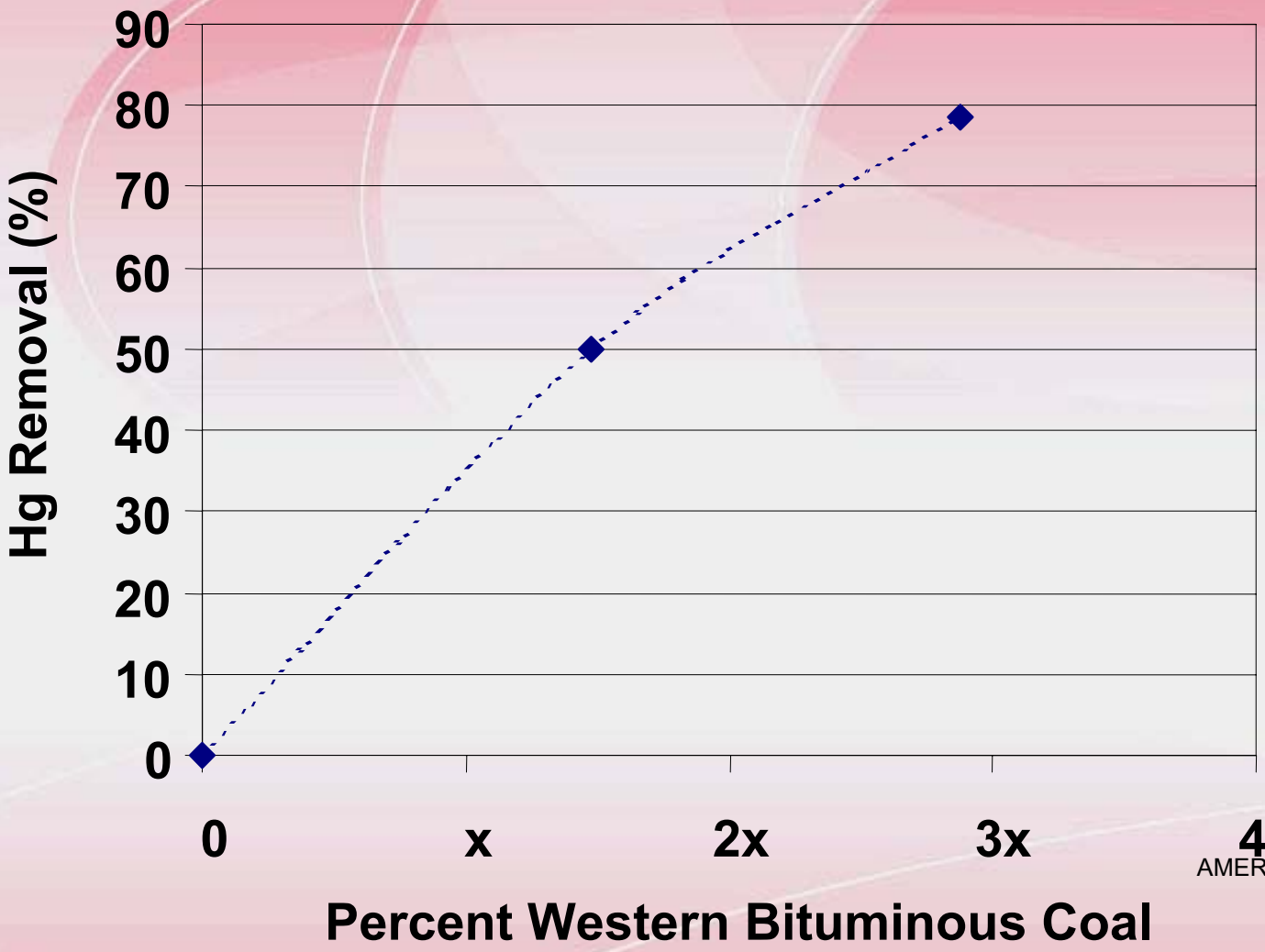
Coal Blending Results - Holcomb



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Coal Blending at Holcomb

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Activated Carbon Injection to Improve Mercury Control

Sunflower Electric, Holcomb Station	Completed 2004
AmerenUE, Meramec Station	Completed 2004
Great River Energy, Coal Creek Station	Completed 2003
We Energies, Presque Isle	2005-2007
Detroit Edison, Monroe Station	2005
Entergy, Independence Station	2005

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ACI Required Equipment

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Testing at Holcomb Station

- Unit Capacity
  - 360 MW
- Coal
  - PRB
  - Hg Content: 0.04 – 0.1 ppm-dry
  - Cl Content: 7-35 ppm-dry
- SO_2 Control – SDA
- Particulate Control – FF

