

NETL Project Review Meeting

DOE Cooperative Agreement DE-FC26-03NT41986

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ADA-ES Program Manager: Sharon Sjostrom

ADA-ES Site Manager: Travis Starns

ADA-ES/ALSTOM Power Evaluation of Sorbent Injection for Mercury Control

Holcomb



Conesville



Meramec



Nanticoke



Program Co-funders

- EPRI
- Sunflower Electric Power Corporation
- AmerenUE
- Ontario Power Generation
- American Electric Power
- MidAmerican
- Southern Company
- Dynegy Generation
- Epcor
- Babcock & Wilcox
- NORIT Americas
- ADA-ES
- Alstom
- Arch Coal

Holcomb Co-funders

- EPRI
- Sunflower Electric Power Corporation
- Western Fuels Association
- Kansas City Board of Public Utilities (KCKBPU)
- Westar Energy
- Empire District Electric Company
- Nebraska Public Power District
- Kansas City Power and Light
- Tri-state/Missouri Basin Power Project
- ADA-ES
- Wisconsin Public Service
- Associated Electric

Test Team

- ADA-ES
- ALSTOM Power
- EPRI
- Reaction Engineering International
- Tetra Tech, Inc.
- Other Support
 - Stack Testing, etc.

Project Goals

- Evaluate performance of sorbent injection for mercury control
- Determine process/equipment costs for various levels of mercury removal
- Quantify balance-of-plant impacts

Area of Interest Matrix

Area of Interest	Holcomb	Meramec	Conesville	Nanticoke
Low-Rank Fuels (PRB)	X	X		X
Bituminous Fuels			X	
Blended Fuels	X		X	X
Medium SCA ESP		X	X	X
Spray Dryer	X			
Synergy between WFGD and Sorbent Injection			X	
Longer-Term Tests (1–2 months)	X	X	X	X

Phase II ESP Test Sites

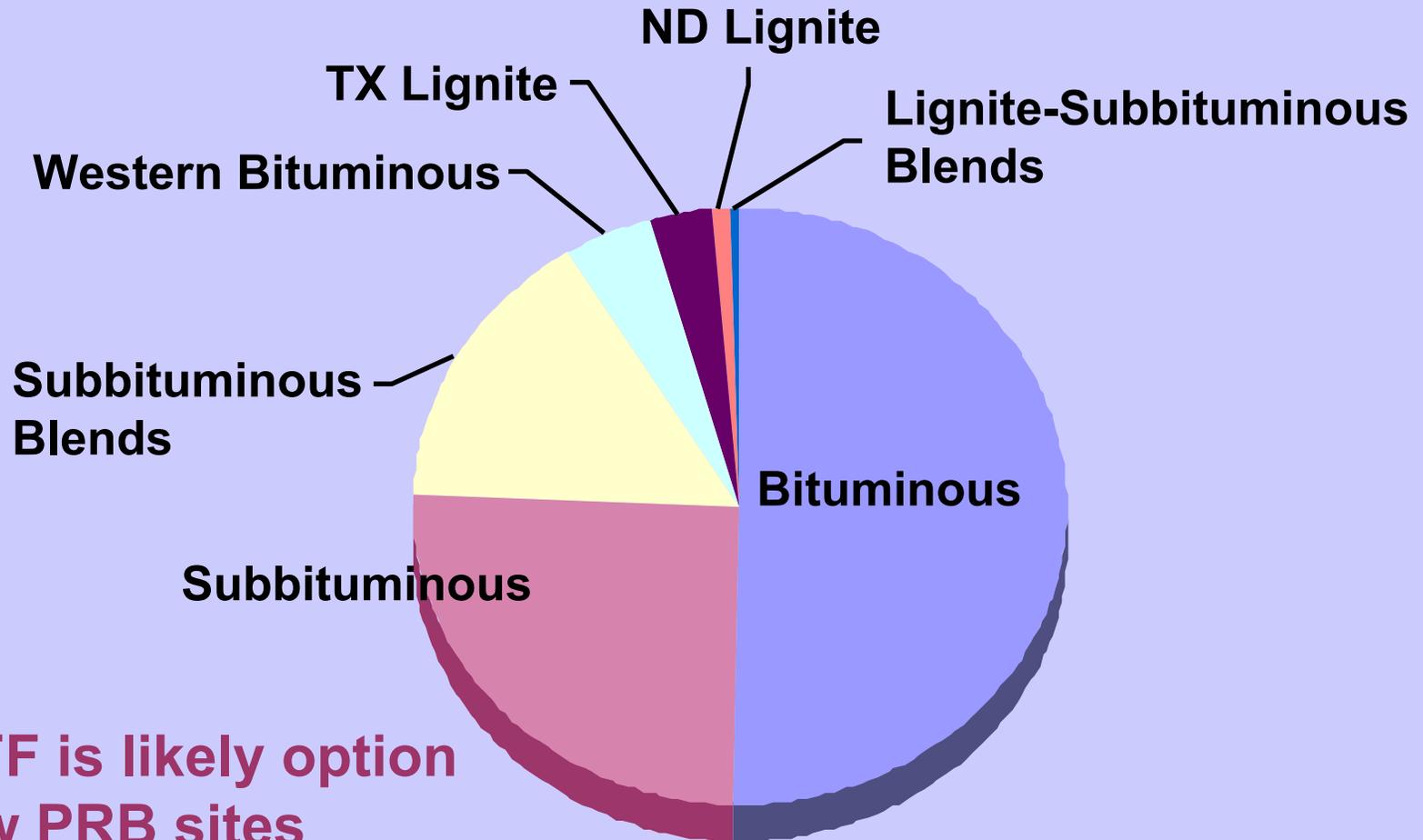
	Meramec	Nanticoke	Conesville
Test Size (MW)	70	500 and 250	375
Coal	PRB	PRB	Bituminous
Heating Value (<i>as rec'd</i>)	8,738	8,840	11,040
Sulfur (% by weight)	0.25	0.5	2.45
Chlorine (%)	0.06	<0.05	0.06-0.16
Mercury (µg/g)	0.052	0.075	0.16
Pollution Control	ESP (400 SCA)	ESP (208 SCA)	ESP (301 SCA) Wet FGD

