Compliance Strategy Options and Costs for PM2.5 Control

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Options

Baghouse (BH)

- Pulse Jet (PJ)*
- Reverse Air (RA)*

Electrostatic Precipitator (ESP)

- Wet ESP
- Dry ESP*
- Conversion to BH

*Cost Comparison

Assumptions

- Inlet Volume to Baghouse/ESP = 3,000,000 ACFM
- Normal Operating Temperature = 280 °F
- Coal Sulfur Content = 3.0%
- Outlet Particulate from Baghouse/ESP = 0.0005 grains/ACFM

Technical Comparison

Cleaning Method	Reverse Air	Pulse Jet	ESP
Air Pressure	Low	Compressed	NA
Filter Media	Woven*	Felt*	NA
Bag Diameter/Plate ga.	12 inch	6 inch	18 ga.
Bag Length/Plate Ht.	35 feet	28 feet	48 feet
Plate Spacing	NA	NA	16 in.
Collect dust	Inside tube	Outside Tube	NA
Filtration Mechanism:			NA
Without Membrane	Dust Cake	Felt + Dust	NA
With Membrane	Surface	Surface	NA
No. of Casings	2	2	2
No. of Fields	NA	NA	4
No. of Chambers	NA	NA	3
Experience:	30 years	15 years	>50 years
With ePTFE Membrane	10 years	7 years	NA

* With and without ePTFE Membrane

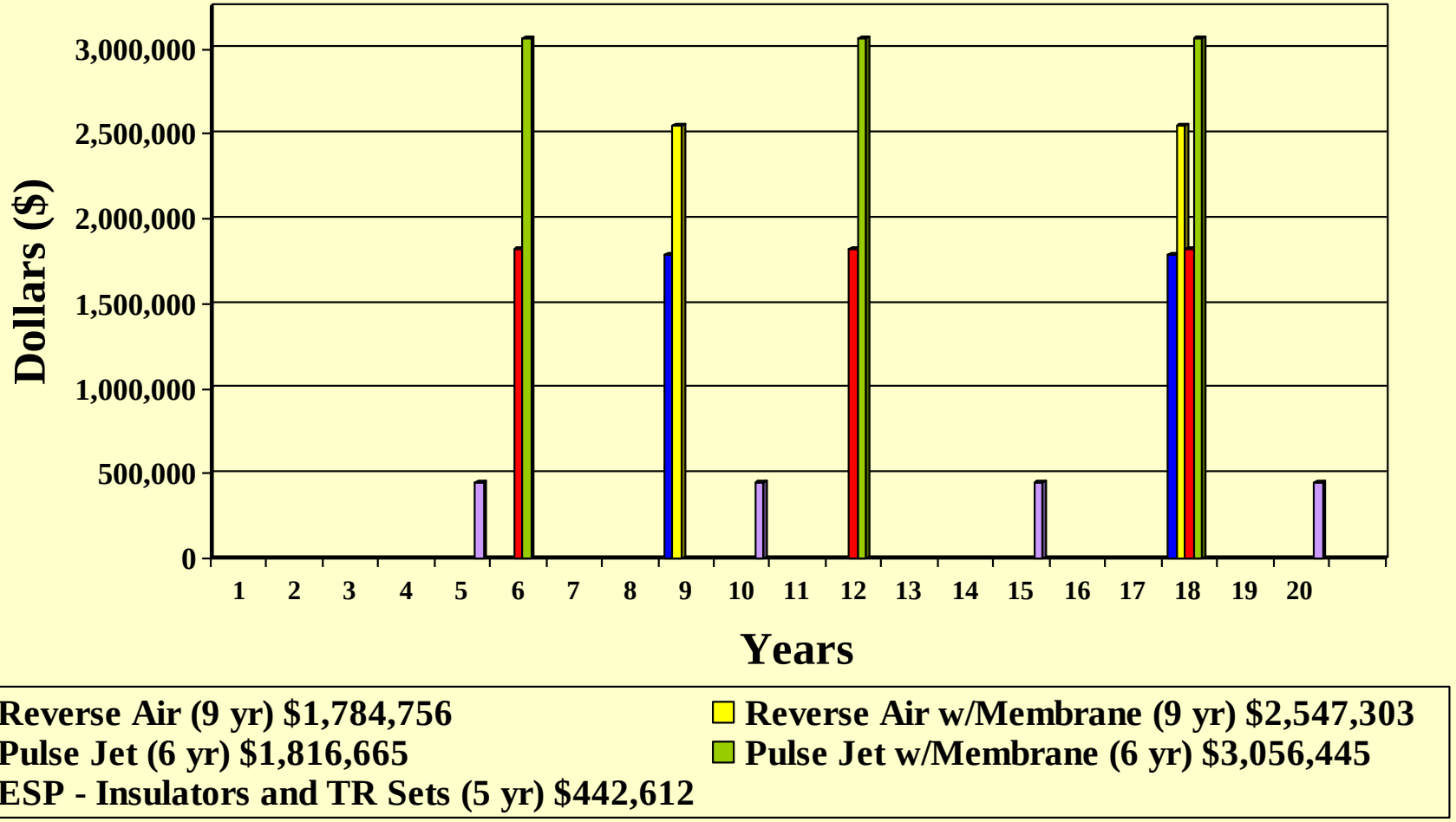
Limitations

- All numbers valid for comparison
- Not to be used for budgetary purposes
- Individual vendors quotes higher and lower
- Relative size of RA & PJ valid
- ESP and Baghouse arrangements vary
- Selection & refined design needed

