



# **Fabric Filter Evaluation in a TOXECON™ Configuration at Presque Isle**

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# Acknowledgements

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- Dr. Ramsay Chang - EPRI
- Theron Grubb – Grubb Filtration Testing Services
- GE/BHA
- Toray
- Alstrom

# TOXECON™ - 270 MW Demonstration

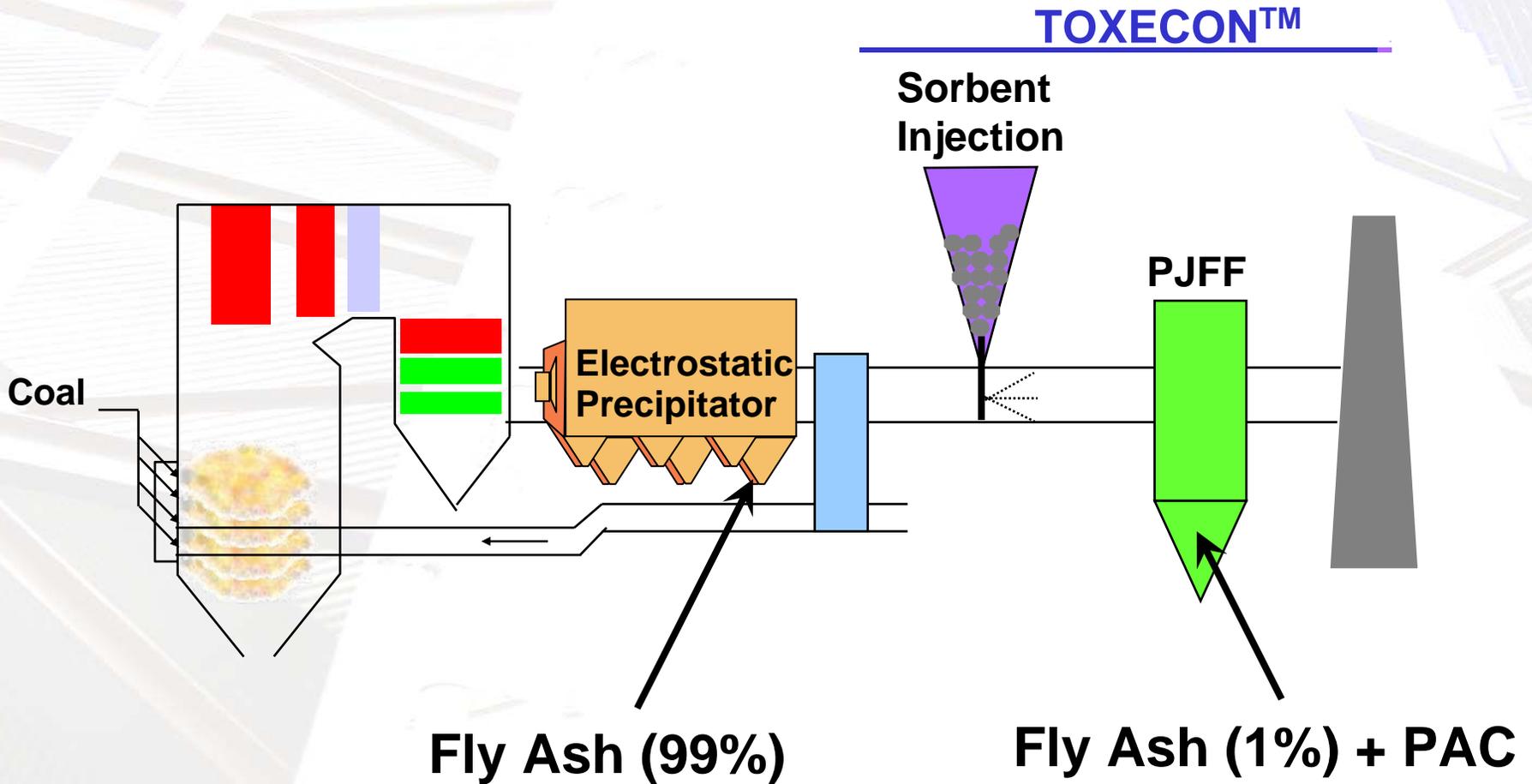
- Presque Isle Power Plant, Marquette MI
  - Units 7-9
  - PRB Coals
- \$53.3M
  - \$24.9M DOE
  - \$28.5M We Energies
- Project Goals
  - 90% Hg - Continuous
  - 70% SO<sub>2</sub> - Short- term
  - 30% NO<sub>X</sub> – Short-term
  - Novel Test Bag Evaluation