Holcomb Station Unit 1

Test Size (MW)	360 and 180
Coal	PRB
Heating Value (as received)	8,500
Sulfur (% by weight)	0.4
Chlorine (%)	~0.01
Mercury ($\mu\text{g/g}$)	0.056
Pollution Control	SDA + FF

Why Holcomb?

Coal Usage by Generating Capacity



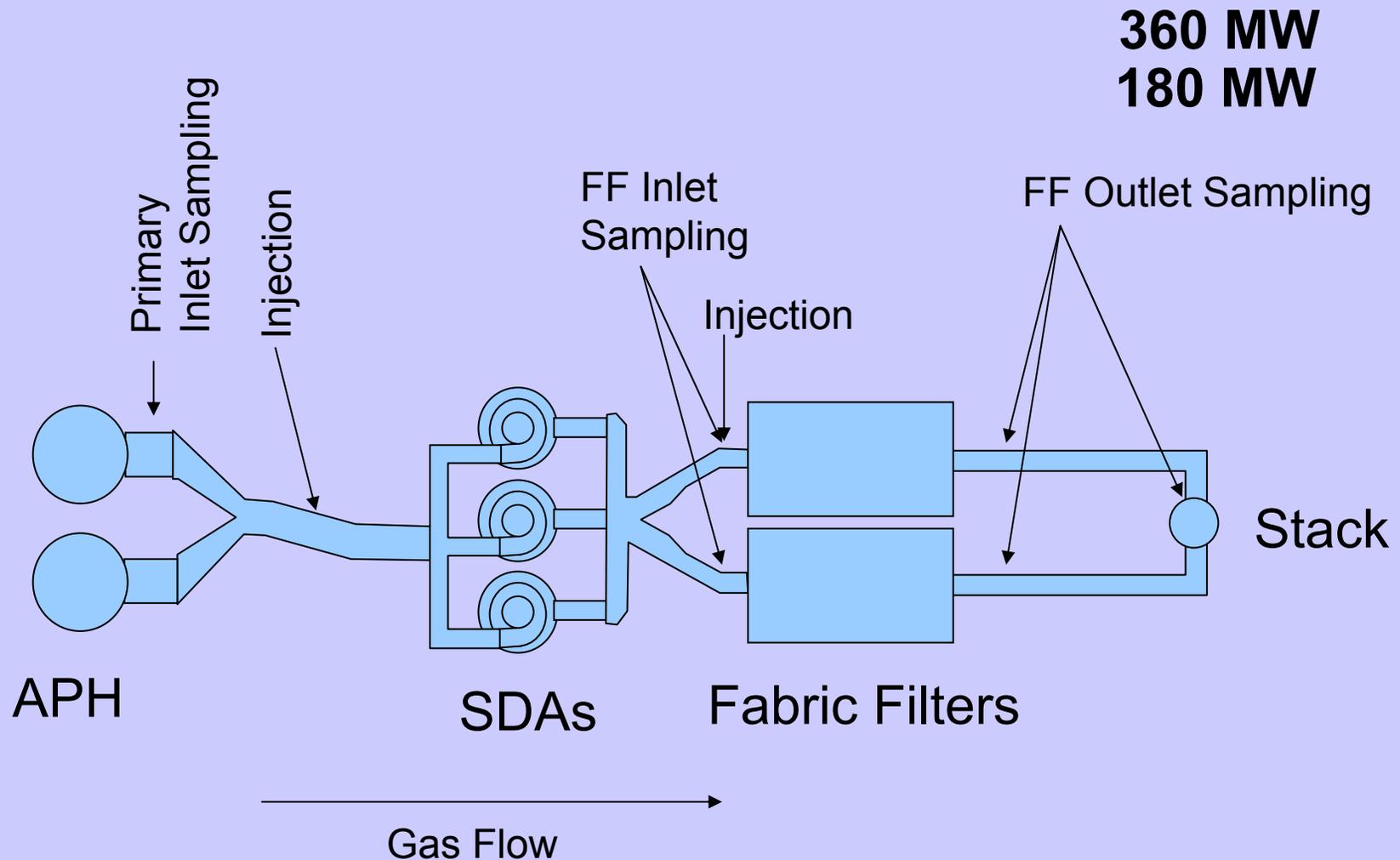
**SDA+FF is likely option
for new PRB sites**

