

REINHOLD ENVIRONMENTAL Ltd.



2011 APC Round Table & Expo Presentation

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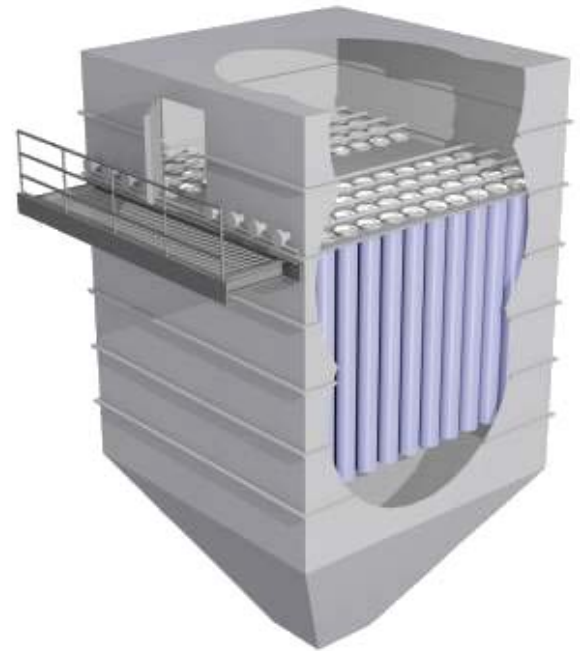
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Solving Boiler Derates Caused by Inadequate Fabric Filter Performanc

Tim Stark
Application Engineer
GE Energy
Environmental Services

Michael McMenus
Environmental Compliance Administrator
Kansas City Power & Light

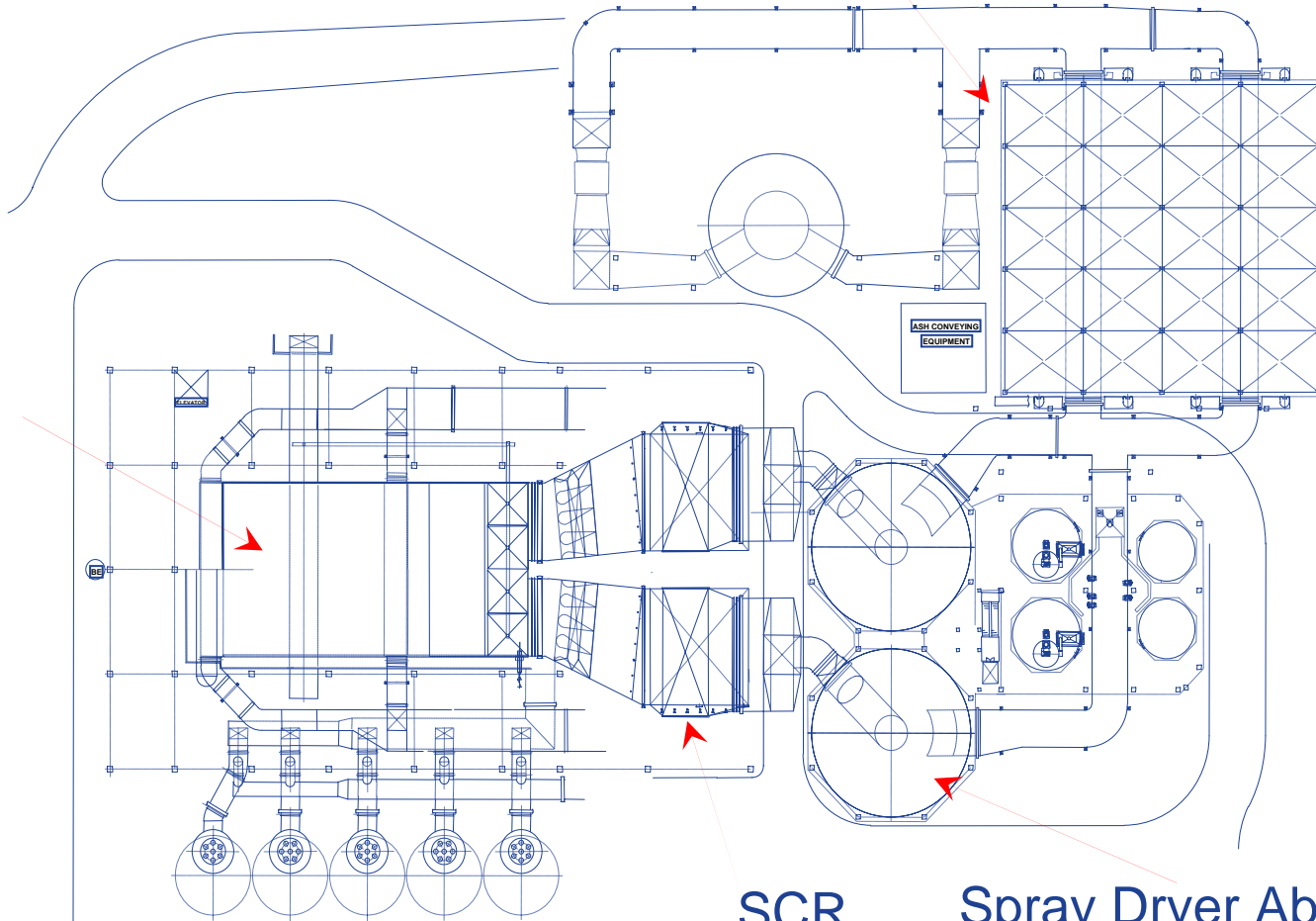
Mary Rembold
Air Quality Control Engineer
Kansas City Power & Light