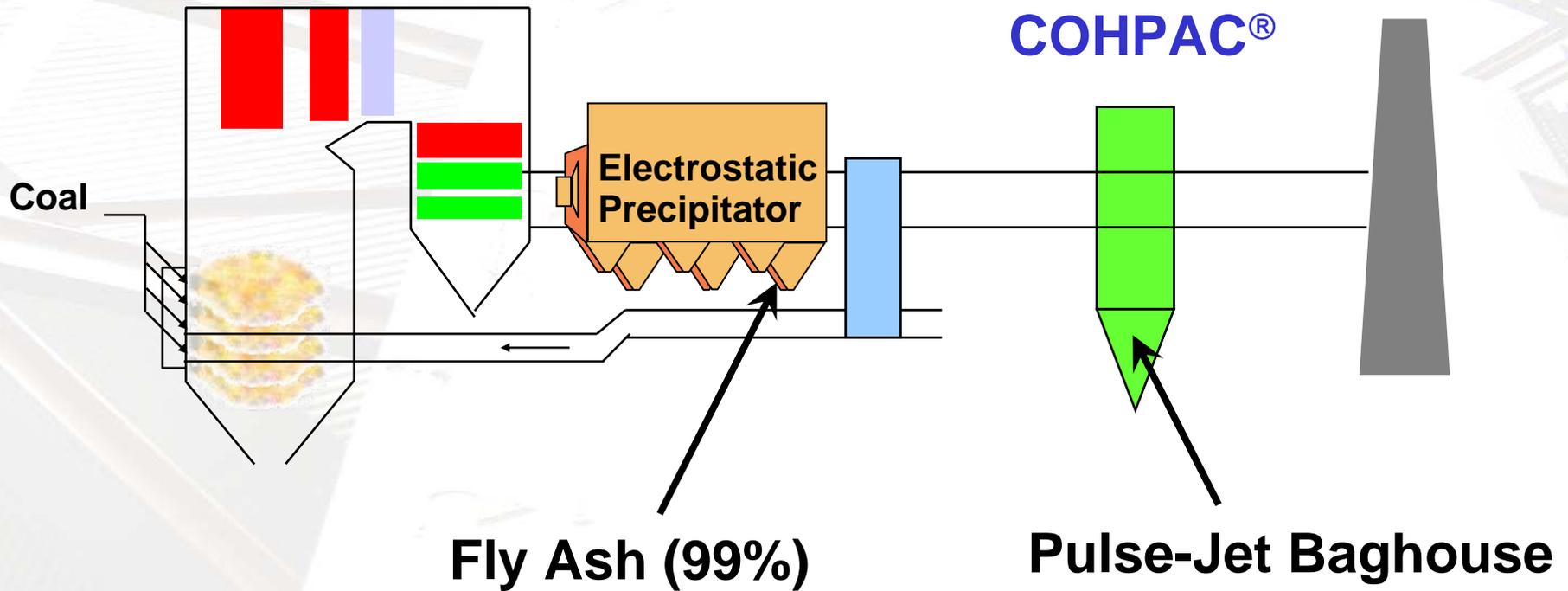
# PIPP TOXECON™



# TOXECON™ Configuration



# COHPAC<sup>®</sup> Configuration



# PIPP TOXECON™ Baghouse

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- Baghouse supplied by Wheelabrator Air Pollution Control Inc.
- 10 compartments, each with 648 bags
- Each compartment separated into two, 18 x 18 row bag bundles
- Bag diameter is approximately 5.25 in.
- Length is 26.25 ft
- Filtering area is 35.5 ft<sup>2</sup>/bag, total filtration area is 230,000 ft<sup>2</sup>.
- With all units in service at full load, gross air-to-cloth ratio is 5.0 ft/min.