Testing at Holcomb Station

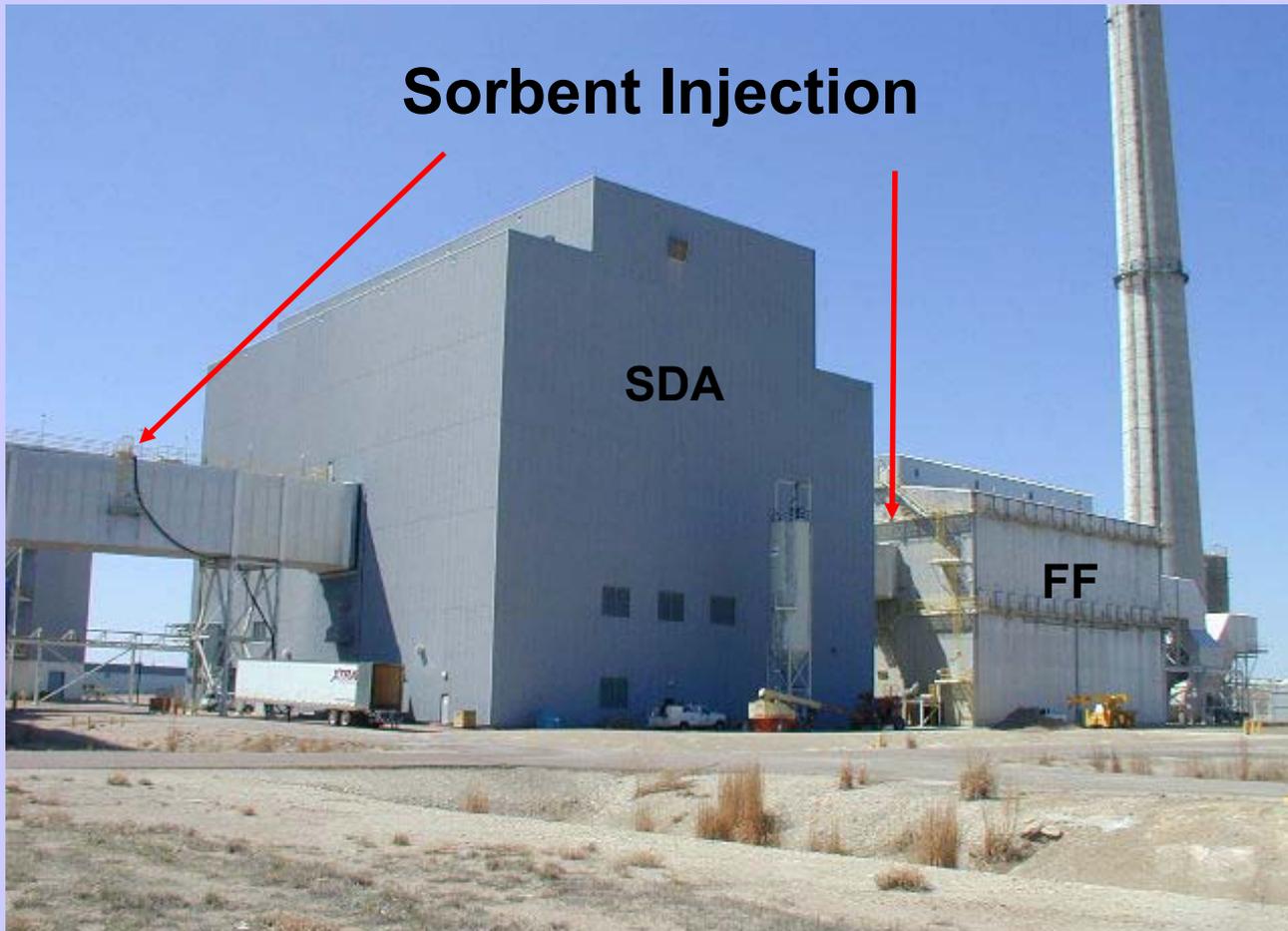


Plant Layout and Test Equipment

Holcomb Overall Layout



Plant Layout



Required Equipment



Field Testing

- Baseline and Coal Blend Testing
- Sorbent Screening
- Parametric Testing
- Long-Term Testing