Hawthorn Unit 5 Emission Control System

Pulse-Jet Fabric Filter

Low NO_x
Burners w/
OFA



SCR

Spray Dryer Absorber

Particulate Control: Pulse-Jet Baghouse

Particulate (PM-10) Emission Limit: 0.018 lb/Mbtu:

Inlet Gas Flow Rate:

1,720,000 ACFM @ 161°
F

A/C Ratio:

3.62 (Net), 3.26 (Gross)

Particulate Loading:

160,000 lbs/hr

Compartments:

10 (Each with 4 sections)

PPS Fabric Filter Bags:

13,520; (150mm x 8m);

Pulse Valves:

1,040



Kansas City Power & Light PJFF Challenges

- Filtration media that can meet or exceed regulatory requirements.
- Filtration media that can address normal operational upset conditions.
- Avoidance of de-rate due to PJFF pressure drops.
- Extension of filter bag life.
- Reduction in Total Cost of Operation.
- Performance Guarantee.

Recommended Solution

Upgrade filter media to a 15.5oz/yd², scrim-supported PPS base filter media with ePTFE (expanded Teflon) membrane laminated on the collection surface based on:

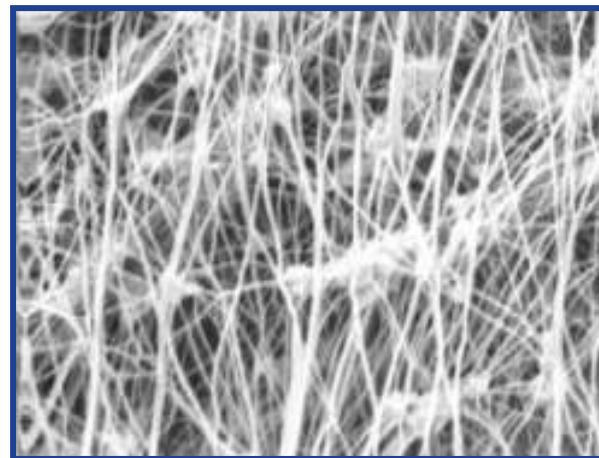
- The slick, water resistant surface provides superior clean down of the filters, even during ammonia slip/catalyst erosion, moisture in flue gas, and operational upsets.
- Enhanced fine ash collection capability.
- Substantial reduction of particulate blinding into media, providing a consistent pressure drop across the PJFF.
- Reduction of system power costs due to reduced pressure drops and pulse cleaning pressures/frequency over the life cycle of the filters.

What is ePTFE Membrane?

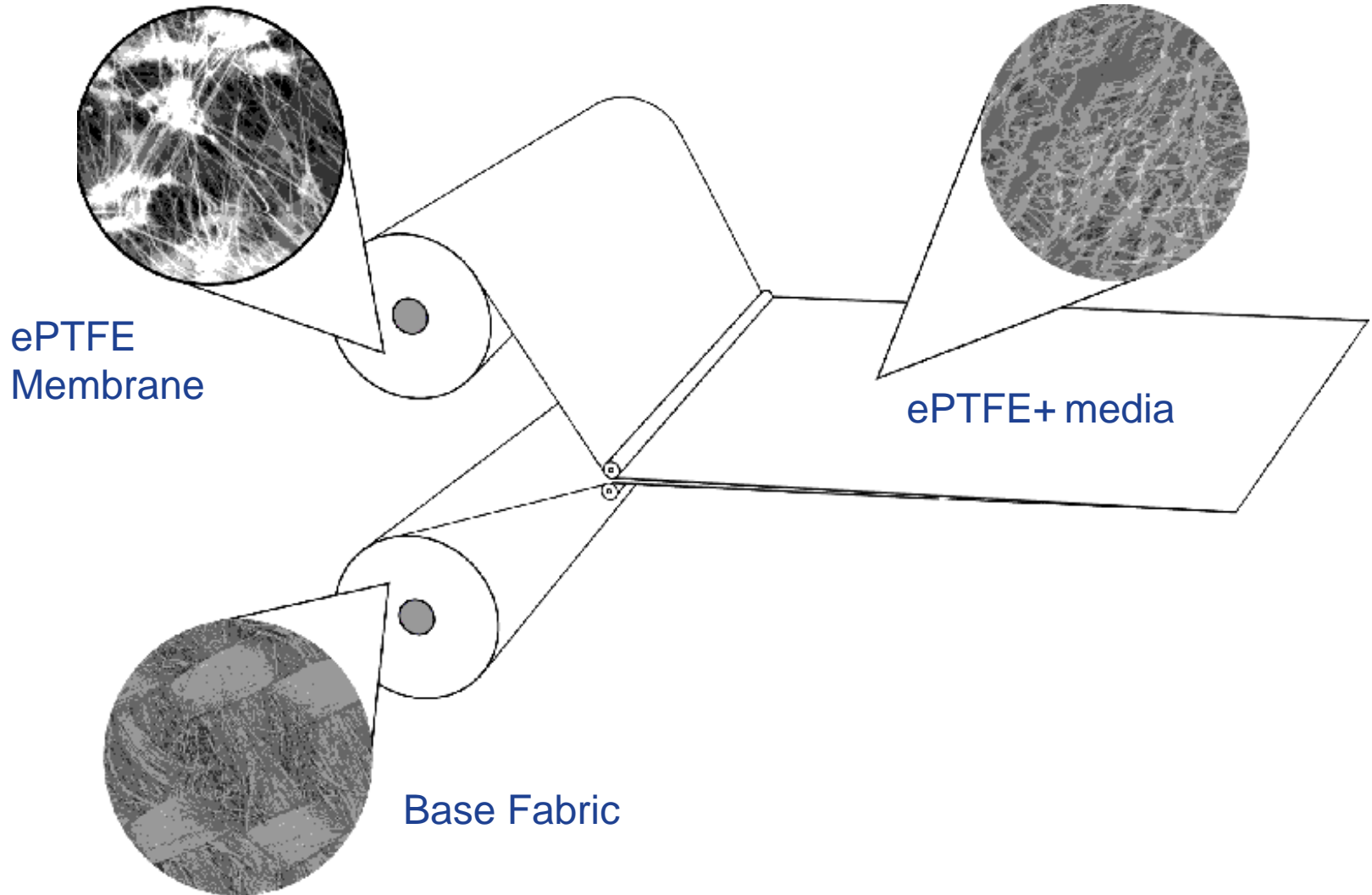
A microporous membrane laminated to traditional filtration fabrics