DOE Cooperative Agreement DE-FC26-03NT41986

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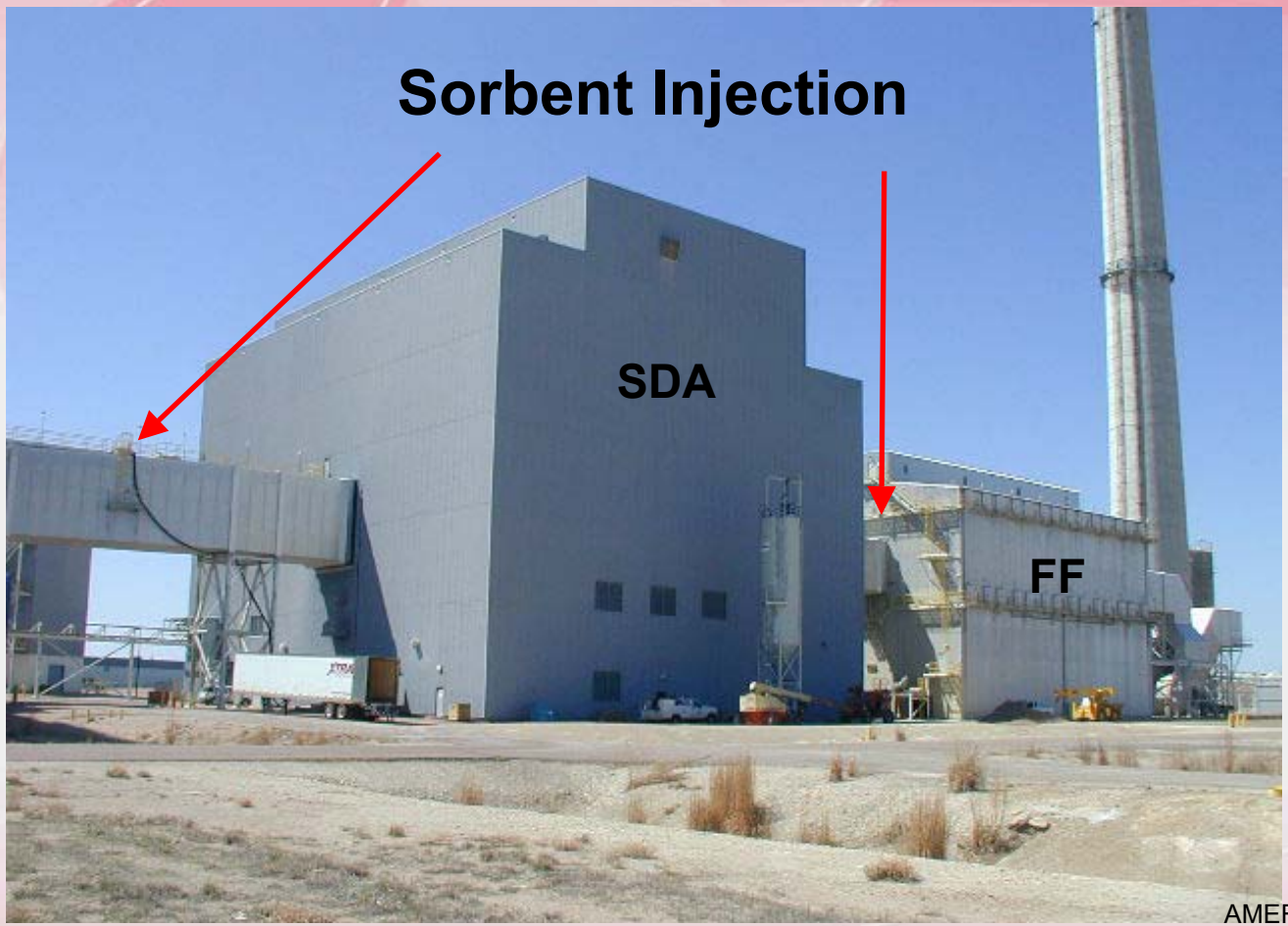
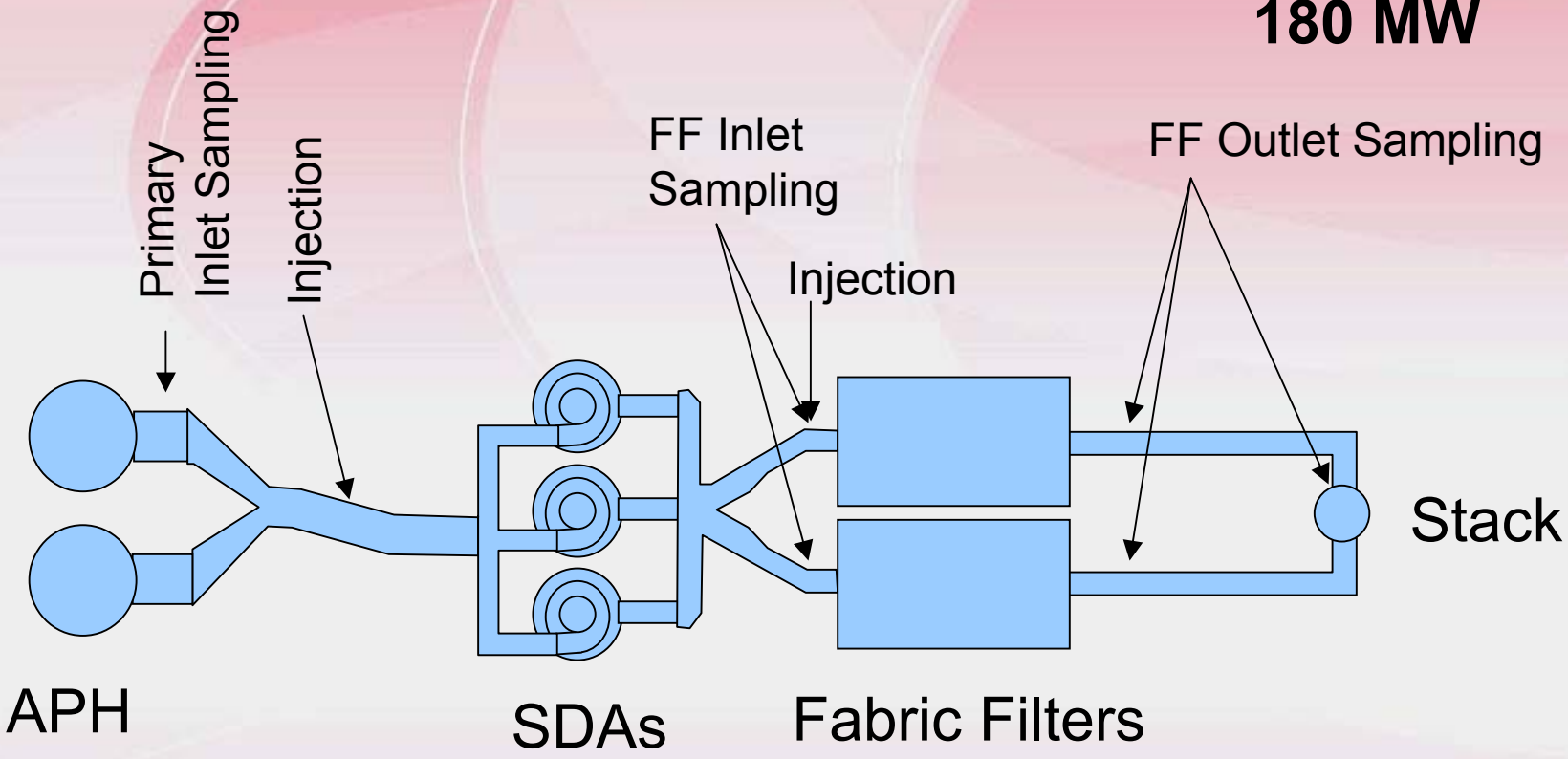
Plant Layout