Baseline and Coal Blend Testing

- Normal Operation (PRB) (1 week)
- Blend Coal (1 week)
 - PRB/Western Bituminous Blend

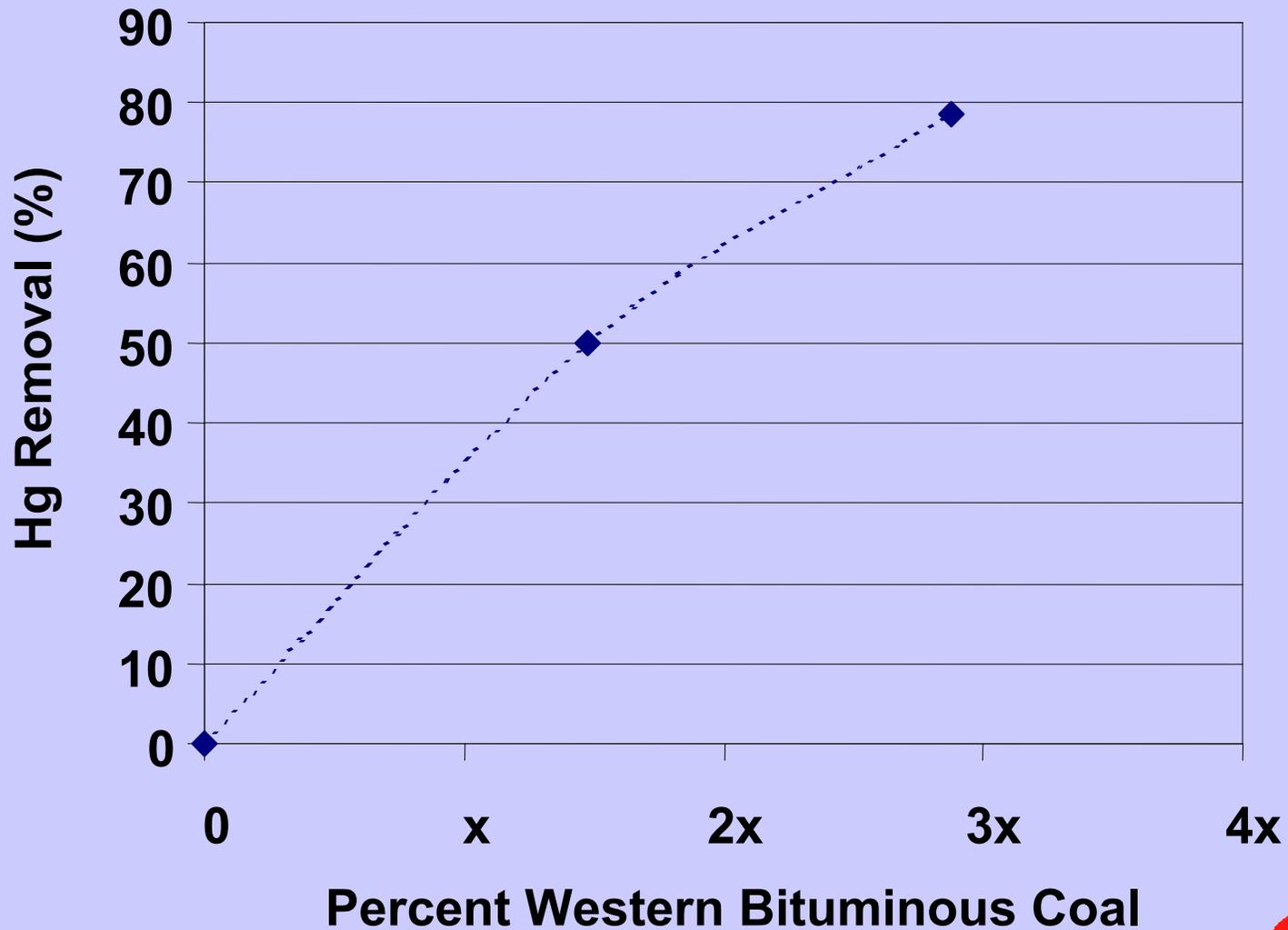
Baseline Testing Results

	Inlet ($\mu\text{g}/\text{dncm}$)	Outlet ($\mu\text{g}/\text{dncm}$)	Removal Efficiency
Particulate	0.47	0.01	98.94%
Oxidized	2.38	0.47	80.42%
Elemental	7.71	10.75	-39.52%
Total	10.55	11.22	-6.35%