Web of overlapping fibrous strands that form millions of air passages, much smaller than the particulate

Because the membrane is a PTFE derivative, its surface is slick; bag cleaning is more complete with less energy.

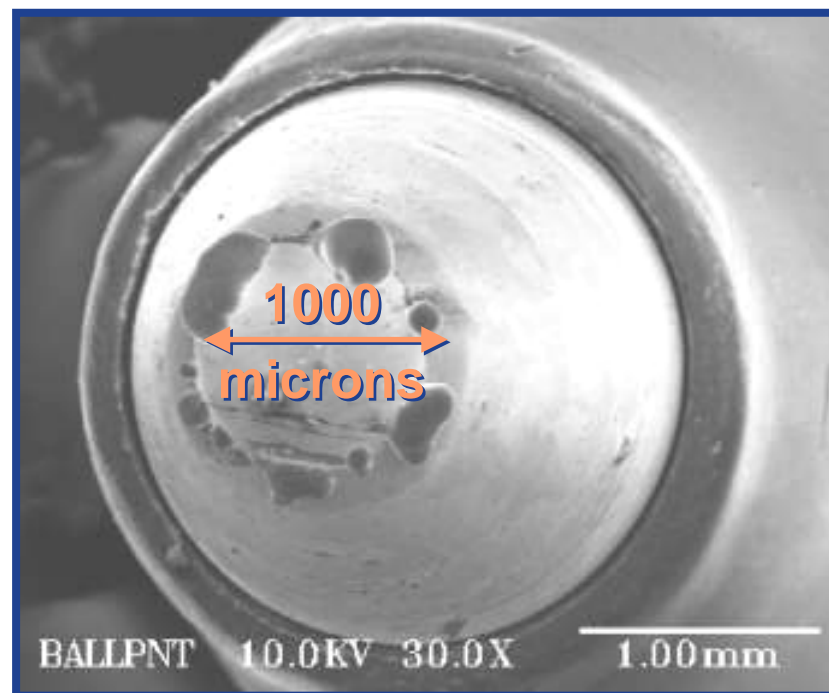
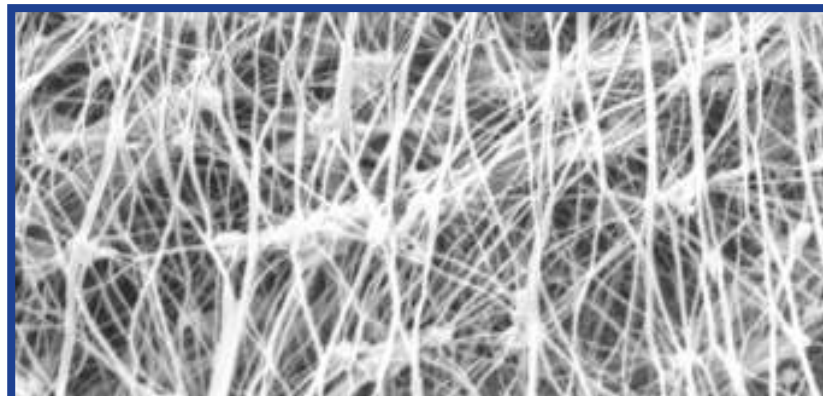