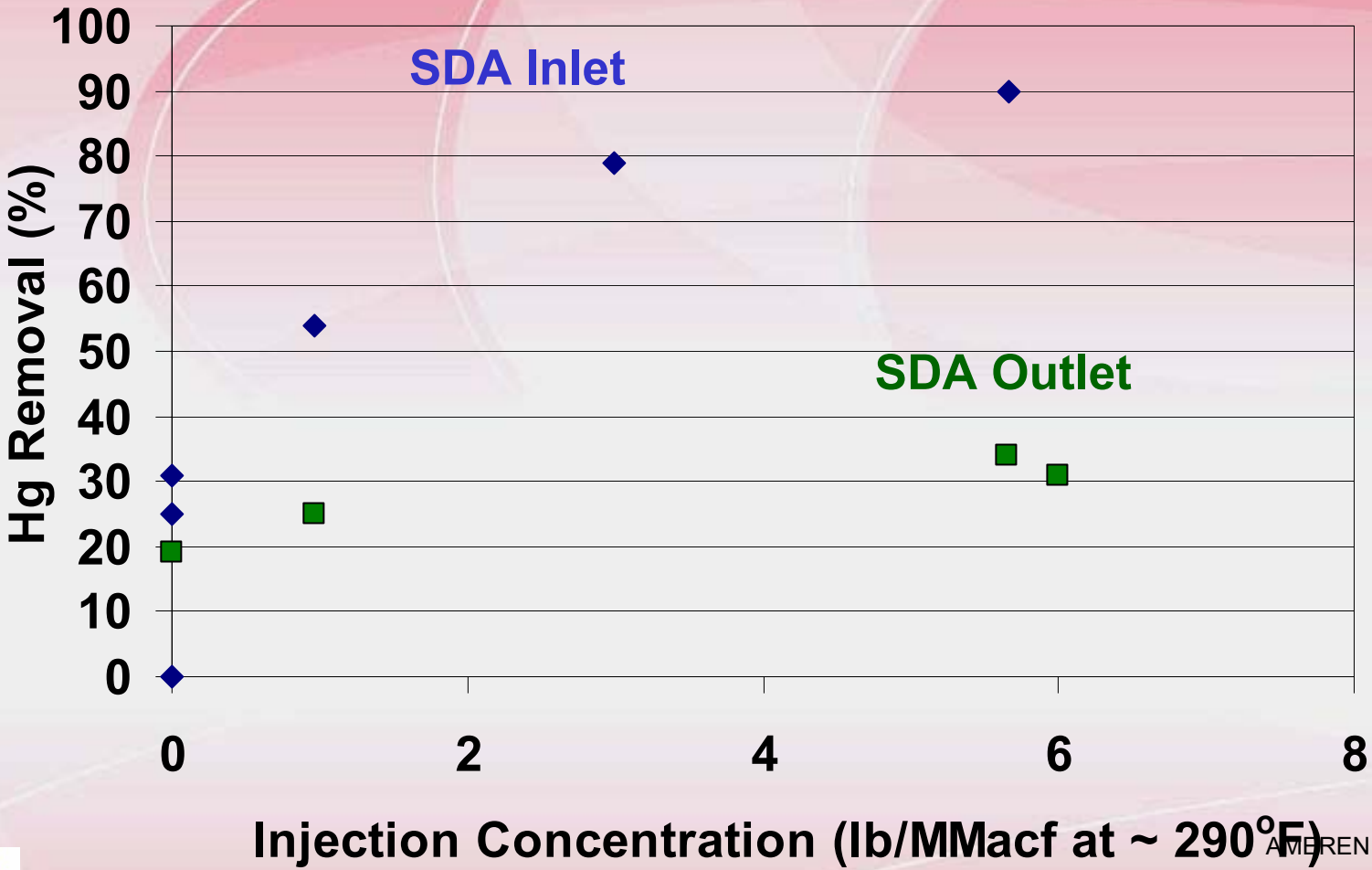


Holcomb Overall Layout

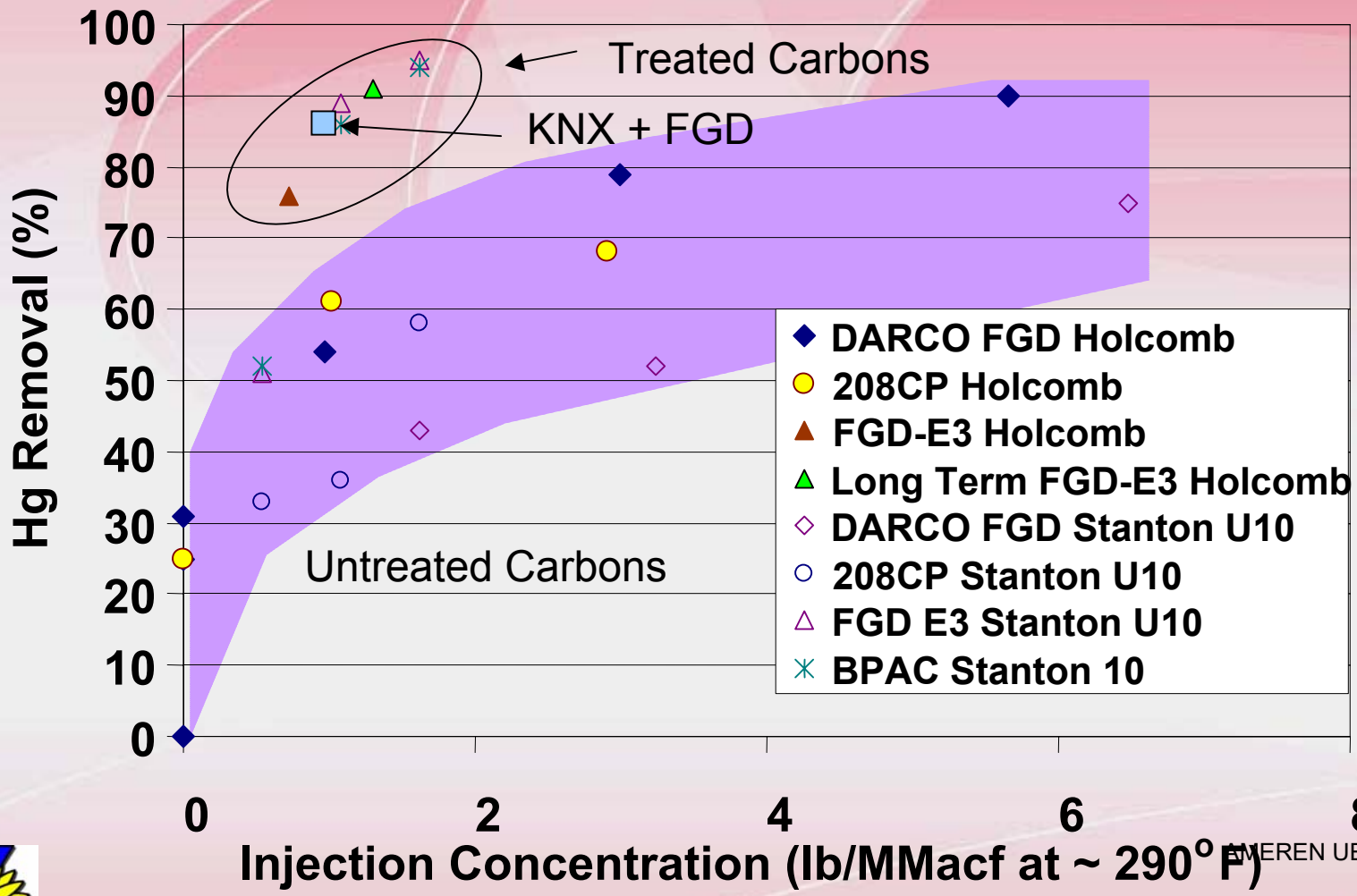
360 MW
180 MW



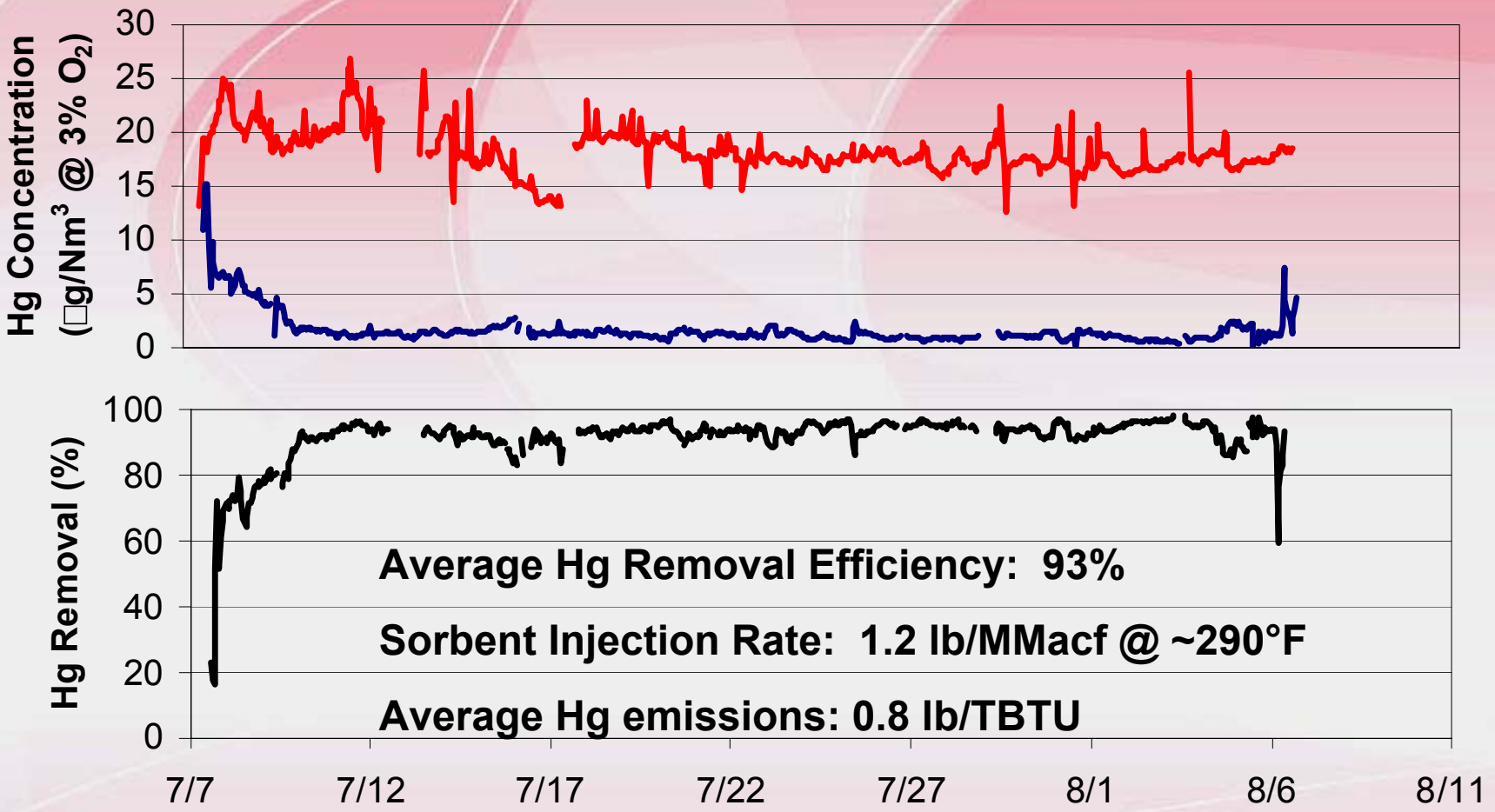
Effect of Injection Location on Hg Removal: DARCO FGD, Holcomb



SDA Results, PRB and Lignite Fuels



Holcomb – 30-day Long Term Results
FGD-E3 Injection



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AmerenUE Meramec Plant

Unit Capacity
- 140 MW

Coal
- PRB
- Mercury Content:
- 0.04 – 0.1 ppm-dry
- Chlorine Content:
- 7-35 ppm-dry