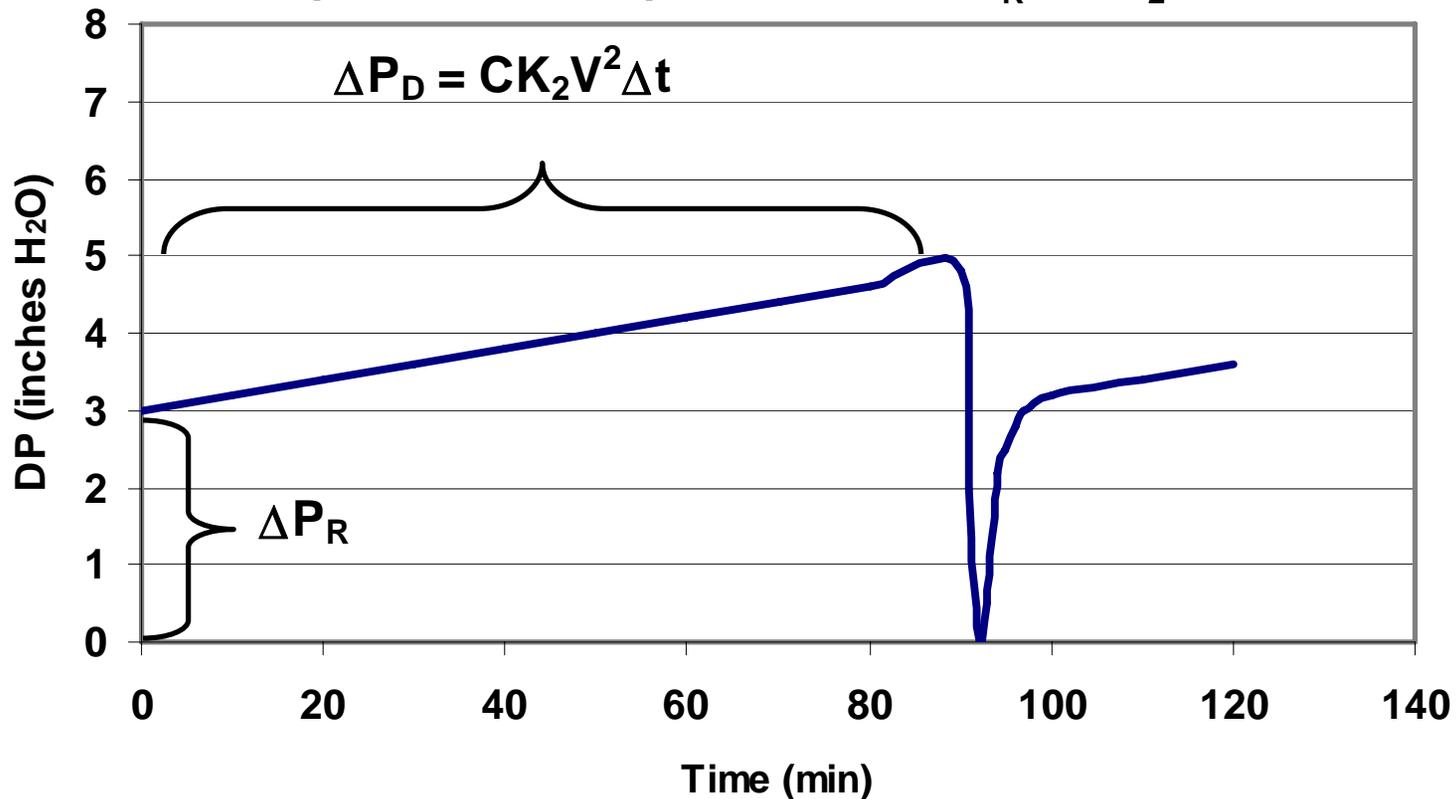
# OEM Bag Specifications

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- Felted, 2.7 denier PPS fabric
- Weight of nominally 18 ounces/yd<sup>2</sup>
- Singed on both sides
- Scrim material made from 3 ounces/yd<sup>2</sup> of PPS
- Mullen burst minimum of 500 psi
- Permeability at 0.5 inches H<sub>2</sub>O of 25–40 cfm/ft<sup>2</sup>

# Typical Off Line Clean $\Delta P$ Cycle

Pressure Drop Predictive Equation  $\Delta P = \Delta P_R + CK_2V^2\Delta t$



$K_2$  = specific resistance coefficient of freshly deposited dust (in H<sub>2</sub>O-ft-min/lb)

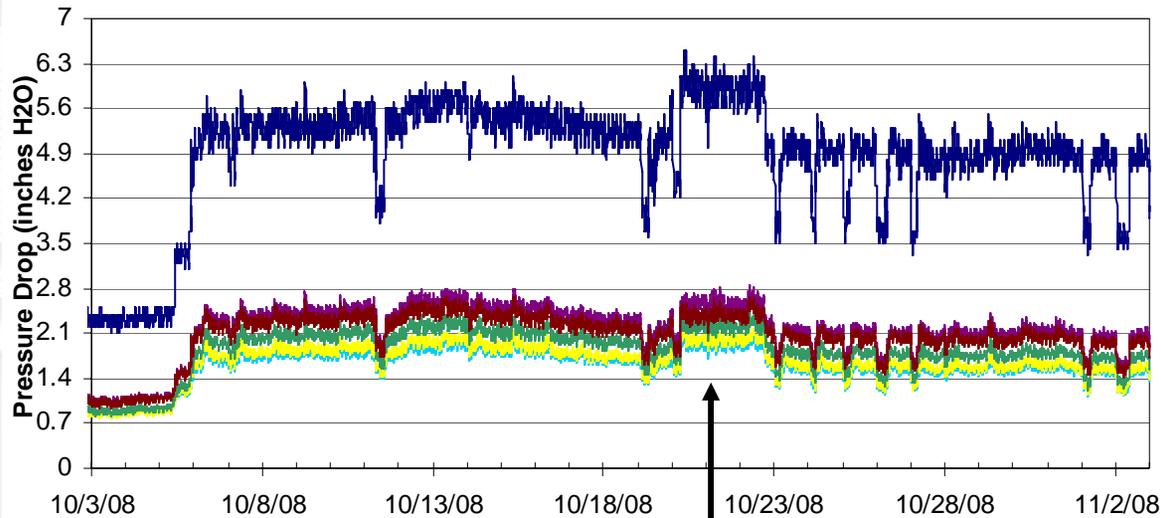
$V$  = air-to-cloth ratio (ft/min)

$C$  = dust loading (gr/acf)

$t$  = time between cleans (min)

# 10% ↑ in A/C Ratio = 25% ↑ in $\Delta P$

Presque Isle TOXECON Baghouse



FI-FI  $\Delta P$

Tubesheet  $\Delta P$

One Compartment Off line for Maintenance

# Drag

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$$\text{Drag} = \Delta P / (A/C)$$