Lamination Process



ePTFE Filtration Facts

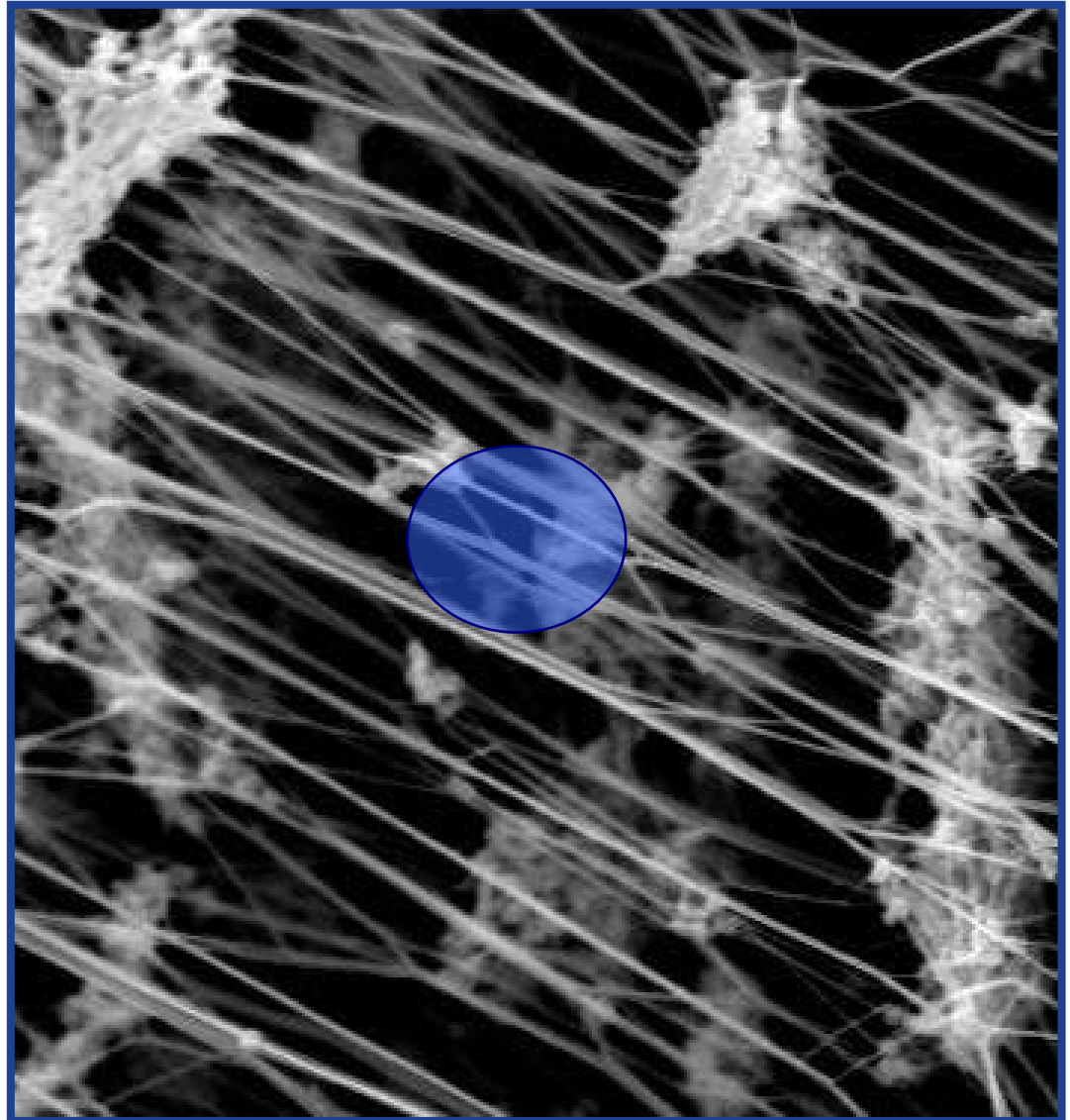
- Average membrane pore size 0.5 - 1 micron, effective pore size much smaller
- Traditional needle-felts typically have a 15-20 micron pore size
- Can fit approximately 1000-2000 pores across the tip of a ball point pen
- 100 million pores per square centimeter



ePTFE Membrane magnified 2500x

Dot represents
1 micron particle

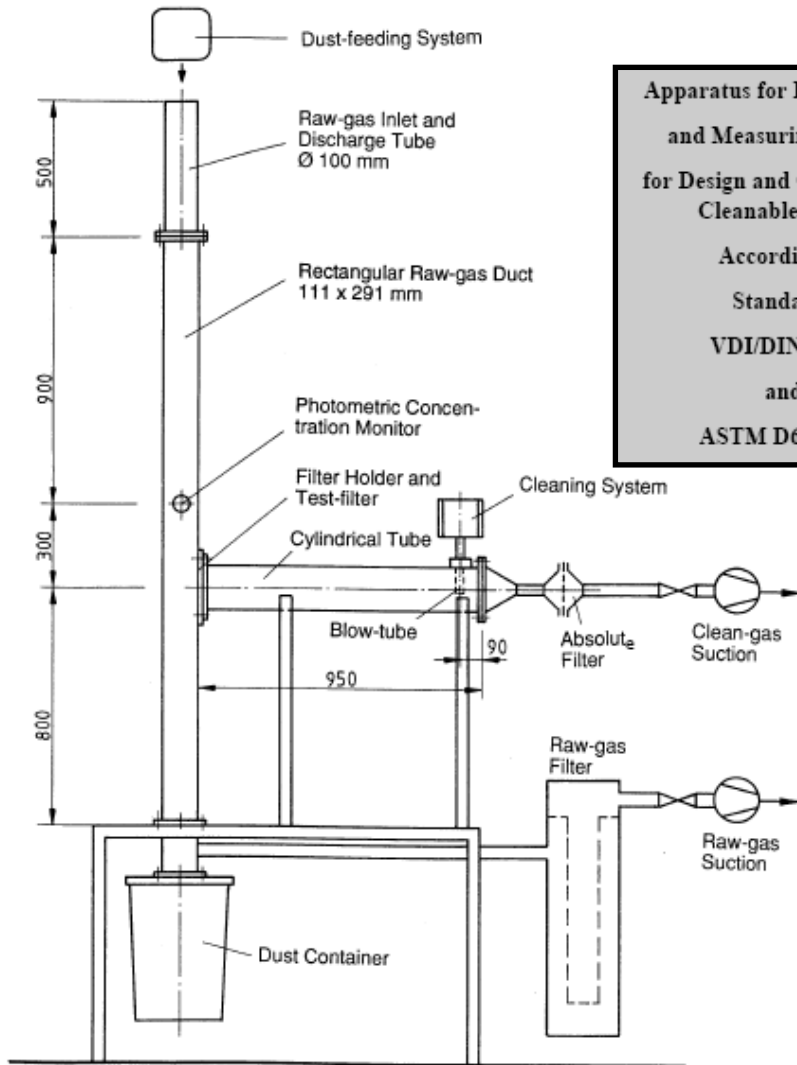
The web-like
structure collects
submicron
particulate, yet
allows air to pass
through