Coal Blending at Holcomb



Coal Blending Results



Sorbent Screening

- Conduct field tests simulating removal across fabric filter
 - Sorbent pre-loaded onto standard sampling filter at representative sorbent loading
 - Slipstream operated at fabric filter temperature and air-to-cloth ratio
 - Flue gas extracted from fabric filter inlet

Results from Holcomb

Suppliers

Barnebey Sutcliffe/Calgon
Carbo Chem
Columbia Chemical
Donau
General Technologies
ISGS
NORIT
RWE
Sorbtech
Superior Adsorbents

Sorbent	Cumulative Average		
	Mercury Removal, %		
A	97	99	99
C	79	88	91
F	64	86	100
D	85	85	89
Mod B	71	79	80
G		78	93
E	60	77	87
I	52	65	63
H	70	65	55
J	60	58	51
K	45	55	69
L	55	53	54
N	58	48	35
M		45	52
O	34	40	39
B	28	30	29
Mod T	22	28	36
Q	21	23	21
R	21	20	16
Eq. Conc. lb/MMacf	1-2	2-3	3-4

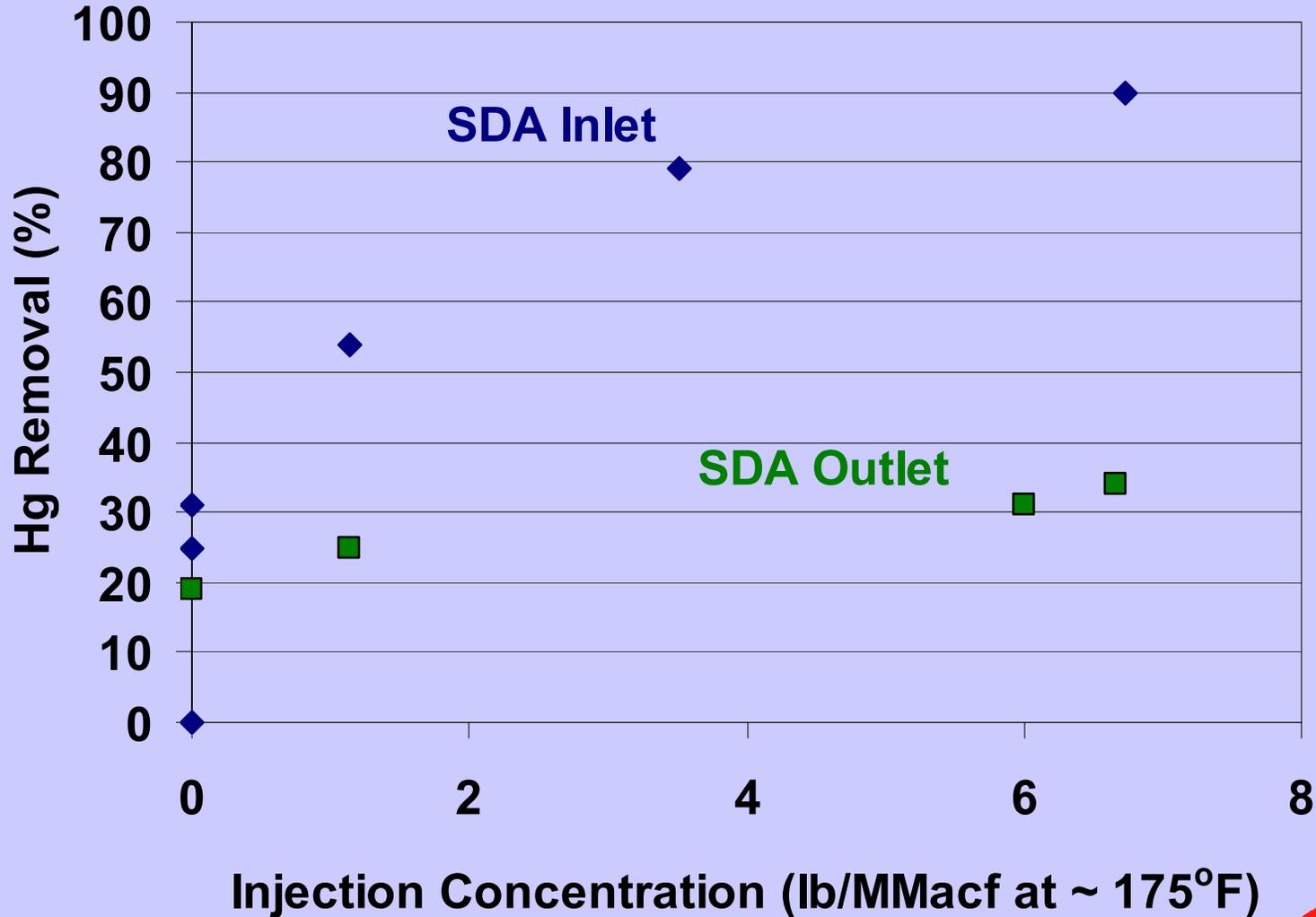
Results from Holcomb

<u>Suppliers</u>	Sorbent	Cumulative Average Mercury Removal, %		
		Eq. Conc. 1-2	Eq. Conc. 2-3	Eq. Conc. 3-4
Barnebey Sutcliffe/Calgon	F	64	86	100
Carbo Chem	D	85	85	89
Columbia Chemical				
Donau				
General Technologies				
ISGS				
NORIT				
RWE				
Sorbtech				
Superior Adsorbents				

Parametric Testing (3 weeks)

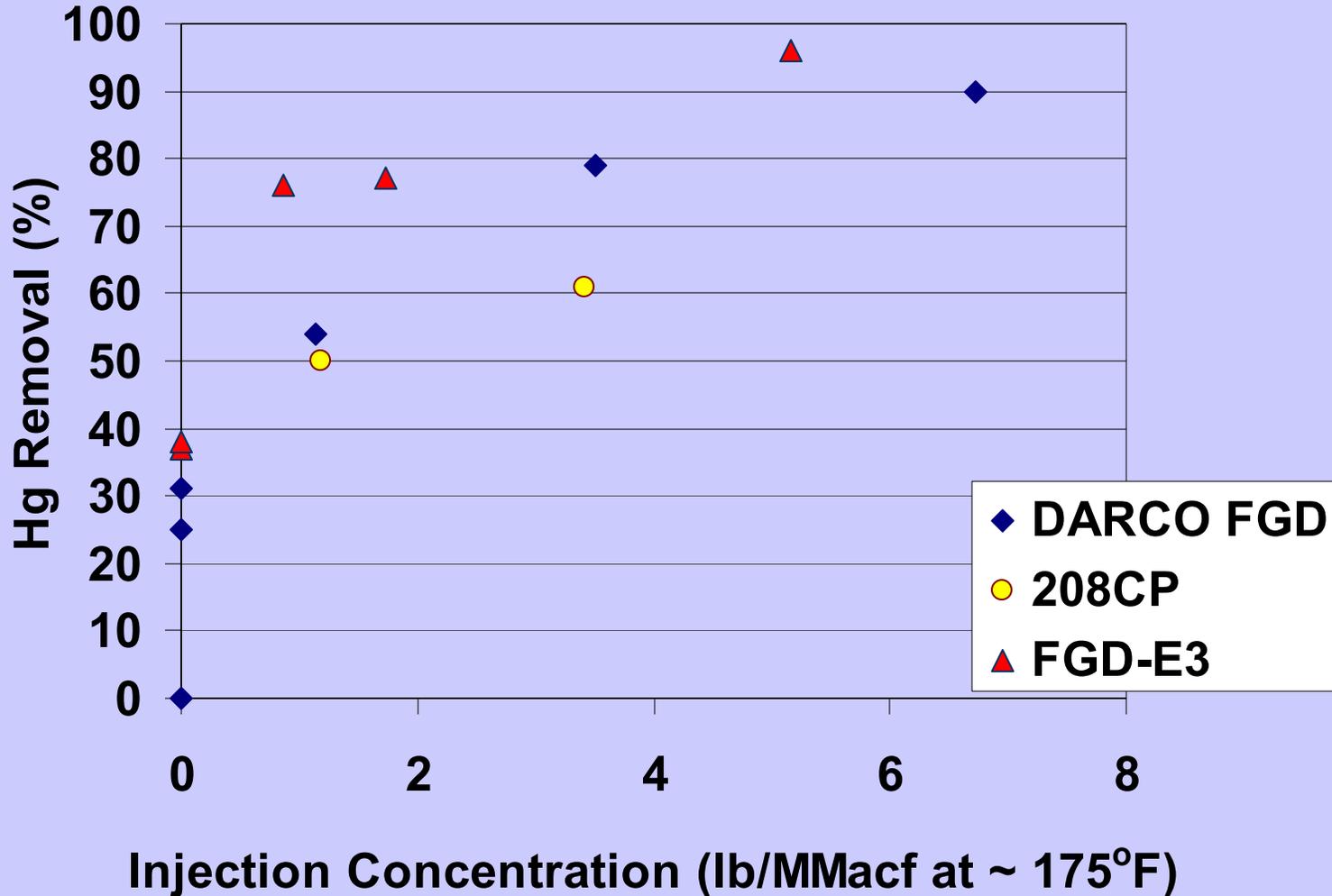
- Standard Activated Carbon
 - DARCO FGD at 3 injection concentrations
 - DARCO FGD upstream and downstream of SDA
- Alternative Sorbents
 - Calgon 208CP, non-treated activated carbon
 - FGD-E3, halogenated activated carbon
- Enhancements
 - Coal additive (KNX) + DARCO FGD
 - Flue Gas Additive + DARCO FGD