Normalizes  $\Delta P$  to  $A/C$

$$\mathbf{S = S_R + CK_2V\Delta t}$$

**S** = drag, inches H<sub>2</sub>O/ft/min

**S<sub>R</sub>** = residual drag, inches H<sub>2</sub>O

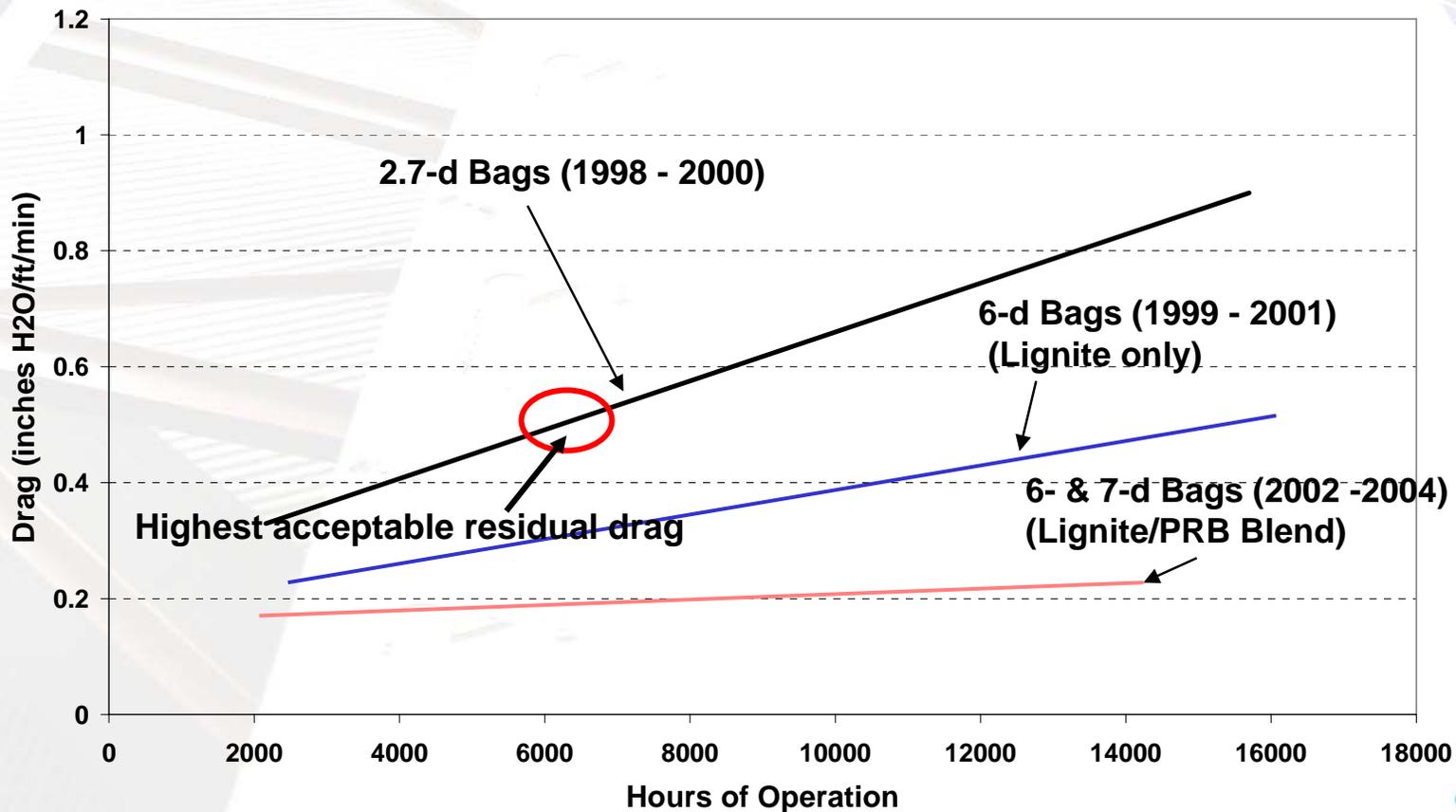
# EPRI's Novel Fabric Testing

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- Started testing in 1998
- Evaluated over 30 different fabrics that could provide cost or performance advantages
- High-perm fabric developed and demonstrated in this program
- Performance measured by
  - In-situ drag measurements (individual bags)
  - Fabric strength (laboratory tests)
  - Bag life (2 – 4 years)

# Impact of High Perm Bags on Residual Drag (pressure drop)

Big Brown In-Situ Drag History  
1998 - 2004



$S_R$

$K_2$

# Standard vs. High Perm PPS

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Property	Standard	High Perm
Fabric	PPS Felt	PPS Felt
Scrim	PPS	PPS
Denier (g/m <sup>2</sup> )	2.7	~ 7.0
Permeability (cfm/ft <sup>2</sup> )	~ 30	~130
Weight (oz/yd <sup>2</sup> )	18	15

# Test Bag Description

Bag ID	Material/Design	Benefit	Quantity
9065	Dual density Torcon (0.9 and 2 denier blend on filter side, 7 denier on other side)	High Perm on one side, high collection efficiency on other side	8
1342	P84	Higher temperature, higher efficiency	10
GE BHA-TEX	Scrim-supported PPS felt with a BHA-TEX Expanded microporous PTFE Membrane	Membrane provides higher collection efficiency and promotes light dustcake formation	9
Toray	Proprietary material		1
Environmental Products and Systems, Inc.	PPS fabric	Alternate source of PPS bags	1
GE PS050	PPS fabric with 0.5 and 2.9 denier fibers on filtration side, 7.9 denier on other side	High Perm on one side, high collection efficiency on other side	5
Proprietary blend			Swatches only
9054 <sup>a</sup>	High- perm, 7 denier Torcon with 2.0 oz. PTFE scrim	High Perm fabric with more robust scrim	8
9055 <sup>a</sup>	High-perm, 7 denier Torcon with 4.0 oz. PTFE scrim	High Perm fabric with more robust scrim	8
9056 <sup>a</sup>	High-perm, 7 denier Torcon with Torcon scrim	High Permeability fabric	12
Proprietary blend	Proprietary material		Swatches only

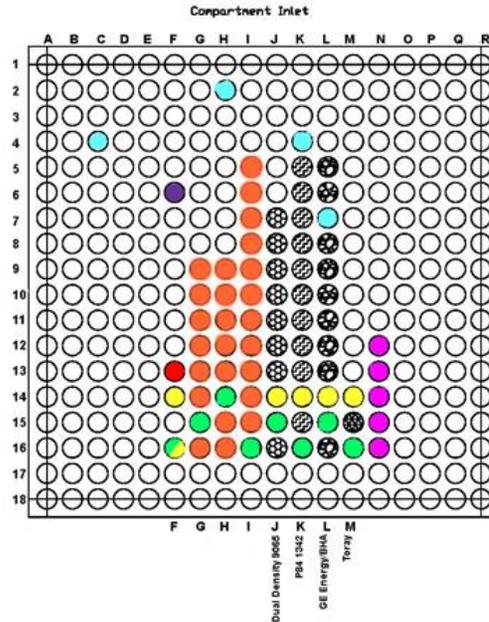
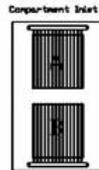
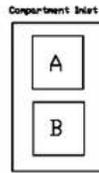
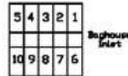
# Test Bag Layout – Presque Isle