ASTM D6830-02 Protocol

- GE Energy's testing was conducted in accordance with ASTM Test Method D6830-02 and with the test specifications and conditions as detailed in Generic Verification Protocol for Baghouse Filtration Products (BFP) developed by the Air Pollution Control Technology Verification Center (APCTVC) which is part of the U.S. EPA's Environmental Technology Verification (ETV) Program and is operated in partnership between RTI and EPA. The protocol was adapted from the German VDI Method 3926, and modified for ETV and is available at etv.rti.org/apct/pdf/GVP_Revised.pdf.
- A 6.0" diameter fabric filter sample is challenged with a standard dust (particulate matter) under simulated baghouse conditions at specified rates for air and dust flow. The test consists of three test runs. Each run consists of three sequential phases or test periods during which dust and gas flow rates are constantly maintained to test specification. The test phases are:
 - A conditioning period consisting of 10,000 rapid pulse filtration cycles (every 3 seconds).
 - A recovery period to allow the test sample to recuperate from rapid pulsing where the filter is pulsed only when the differential pressure reaches 4" w.c.
 - A 6 hour performance test period, consisting of normal filtration cycles, during which measurements for particulate emissions are determined by gravimetric measurement of the particulate matter that passes through the sample.

ASTM D6830-02 Test Apparatus



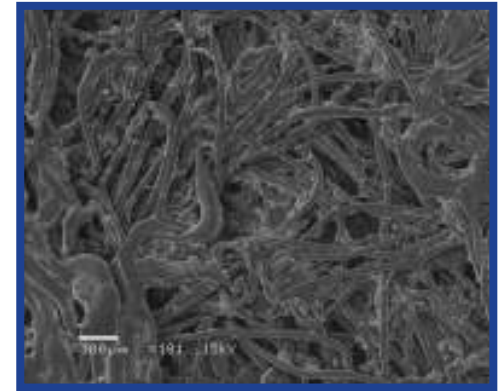
Apparatus for Filter-testing
and Measuring of Data
for Design and Operation of
Cleanable Filters
According to
Standards
VDI/DIN-3926
and
ASTM D6830-02



Media Descriptions & SEM's

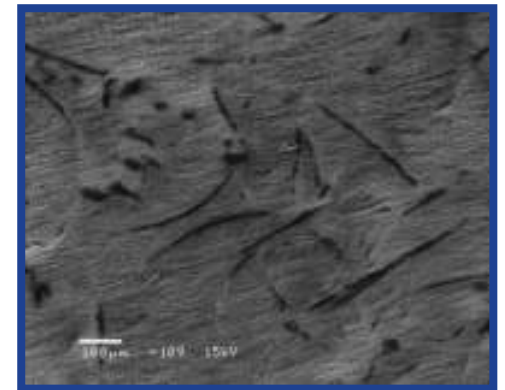
Original OEM Filter Media

16 oz. scrim supported, 2.7 denier PPS
with PTFE coating



GE Recommended Filter Media

15.5 oz. scrim supported PPS with
ePTFE membrane



Test Results

Verification Test Results

	<u>Original OEM Media</u>	<u>15.5 oz. PPS/ePTFE Membrane</u>
Mean Outlet Particle Conc. PM2.5 (gr/dscf)	.0001834	.0000000*
Mean Outlet Particle Conc. Total mass (gr/dscf)	.0001834	.0000000*
Average Residual Pressure Drop (in w.g.)	1.04	1.32
Mass Gain of Filter Sample (grams)	2.18	.11
Average Filtration Cycle Time (s)	136	222
Number of Pulses	53	32