NOx Control – SOFA, LNB

SO_2 Control – Compliance Coal

Particulate Control – CSESP

DOE Cooperative Agreement DE-FC26-03NT41986

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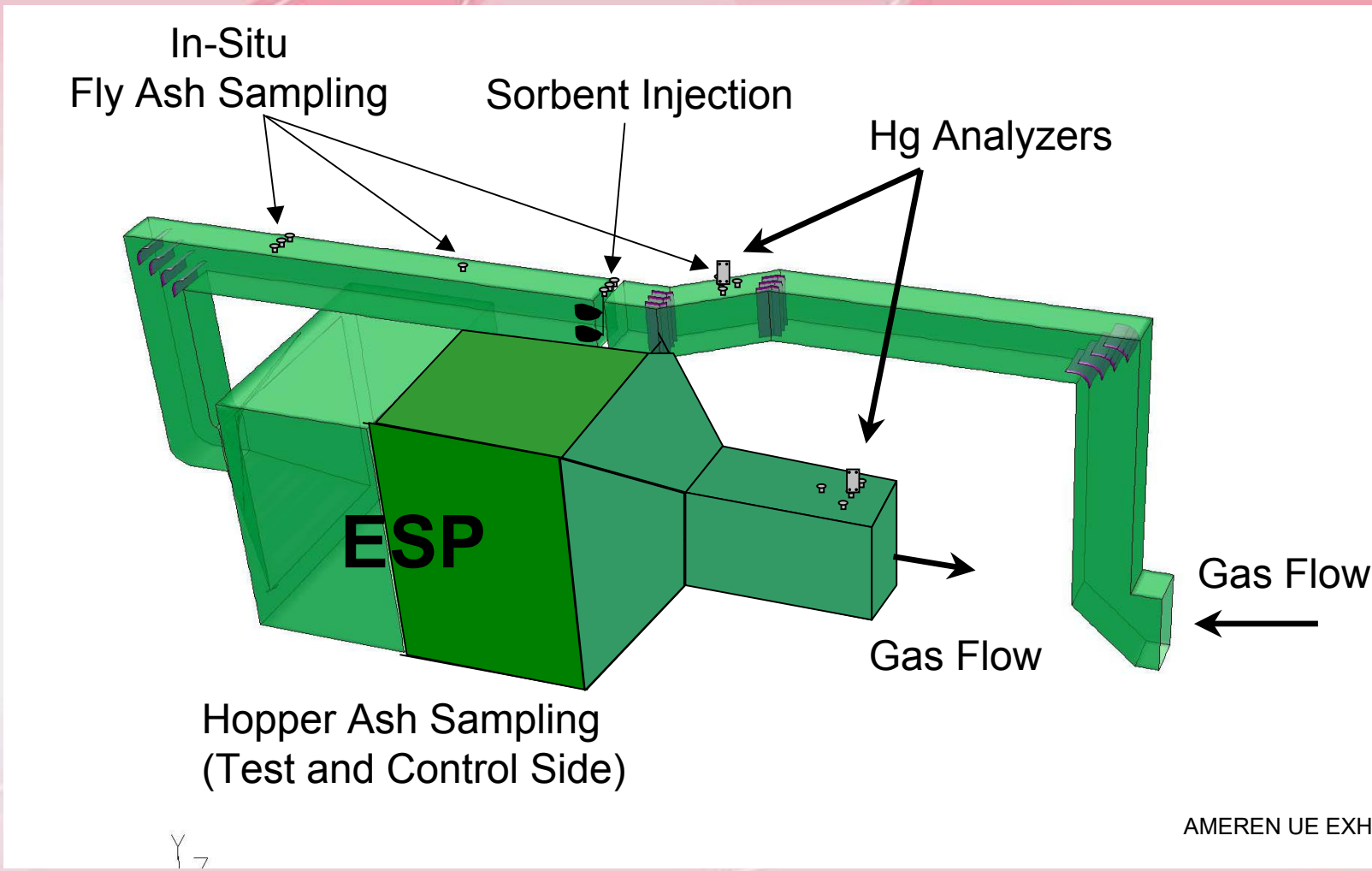
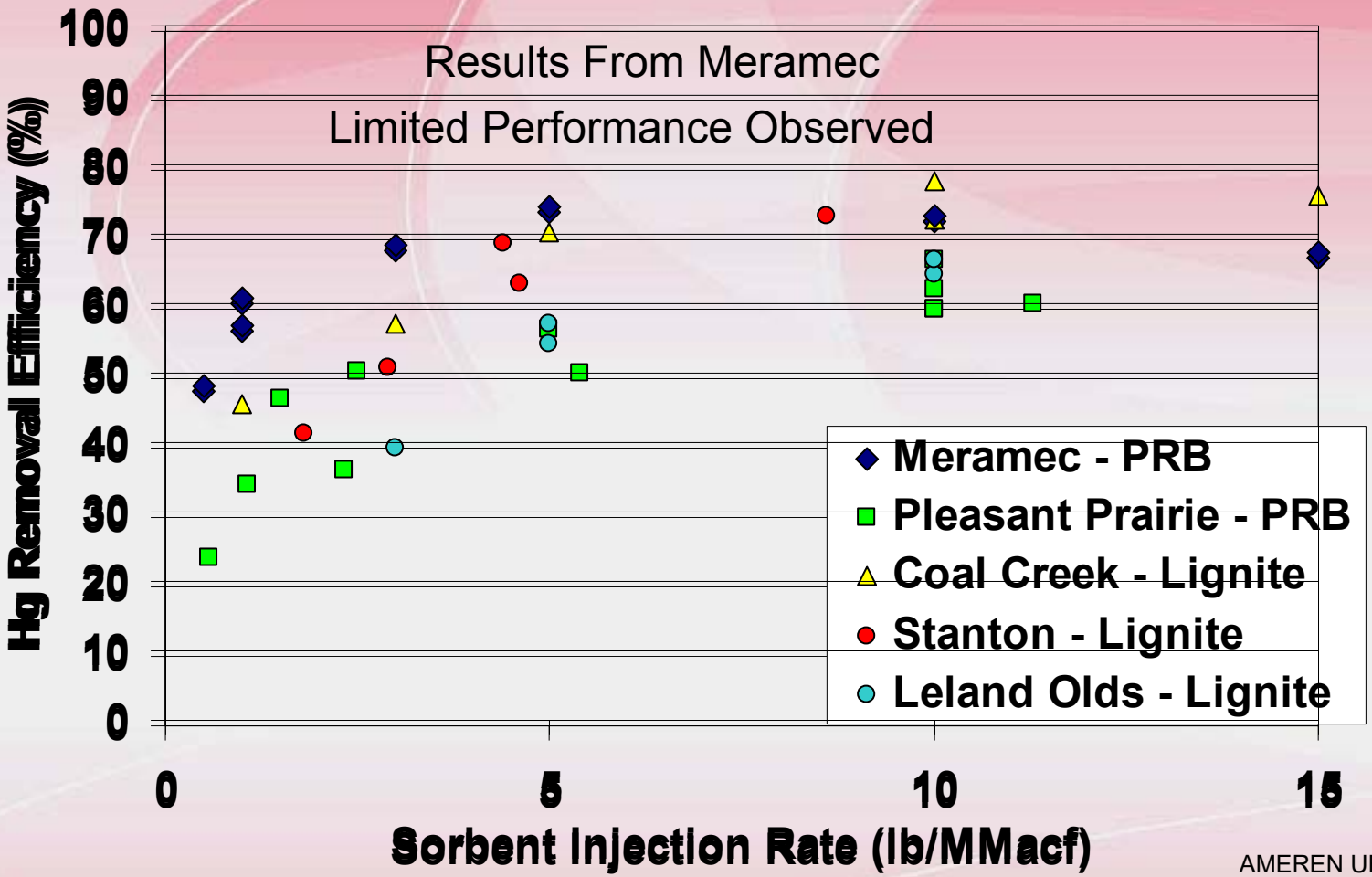
Flue Gas Flow – ½ of Unit 2