## Presque Isle Power Plant Units 7-9 Baghouse Bag Layout

Date 10-14-08

Compartment/Bank 8

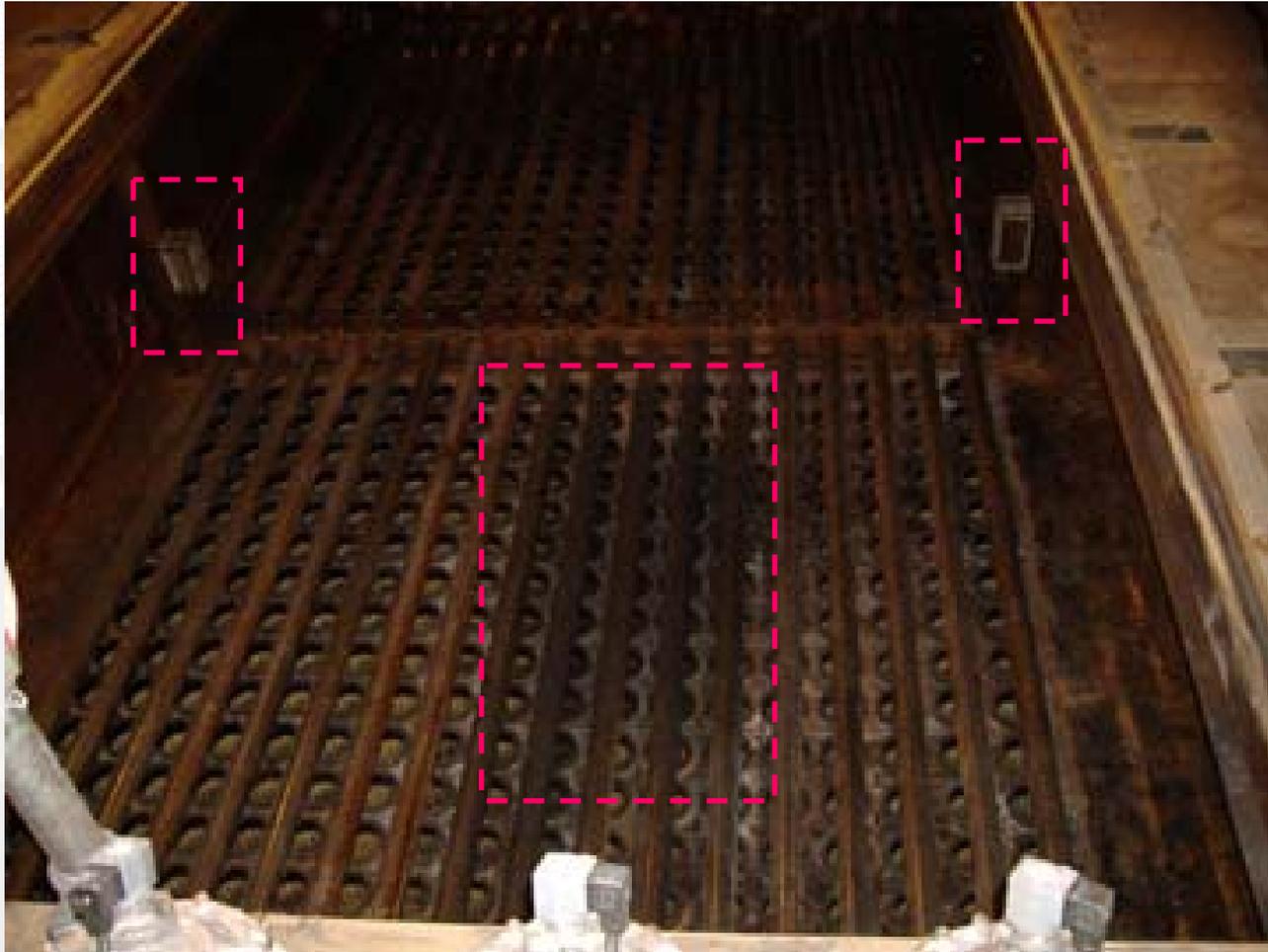
### Baghouse Key:



- 1. 3-21-06: K4, L7, H2, and C4 removed for analysis.
- 2. 2-26-07: F16, G15, H14, I16, J15, K16, L15, M16 removed for analysis and replaced with OEM bags.
- 3. 9-25-07: F6 installed. A PPS fabric from Environmental Products and Systems, Inc.
- 4. 4-18-07: Remaining test bags in rows G, H, and I were removed and replaced with OEM PPS.
- 5. 4-18-07: Kernel swatches removed. Armorguard and new PPS swatches were installed.
- 6. 5-21-08: F14, F16, J14, K14, L14, M14 removed for analysis and replaced with new OEM bags.
- 7. 7-08: N13-N16. GE PS050 bags installed.
- 8. 10-08: F13 removed for analysis and replaced with a new OEM bag.