Permeability

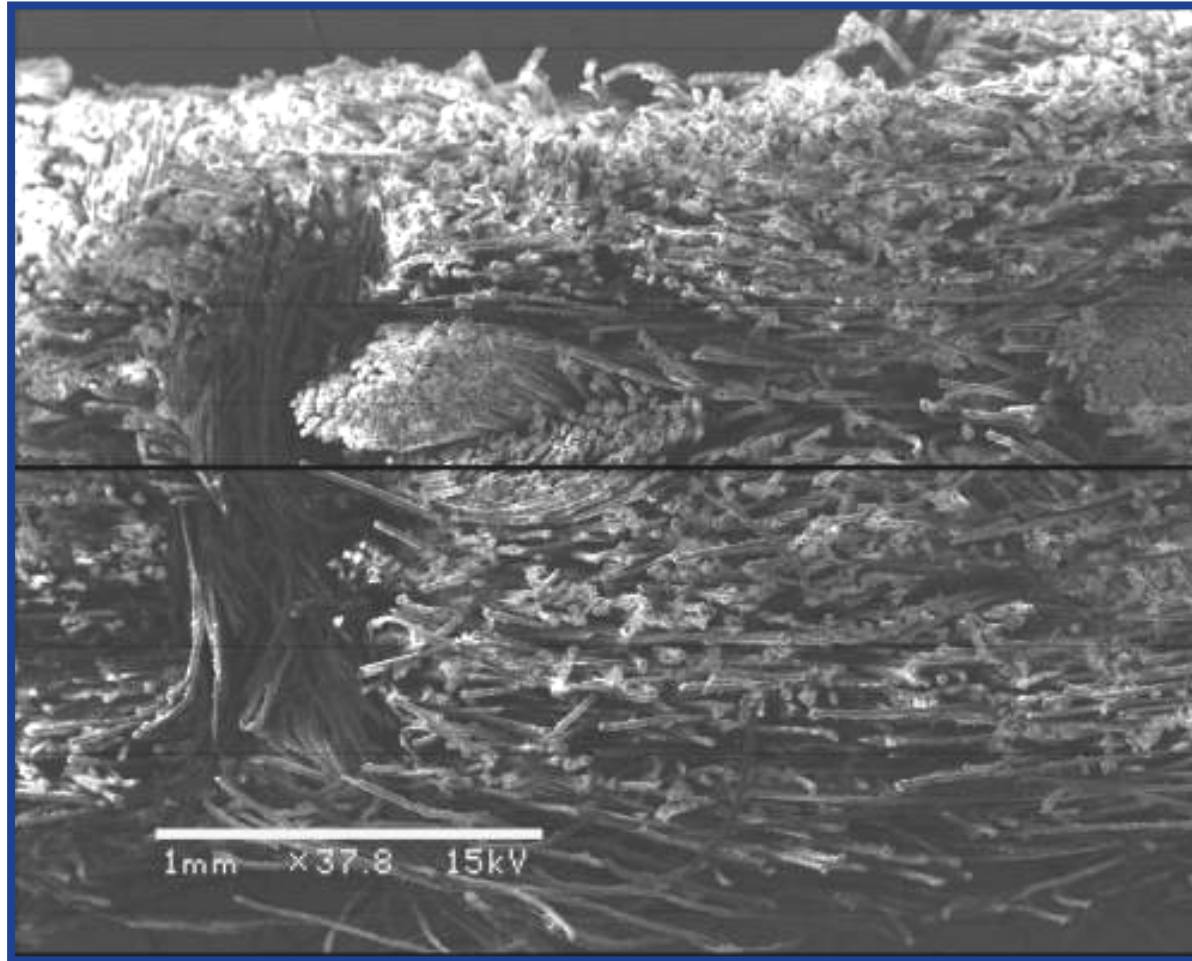
Initial Perm ft ³ /min/ft ² (CFM) @ .5" H ₂ O	40.8	4.70
Perm After Testing	2.99	2.98
Percent Retained Perm	7.3%	63.4%

Removal Efficiency (%)

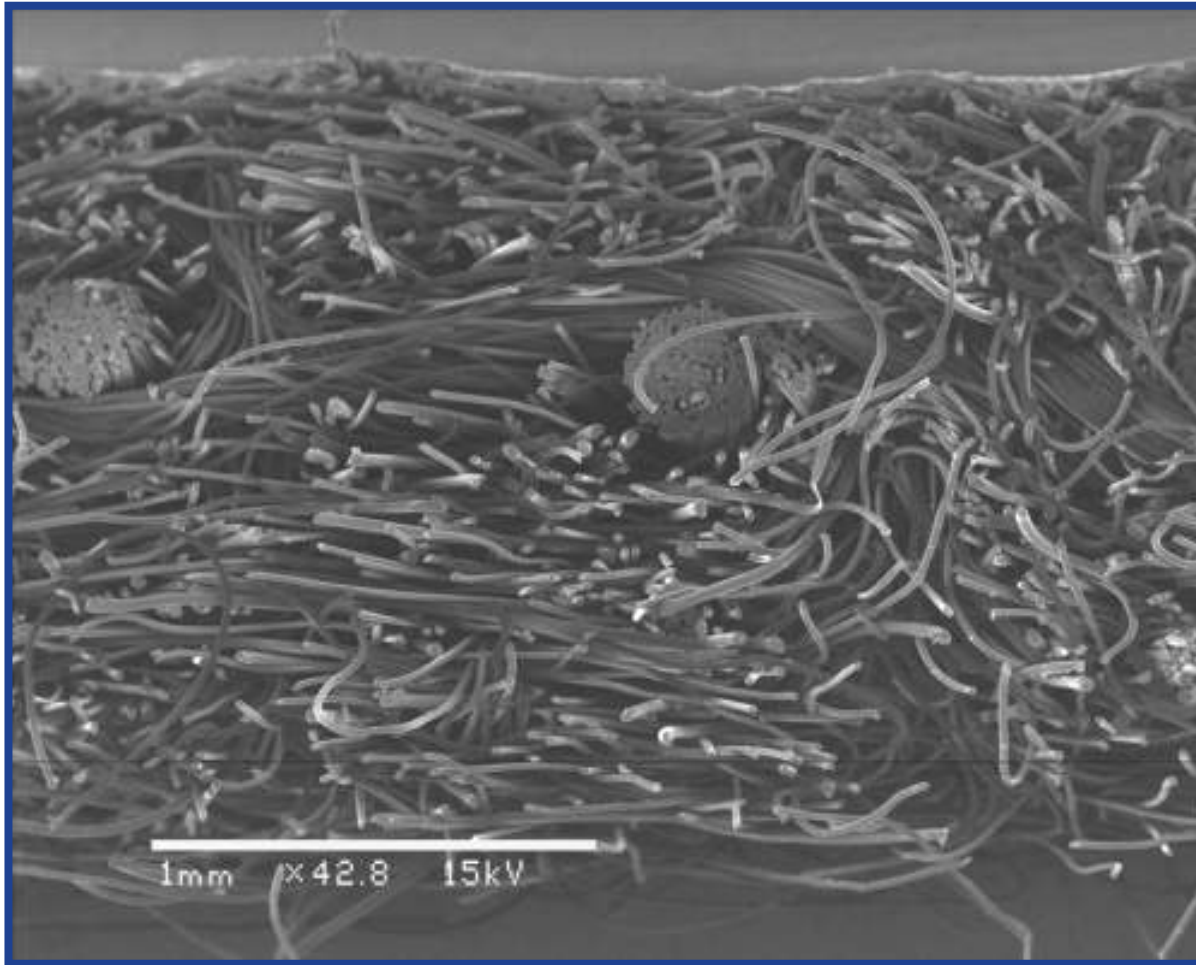
Dust Conc. (gr/dscf)	8.23	8.23
Total Mass	99.997771	100