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

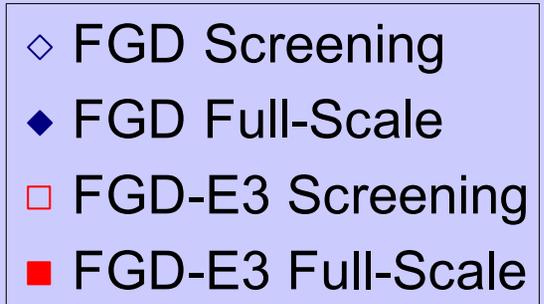
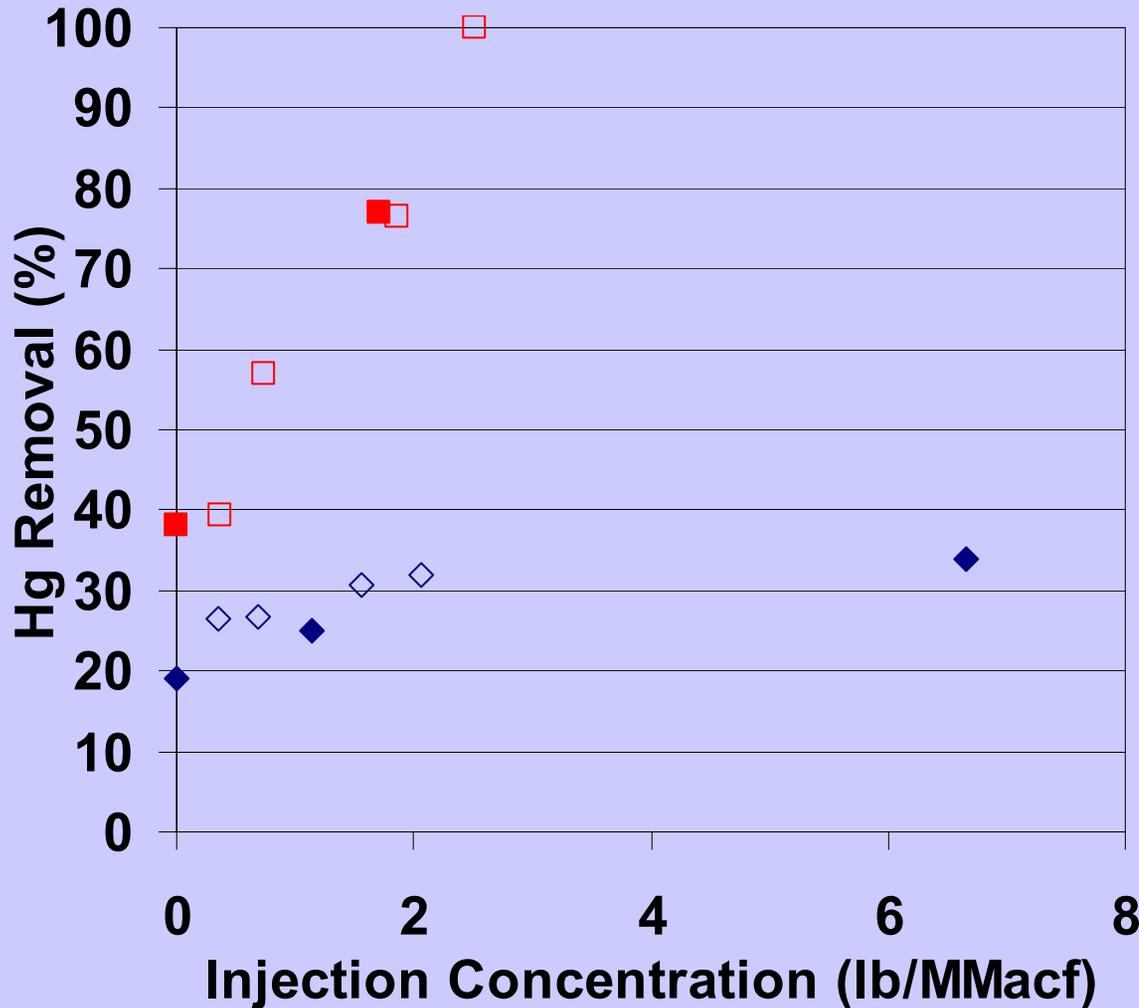