# Activated Carbon Bleeding Through Test Bags and Test Swatch Frames

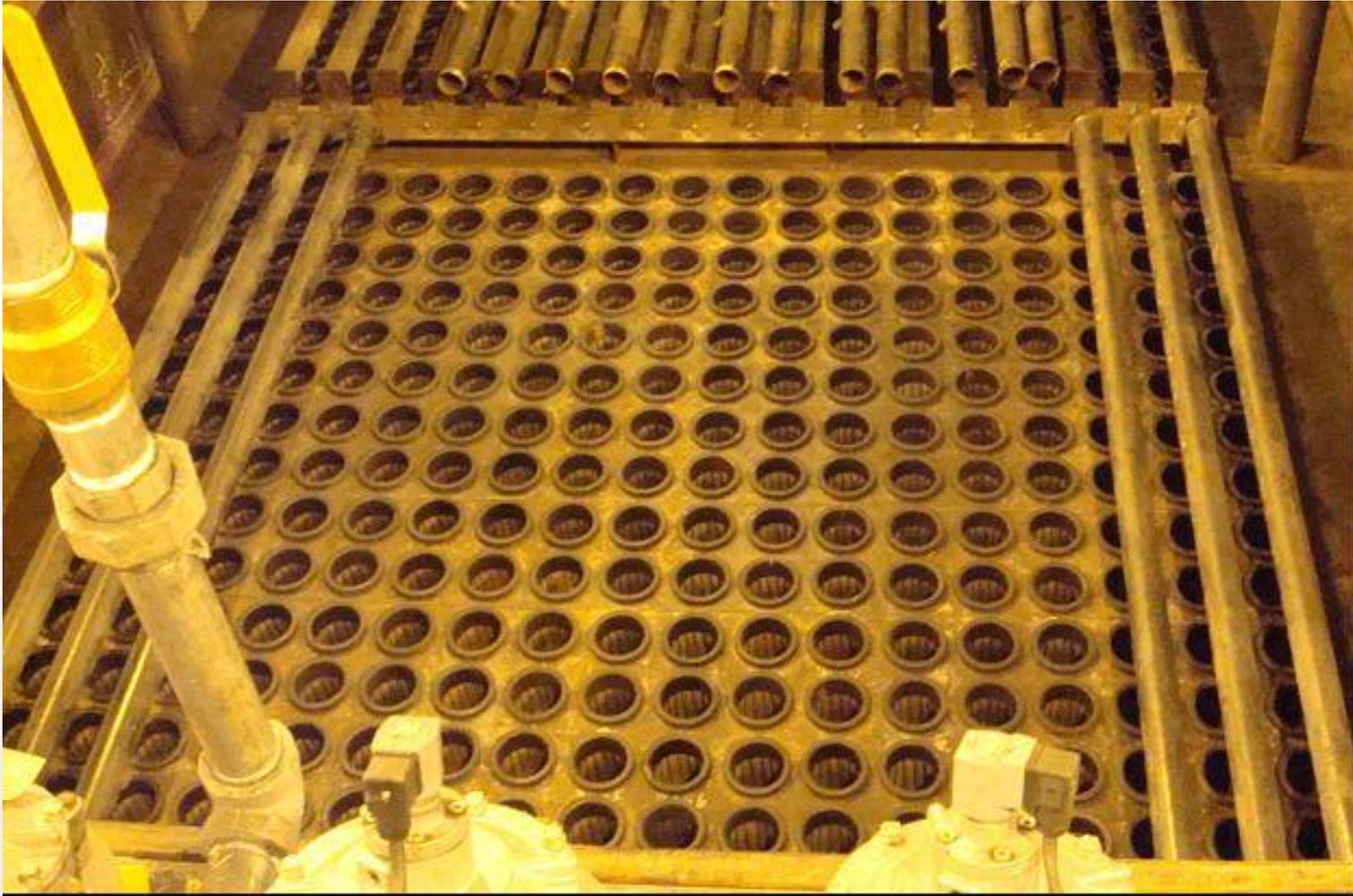
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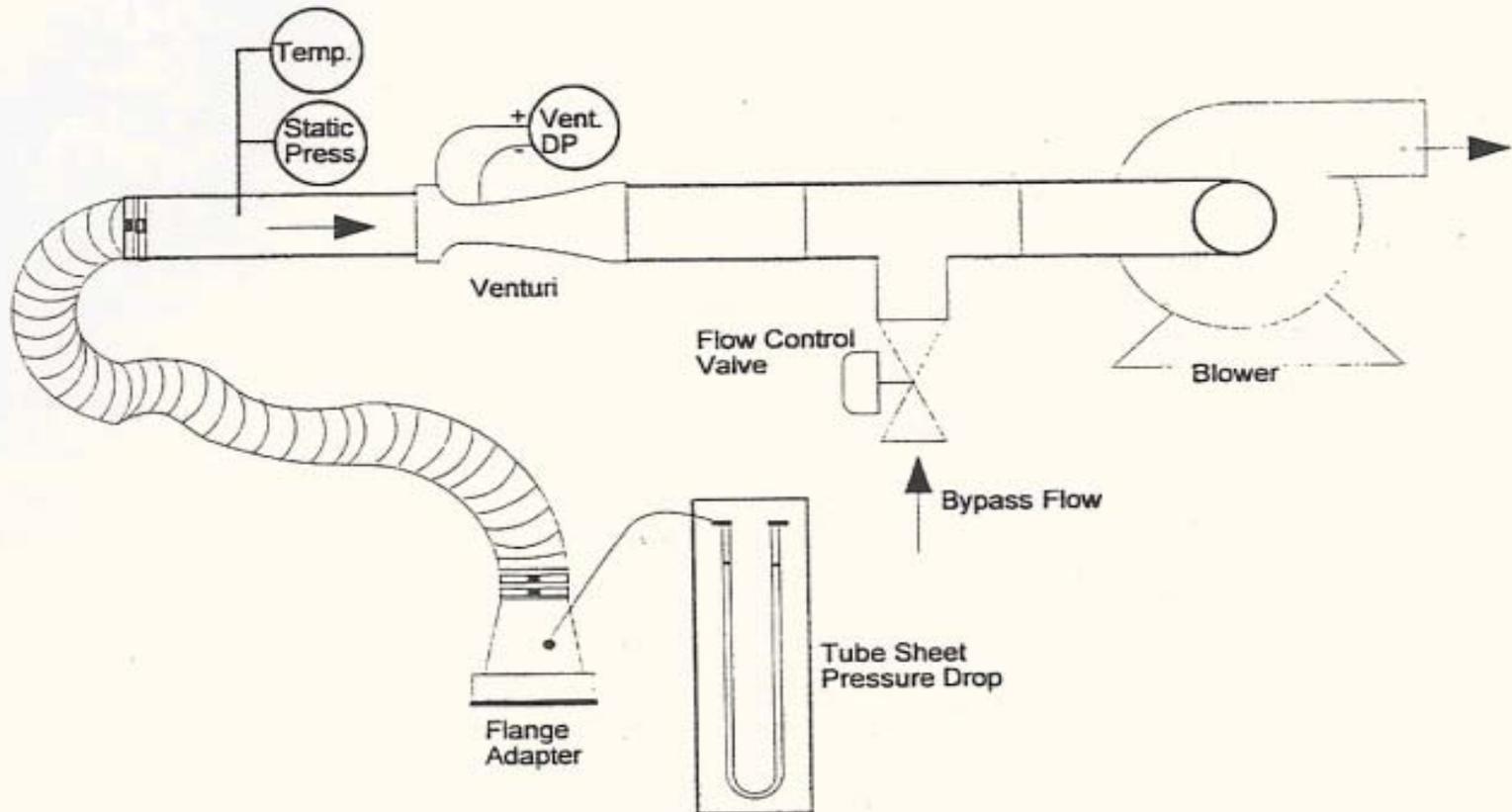
# Failed test swatch and PPS swatch