*Denotes below method detection limit

Original OEM PPS Needle Felt Filter Media



PPS with ePTFE Membrane



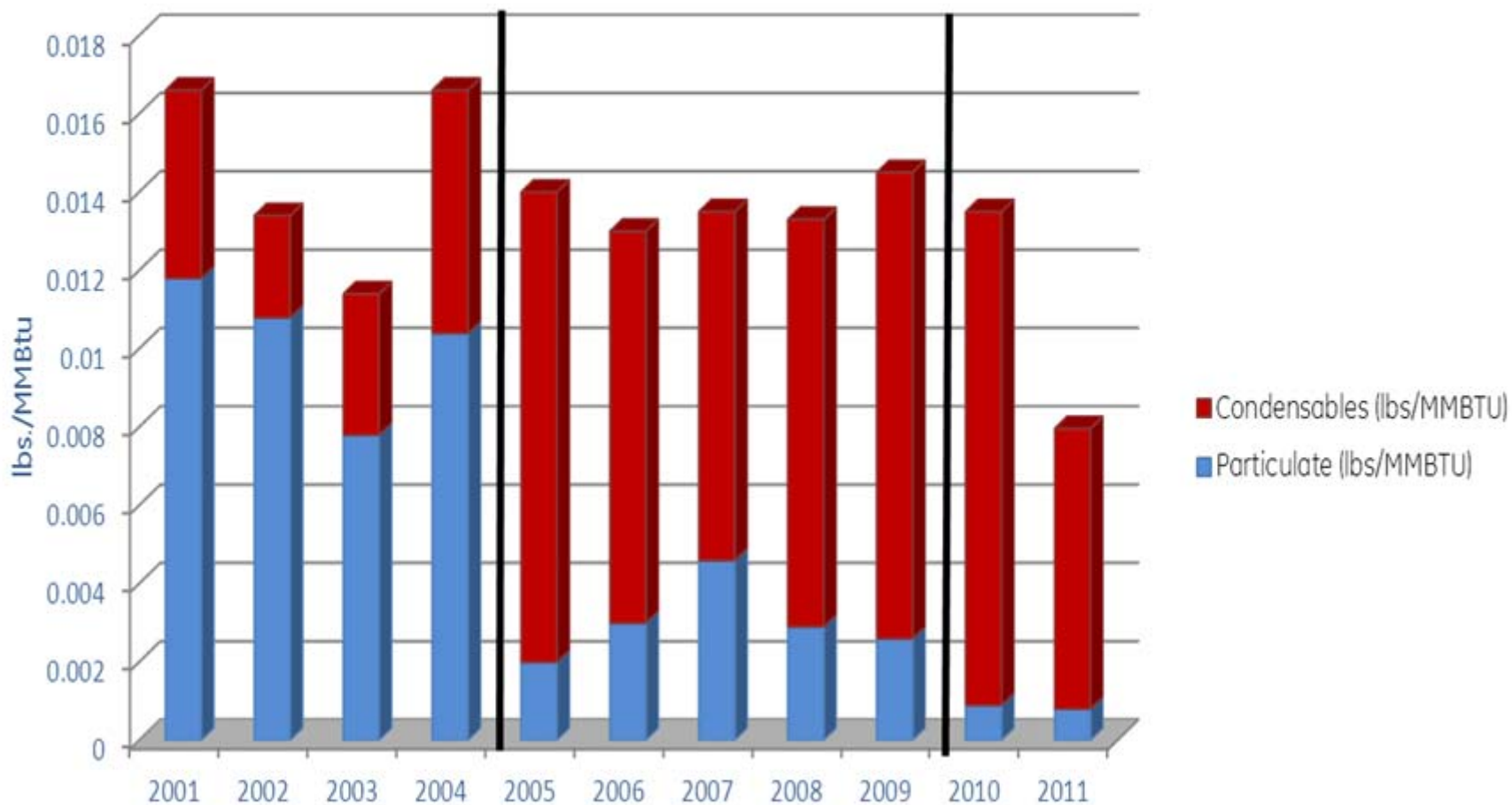
Fabric Filter History at KCP&L

May 2001	First coal fire and start-up with initial installation of 16 oz. OEM filter bags. PPS filter media with PTFE surface coating.
Early 2004	After 3 years of bag life differential pressure levels were at 10" even with continuous pulsing at 100 psi. This condition resulted in the boiler being de-rated.
Dec. 2004	Installation of new filter bags from GE. Upgraded to 15.5 oz. PPS co-blended filter media with ePTFE membrane laminate.
Dec. 04 to Mar. 10	<p>Since installation of PPS with ePTFE membrane fabric filters the baghouse has experienced several typical