Parts Comparison

REVERSE AIR	REVERSE AIR	PULSE JET	PULSE JET	ESP
10 oz. FG	10 oz. FG + ePTFE membrane	16 oz. PPS	16 oz. PPS + ePTFE membrane	$368/insulator
35 ft L x 12 in D	35 ft L x 12 in D	28 ft L x 6 in D	28 ft L x 6 in D	192 insulators
$95/bag (± 7%)	$142/bag (± 7%)	$70/bag (± 15%)	$123/bag (± 15%)	$70,656/192
16,128 bags	16,128 bags	23,296 bags	23,296 bags	$40,250/other
$1,525,095 / bag set	$2,287,642 / bag set	$1,629,132 / bag set	$2,868,912 / bag set	$4,600 / TR set
$259,661 labor	$259,661 labor	$187,533 labor	$187,553 labor	24 TR sets
$1,784,756 / bag set + labor	$2,547,303 / bag set + labor	$1,816,665 / bag set + labor	$3,056,445 / bag set + labor	$110,400 / 24 sets
9 yr. life	9 yr. life	6 yr. life	6 yr. life	5 yr. life
$198,306 / yr bags + labor	$283,034 / yr bags + labor	$201,852 / yr bags + labor	$339,605 / yr bags + labor	$88,522 / yr parts + labor

Bag & ESP Parts Replacement
Expenditure Timeline



Annual Costs-ESP & Baghouse Fifteen Year Straight Line

Baglife: RA= 9 yr, PJ = 6 yr, ESP Insulators/TR = 5 yr

For comparison only & not for budgetary purposes

Interest charges not included

REVERSE AIR	REVERSE AIR	PULSE JET	PULSE JET	ESP
10 oz. FG	10 oz. FG + ePTFE membrane	16 oz. PPS	16 oz. PPS + ePTFE membrane	Insulators / TR
$44,850,000 (house)	$44,850,000 (house)	$26,450,000 (house)	$26,450,000 (house)	$28,750,000 (stacked)
$2,990,000 / yr (house)	$2,990,000 / yr (house)	$1,763,333/ yr (house)	$1,763,333 / yr (house)	$1,916,667/ yr (stacked)
$198,306 / yr (bags)	$283,034 / yr (bags)	$201,852 / yr (bags)	$339,605 / yr (bags)	$88,522 / yr (insul./TR)
$3,188,306 / yr	$3,273,034 / yr	$1,965,185 / yr	$2,102,938 / yr	$2,005,189 / yr

Reliability

Keys to trouble-free operation

1) Conservative G/C and/or SCA Equiv.
2) Vendor with direct experience
3) Detailed specification
4) QA/QC & Installation
5) Training, Start-up
6) O&M plan & implementation
7) Operate above the acid dew point
8) True for both Baghouse and ESP

ESP Pros & Cons

Advantages:

1) Low pressure drop
2) High experience
3) High temperature capability

Disadvantages:

1) Very sensitive to fluctuations in gas stream conditions : flow, temperature, particulate & gas composition, dust loading
2) Not effective in capturing some contaminants: heavy metals, dioxins

Baghouse Pros & Cons

Advantages:

1) Extremely high efficiency on both course & fine particulate
2) Relatively insensitive to gas stream fluctuations including flow, dust loading and particulate and gas composition
3) Relatively simple operation
4) In the case of pulse jet relatively small “footprint”

Disadvantages:

1) Temperature limited by bag selection (500°F max)
2) Relatively high flange to flange pressure drop
3) Bag change might require respiratory protection