Untreated PAC Injection into ESP PRB and Lignite Coals



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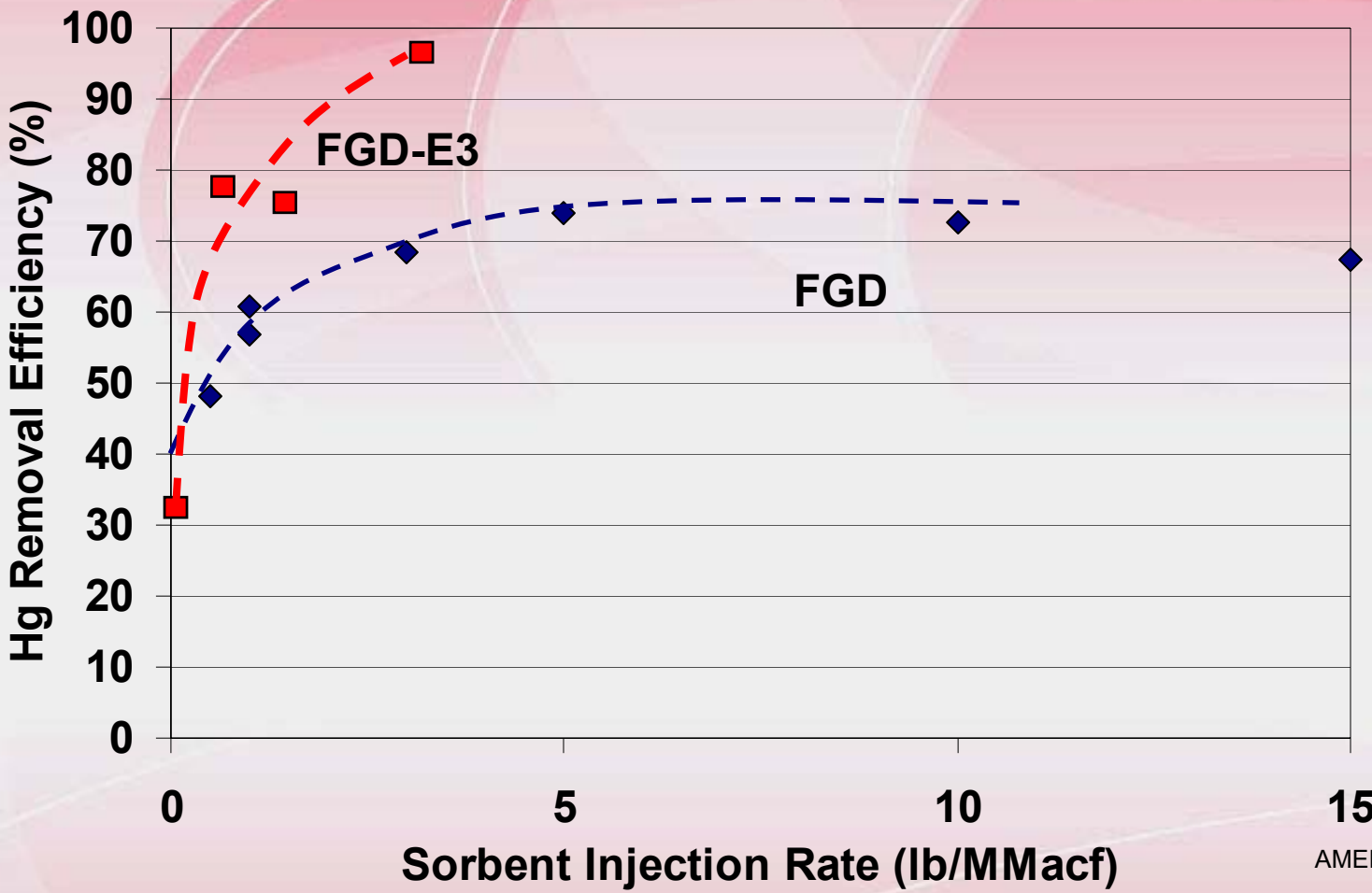
Parametric Results – Treated Carbon



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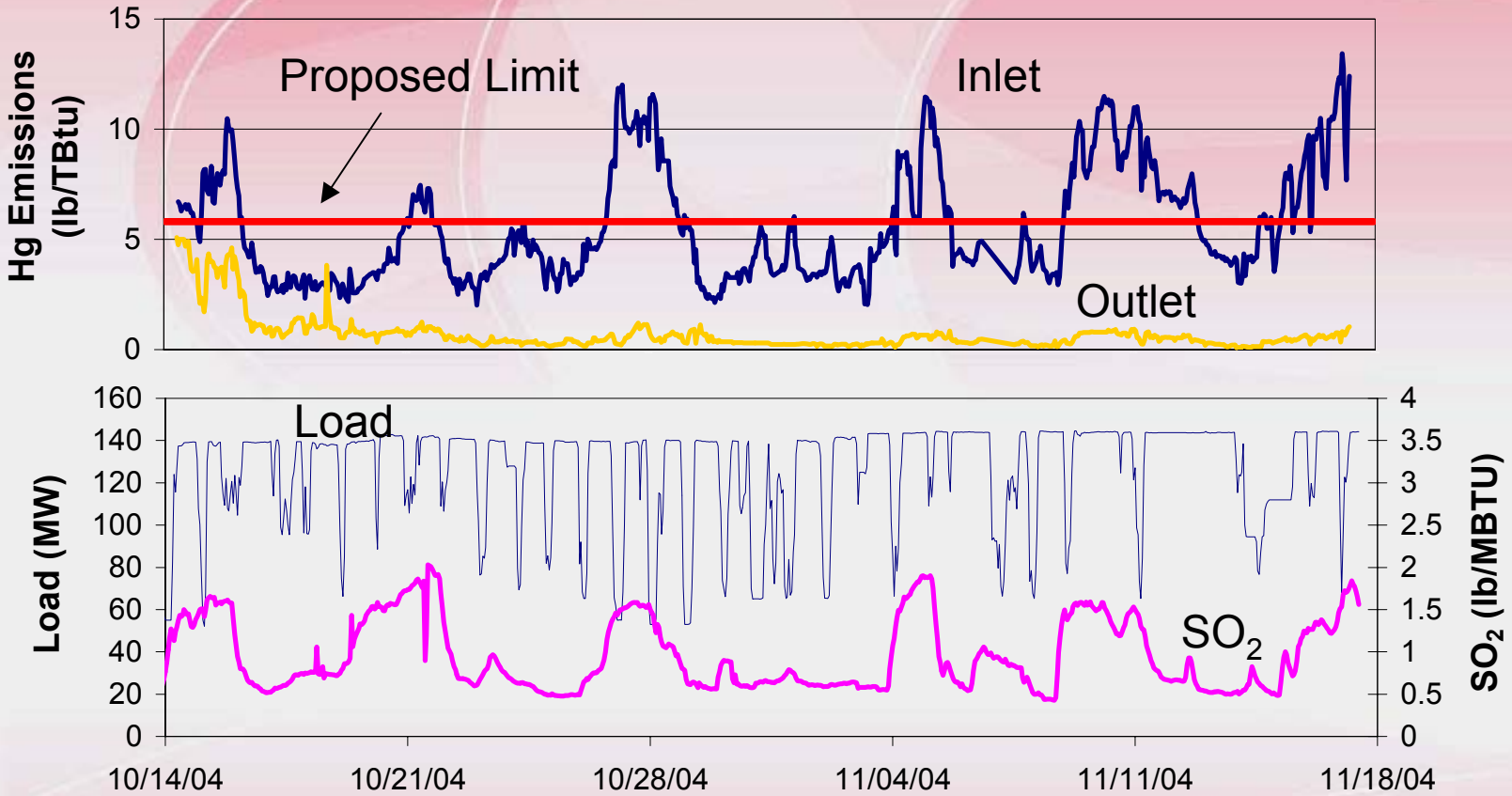
Preliminary Long-Term Results



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Coal Additives at Meramec

- KNX (Alstom Power) and SEA2 (EERC)

  >80% mercury removal measured with additive injection during high LOI periods

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Is Meramec "Typical"?