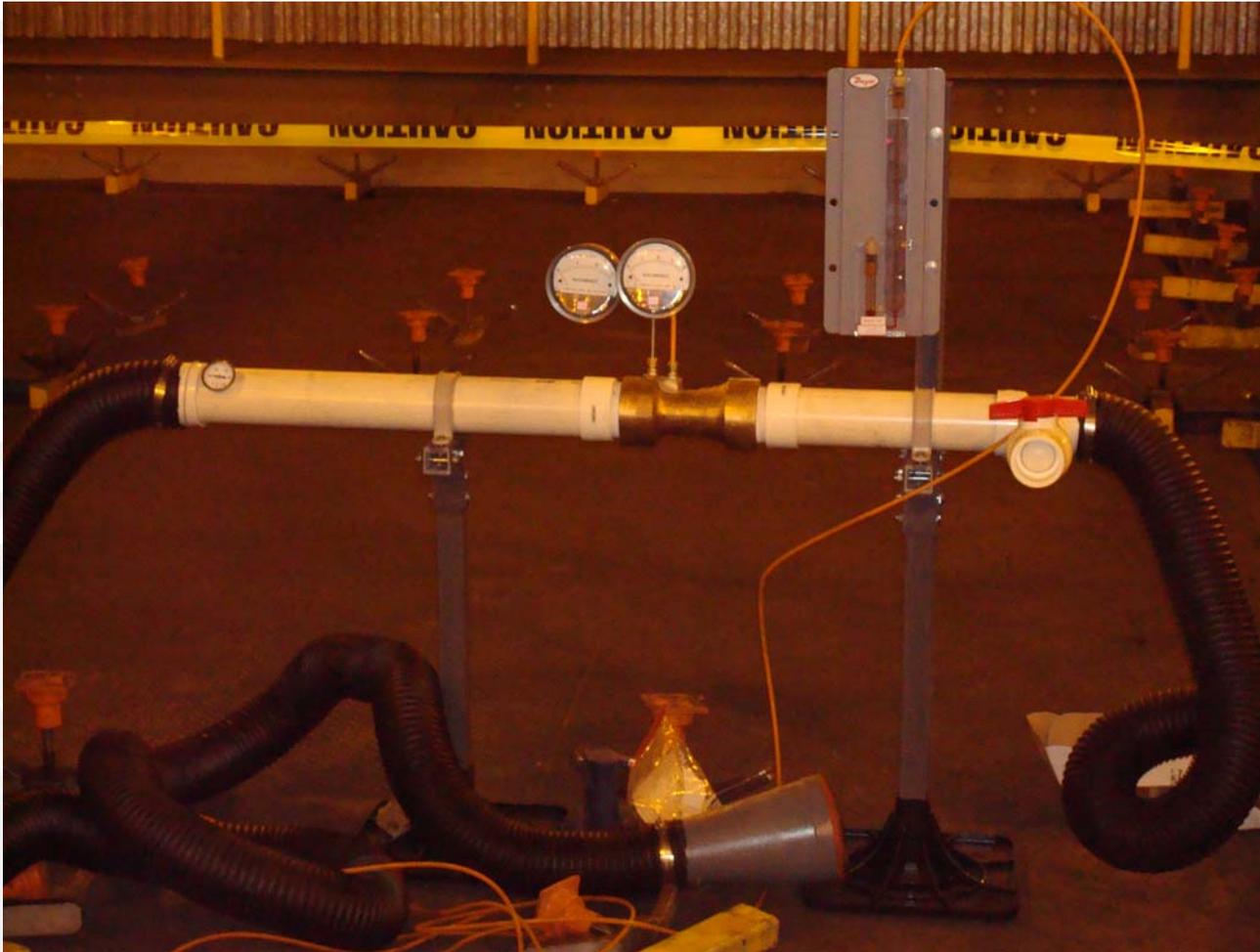
# Compartment 8 Bundle A- Dec 2008



# In-Situ Drag Tester



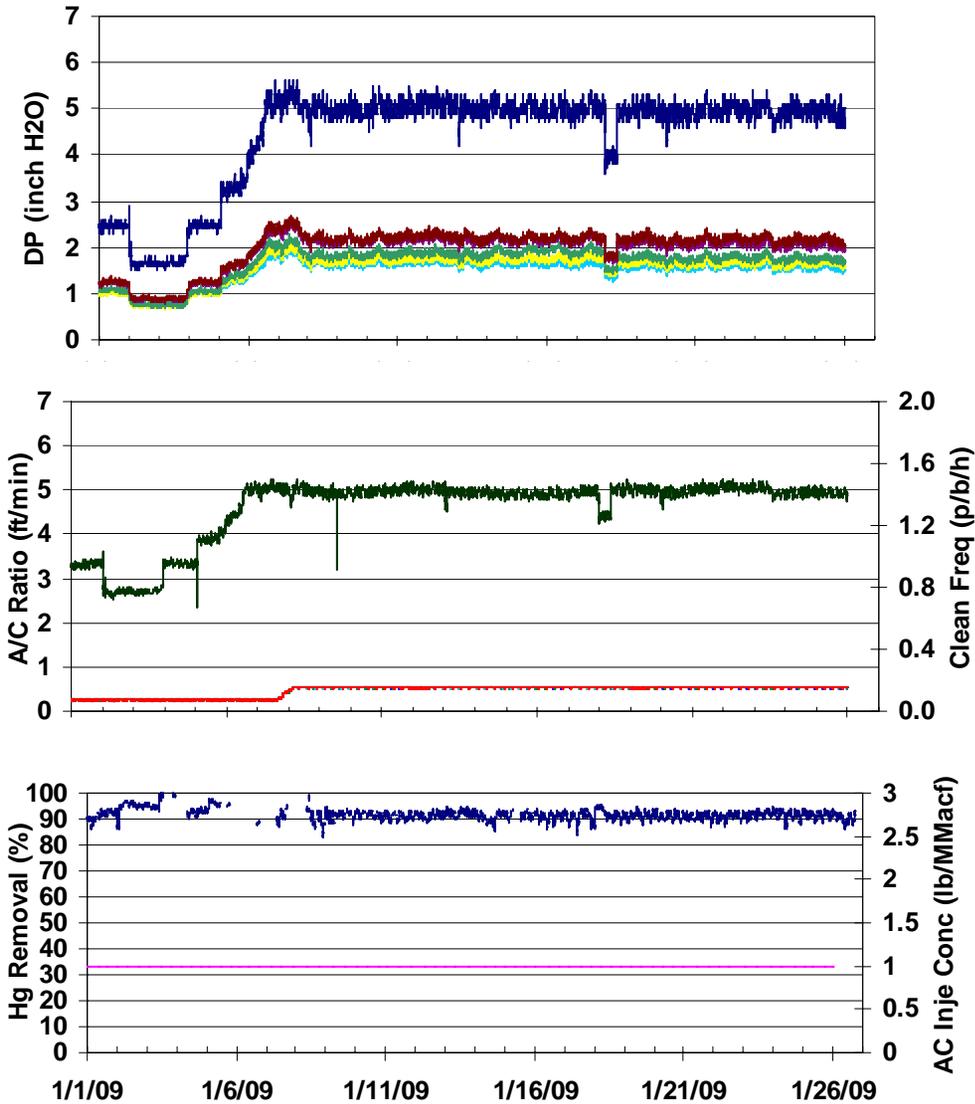
# In-Situ Drag Tester



# Drag Results

Bag Description (Installation Date)	Row ID	Number of Bags Tested	Average Drag 12/3/08	Estimated Operating Hours
OEM Std	F	8	0.23	22,981
OEM Std	O	12	0.10	22,981
Dual Density	J	8	0.21	22,981
P84 –	K	10	0.26	22,981
GE/BHA Membrane	L	9	0.29	22,981
Toray	M	1	0.13	22,981
OEM Std (Feb 2007)	Mix	7	0.19	14,892
OEM Std (Apr 2007)	G	7	0.25	13,728
OEM Std (Apr 2007)	H	7	0.20	13,728
OEM Std (Apr 2007)	I	11	0.21	13,728
EPS – PPS (Sep 2007)	F	1	0.16	9,935
OEM Std (May 2008)	Mix	6	0.12	4,285
GE PS050	N	5	0.07	3,255

# PIPP TOXECON™ Data January 2009



# Conclusions

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- Average drag of the original standard PPS, OEM bags with nearly three years of service was between 0.1 and 0.23 inch H<sub>2</sub>O/ft/min. These are excellent values.
- The average drag of the OEM bags in February 2007, May 2008 and December 2008 was 0.25, 0.19, and 0.23 inches H<sub>2</sub>O/ft/min, respectfully. These data show that drag in not increasing with time, which is what would be expected.
- The average drag values of the dual density, P84 and Toray proprietary fabrics installed at start up were acceptable and should provide long term, acceptable filtering characteristics.

# Conclusions

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- These low, steady drag values indicate that this baghouse design fully meets the requirements for this application and performance is above average.
- Bag strength has decreased significantly to that point that bag failures could be expected. A new set of replacement bags were ordered.
- However, we have seen no failures nor indications that failures are imminent. Bags will be left in operation until failures begin, this could be shortly or several years.

# New Fabric Development – Needs To Continue



Questions?