ADA-ES Long Term Evaluation ref no 8

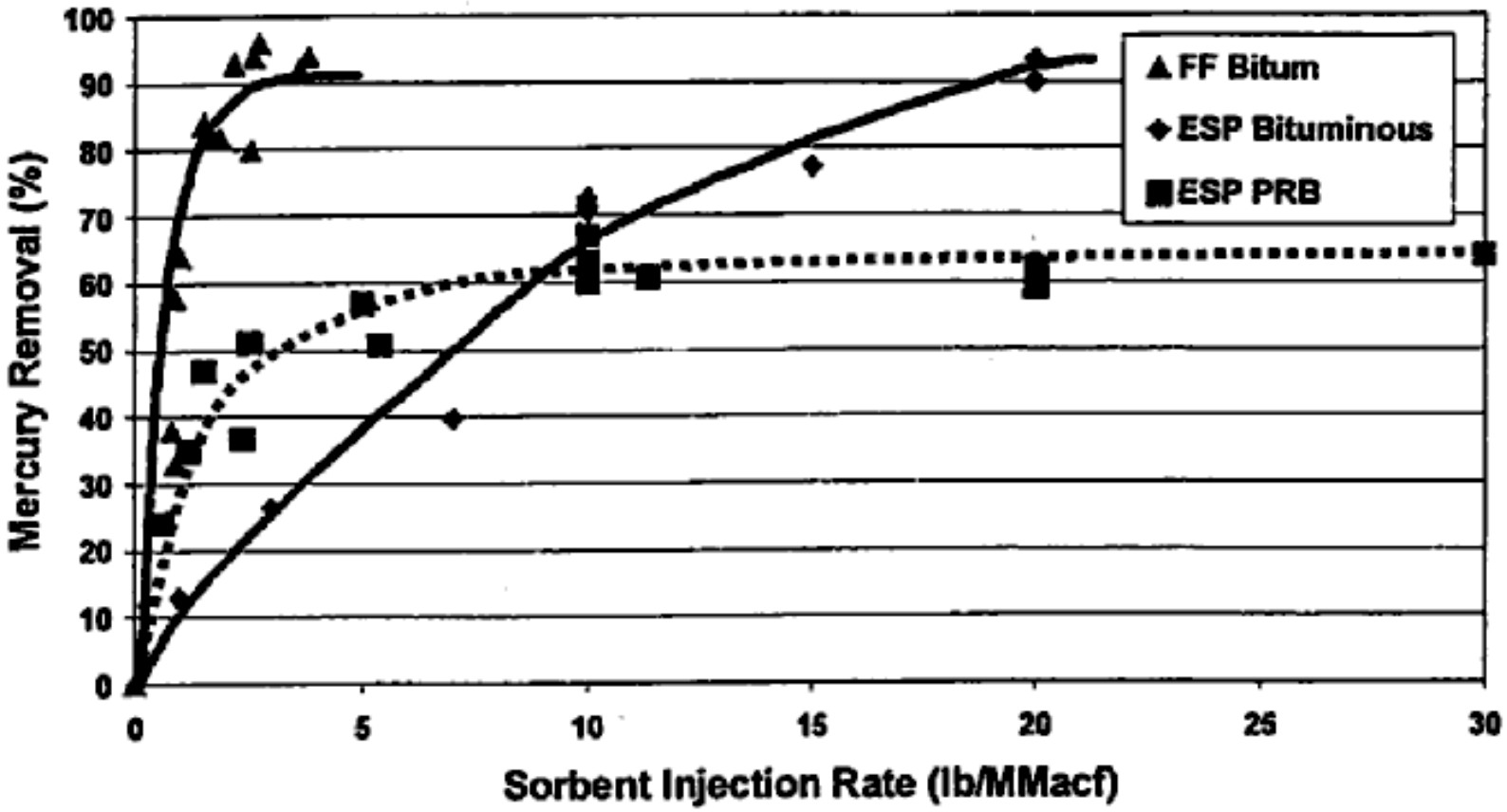


Figure 2. Mercury Removal Trends with Activated Carbon from NETL Phase I Test Program

Summary Comparison

	Reverse Air	Reverse Air w/Membrane	Pulse Jet	Pulse Jet w/Membrane	ESP
Initial House Cost	$45 mil	$45 mil	$26.5 mil	$26.5 mil	$28.8 mil
Annual O&M Expense	$198,306/yr	$283,034/yr	$201,852/yr	$339,605/yr	$88,522/yr
Total Annual Cost	$3.2 mil/yr	$3.3 mil/yr	$2.0 mil/yr	$2.1 mil/yr	$2.0 mil/yr
Size (ft): • Height	84	84	81	81	85
• Width	151	151	111	111	326
• Length	255	255	177	177	101
Reliability: • Years experience	30+	10+	15+	7+	50+
• Reported	Very Good/ Excellent	Very Good/ Excellent	Very Good	Very Good	Excellent
Flexibility: • Gas Volume	Very Good	Very Good	Very Good	Very Good	Fair
• Coal Characteristics	Excellent	Excellent	Excellent	Excellent	Fair/Poor
Future: • Fine Particle	99.99% +	99.99% +	99.99% +	99.99% +	99%+
• Mercury	90%* $1.5 mil/yr**	90%* $1.5 mil/yr**	90%* $1.5 mil/yr**	90%* $1.5 mil/yr**	60%* >$10 mil/yr**

* Sorbent efficiency **Carbon Injection comparative cost for mercury capture

Size Comparison