upsets:</p> <ul style="list-style-type: none"> - High hopper levels. -Cleaning system turned off. -Flooded the baghouse due to broken fire header - Ammonia slip upwards of 10 ppm. <p>Operational improvements since installation of PPS with ePTFE membrane:</p> <ul style="list-style-type: none"> - Filter Life Improved from 3.5 Years to +5 Years. - Pulse Cleaning Pressure Reduced from up to 100 psi to 75 psi. -Substantial Reduction in Pulse Cleaning Frequency. - System averaged 6" to 7" pressure drop. -Met PM-10 emission rate of 0.018lb/MMBtu.

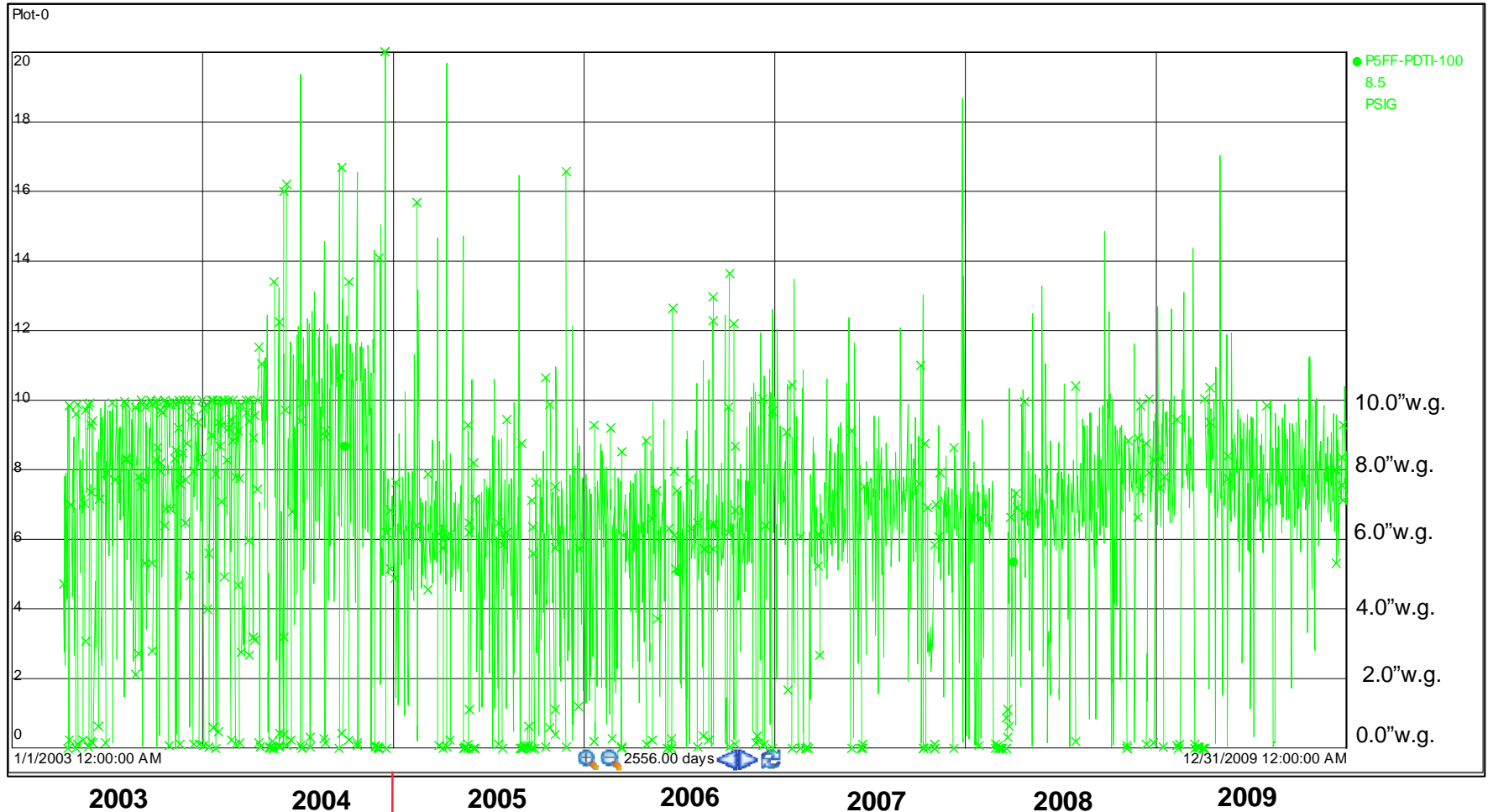
PM-10 Data

Title V Emission Limit - 0.018 lbs/MMBtu

(excludes start up/shutdown/emergency situation)



System Pressure Drop 2003-2009



Filter Media Change

Questions?