- Tubular Air Preheater
  - Data from Salem Harbor (Phase I program) and Meramec indicate higher than expected Hg removal. Both have tubular APH. Both had high LOI during testing.
- Large fraction of particulate-phase mercury
  - Large carbonaceous ash particles were present in ash and have very high Hg (~ 4 ppm)

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Secondary Emissions from Coal Additives or Treated Carbon

- Holcomb:
  - Halogen emissions decreased across SDA + FF during FGD-E3 testing
  - No increase in halogen concentrations during coal additive tests
- Meramec:
  - Halogen emissions were slightly higher during FGD-E3 testing but remained within range expected from PRB coal
  - No M26 results available from coal additive tests

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Plant Operation and Effects on Ash

- Plant Operation
  - *No adverse effects on ESP power, SDA operation or FF cleaning frequency, or opacity during longer-term tests*
- Landfill Concerns: leaching (mercury or halogens) from ash
  - *Initial tests indicate ash does not leach significant halides or measurable mercury*
- Ash Sales - Meramec
  - *Fly ash may require additional AEA due to fly ash contamination from ACI injection*

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Additional Testing

Monroe Unit 4

- Fires blend of PRB and E. Bituminous (60/40)
- 750 MW, Wall-Fired Unit
  - Test size ¼ of unit
- Low NOx burners (B&W)
- Cold-Side ESP, Small SCA (280 ft^2/kacfm)
- SCR in-service during ozone season

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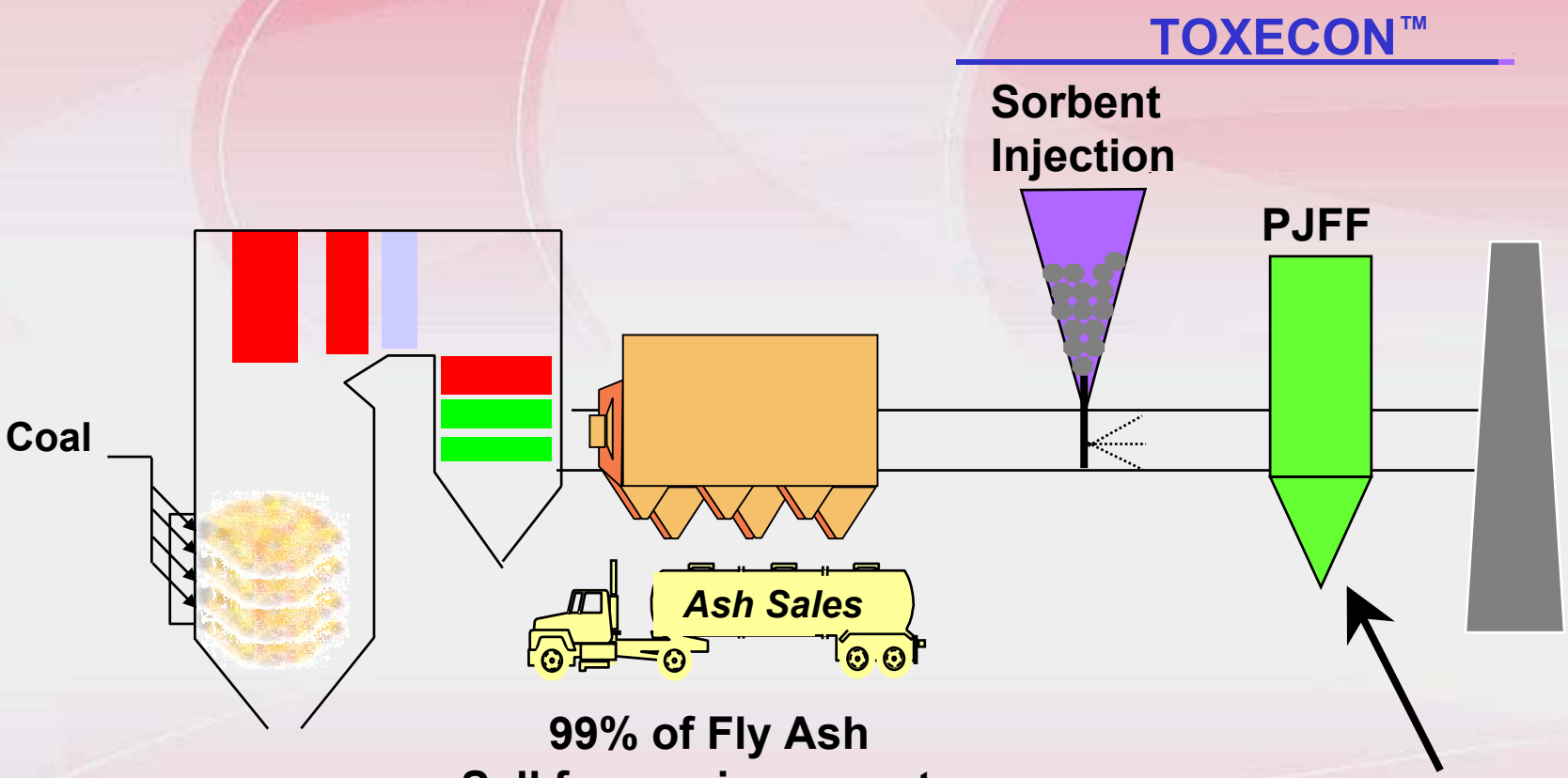
EPRI TOXECON™ Configuration



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First TOXECON Hg Control System at We Energies Presque Isle Power Plant

- Units 7 – 9 on PRB Coal
- 270 MW
- System designed for 90% Hg control

DOE Clean Coal Power Initiative

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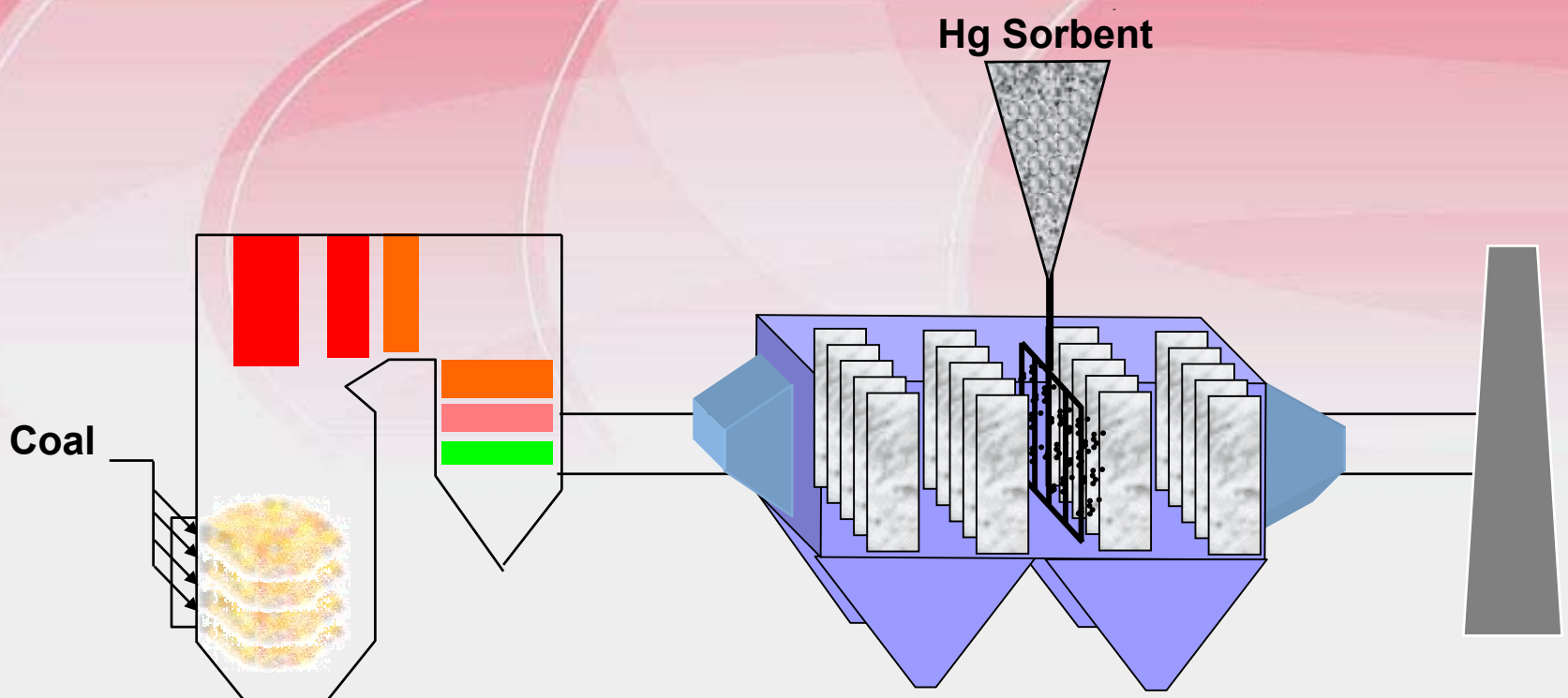
EPRI TOXECON II™ Configuration