Alternative Sorbent Performance

SDA Inlet Injection, Holcomb Station

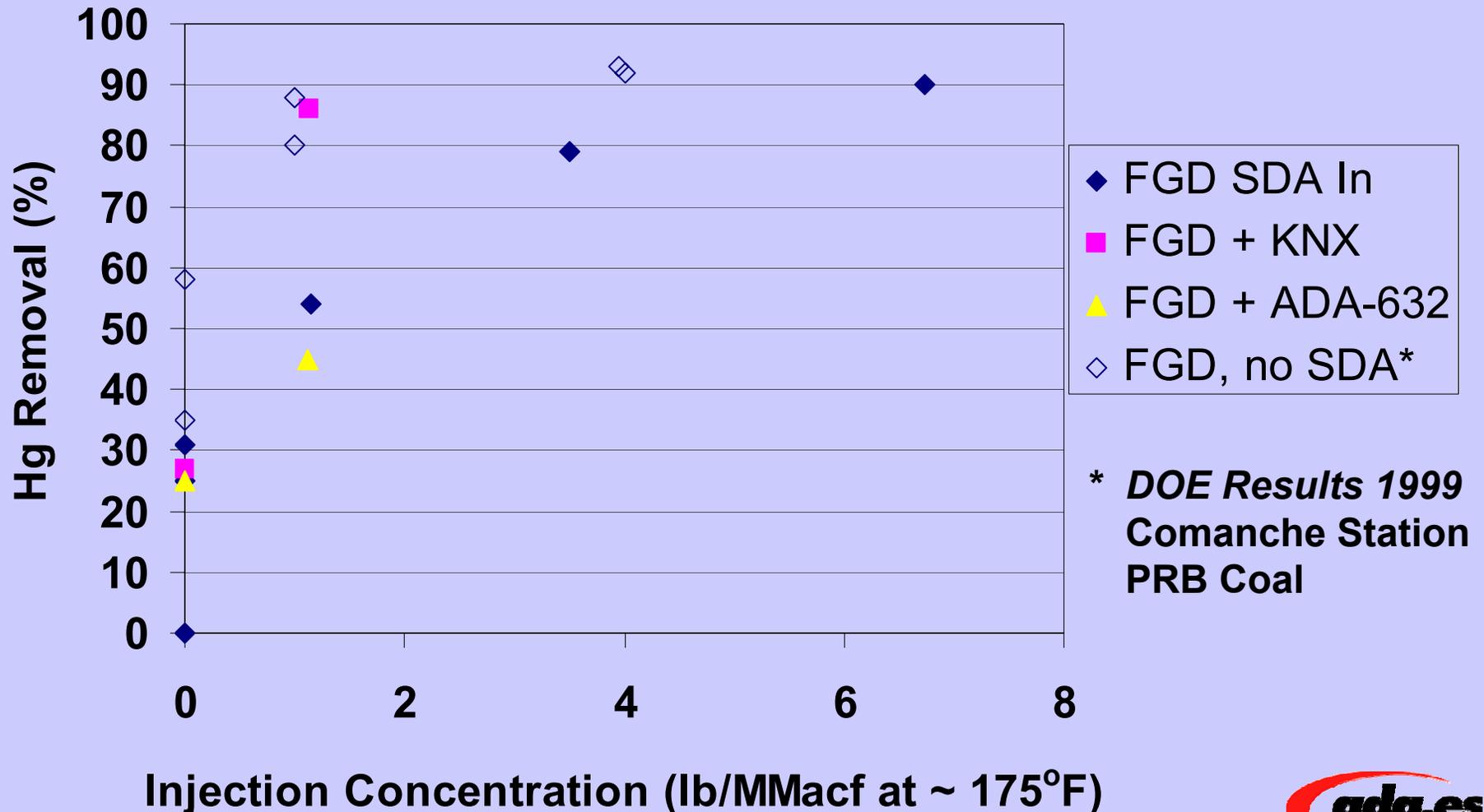


Holcomb Station Comparison to Screening Results



Screening: ~ 0.05 acfm
Full-Scale ~ 1,200,000 acfm

Chemical Additives at Holcomb Station



Longer-Term Testing (4 weeks)

Continuous FGD-E3 injection at SDA Inlet

- Sorbent injection concentration will be adjusted for $> 80\%$ Hg removal
- Goal: prove viability of the process and determine the economics by measuring the effects of continuous injection on:
 - SDA equipment and fabric filter
 - byproducts, and
 - balance of plant equipment

Preliminary Conclusions

- *SDA-FF is likely configuration for new PRB units*
- *Previous data indicated high cost sorbents required for high mercury removal*
- ✓ Three lower-cost options identified for PRB units with SDA-FF
 - Coal blending
 - Treated sorbents
 - Coal additives + untreated activated carbon

Project Field Testing Schedule