90% of Fly Ash
Sell for use in concrete

10% of Fly Ash + Sorbent
Sorbent recycle
Sorbent regeneration or disposal

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TOXECON II™ at Coal Creek Station

- Unit Capacity
  - 590 MW
- Coal
  - North Dakota Lignite (Falkirk Mine)
  - Mercury Content: 0.096 ppm-dry
  - Chlorine Content: 0.009 %-dry
- NO_x Control – OFA
- SO_2 Control – WFGD
- Particulate Collection Device – CESP
  - SCA = 599 ft^2/1000cfm
  - ESP Inlet Temperatures: 340-360ºF

Tests Funded by EPRI and Great River Energy

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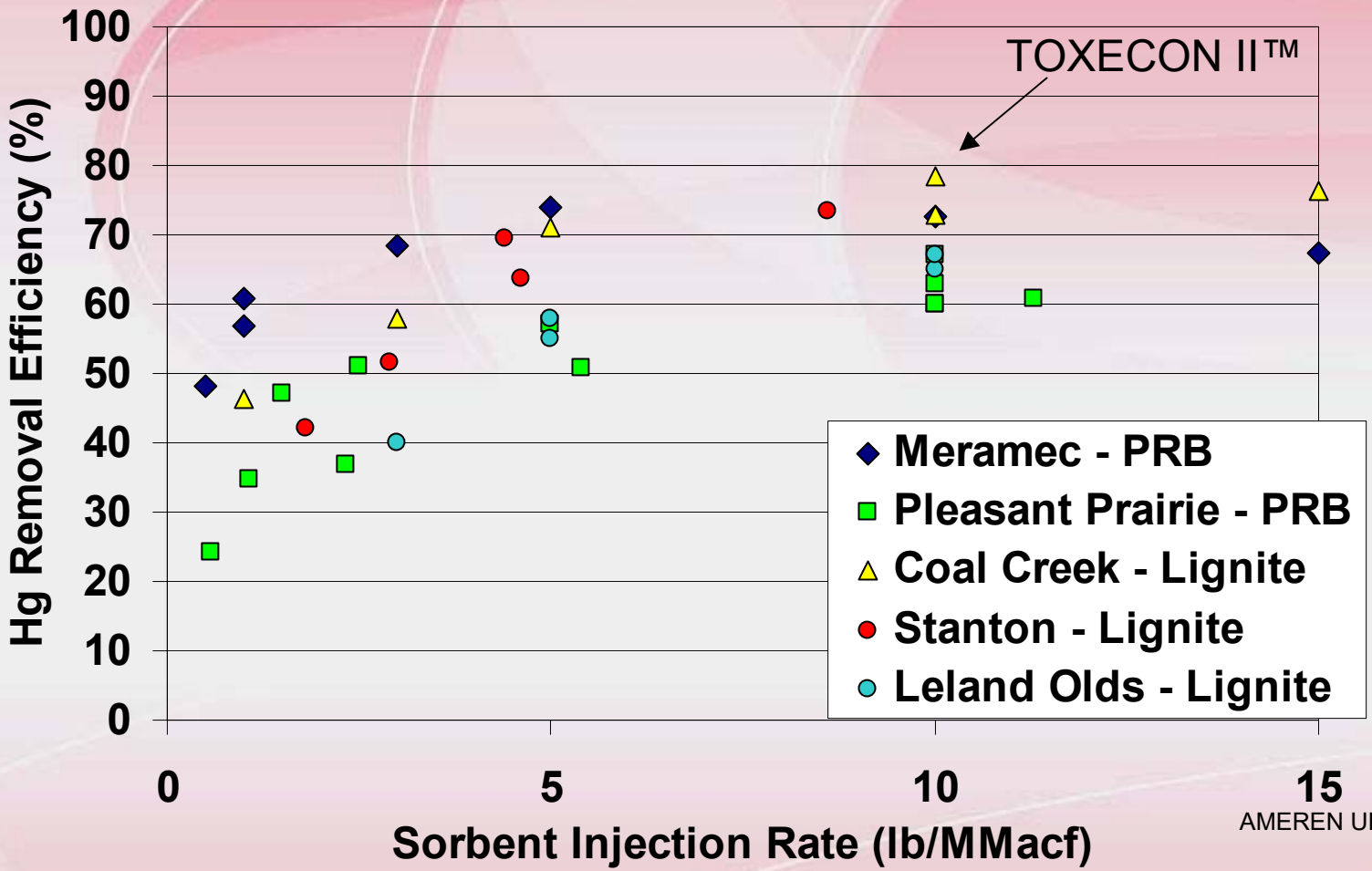
Comparison of ESP and TOXECON II™



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DOE/NETL Full-Scale Field Test of TOXECON II in 2005

- Host Site:
  Entergy Independence Station (842 MW)
  - PRB Coal, CS ESP
- Goals
  - Document mercury capture performance
    - Evaluate possible improvements with treated carbons
  - Identify impacts on ESP
- Participation by other utilities encouraged

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Options for Western Fuels: Summary

- Treated Activated Carbon Injection
  - High removal achieved at Holcomb and Meramec
  - No adverse balance-of-plant impacts noted
- Coal Additives
  - >80% removal achieved at Meramec without ACI *(plant configuration and high LOI may have contributed to removal)*
  - ACI required at Holcomb for high removal

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Options for Western Fuels: Summary

- Coal Blending
  - Up to 80% mercury removal achieved during short-term test at Holcomb
  - Additional tests required to confirm this result

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