Hamon Companies

Integrated solutions for a clean environment

Integrated Solutions For

- *Hamon et Cie is a Belgium based global group specializing in pollution control, heat recovery and cooling technology and related manufacturing for the utility, petrochemical and heavy industries.*
- *Hamon has operating companies in Europe, Asia, Africa, South America and the U.S.*

HAMON

Integrated solutions for a clean environment

Hamon Research-Cottrell

- **Extensive experience in air pollution control systems**
- **Worldwide reference installations**
- **Integrated solutions for emissions control**
  - *Electrostatic Precipitators (PM)*
  - *Fabric Filters (PM)*
  - *ESP/FF Conversion (PM)*
  - *ACI/FF and DSI/FF systems (Hg and Acid Gas)*
  - *Wet Gas Scrubbers (SO2 and PM)*
  - *Thermal DeNOx (SNCR NOx)*
  - *Dry FGD systems (SO2, HCl, PM)*
  - *U2A® systems (urea to ammonia)*
  - *ReACT^{tm} MultiPollutant Control (SO2, NOx, Hg, HAPs)*

Low Pressure High Volume FF

- Low Pressure/High Volume (LPHV)
  - ~25,000 MW utility capacity installed (HRC/Howden/Lurgi…)
  - HRC over 12,500 MW installed
- Enhanced LPHV technology
  - Improved cleaning intensity and frequency distribution
  - Attention to particle and flow dynamics
  - Cleaning system operation at lower pressures with longer bags (to 30')

- Fabric Filter Applications
  - Primary particulate control
  - Following SDA and/or CFB
  - Polishing filters (downstream of ESP)
  - High ratio COHPAC
  - PAC/DSI for Hg/Acid gas control
  - Large scale ESP to FF conversions

Hunter #1 & #2 FF

Overview

Technology	Fabric Filter
Industry	Power
Application	Coal Fired Boiler
Client	Western Power Plant
Location	Utah
Units	2
Boiler Rating	488 MW
Gas Volume	2,200,000 ACFM
Material of Construction	Carbon Steel
Award	2006
Guarantee	0.012 lb/MMBtu
Test Results	0.004 lb/MMBtu
Schedule	Startup in 2008

ESP to Fabric Filter Conversion

Description

Hamon Research-Cottrell designed and furnished an ESP to Low Pressure Pulse Jet Fabric Filter Conversion for installation on the boilers at a Western USA Power Generation Station. The Hamon Research-Cottrell LPHV design services the Station in the collection of flyash particulate. Each Fabric Filter in particular, consists of 8 compartments with 2436 bags per compartment. Each compartment houses filter bags, which are oblong in shape and with an approximate 2 ½" x 6" (4.9" equivalent diameter) x 26'- 3" long, mounted on bag cages and suspended from a tube sheet.

Existing ESP casing components including the side frames, center partitions, lower girders and hopper were reused and incorporated into the design of the new Fabric Filter. This allowed the new Fabric Filter to occupy the same footprint as the original ESP. The existing inlet ductwork and outlet ductwork was also reused. The original precipitator roof weather enclosure, bridge crane and electric hoist were moved to grade at the start of construction and then put back in place after the new Fabric Filter was complete.

Wyodak FF

Overview	
Technology	Fabric Filter
Industry	Power
Application	Coal Fired Boiler
Client	Western Power Plant
Location	Wyoming
Unit	1
Boiler Rating	365 MW
Gas Volume	2,141,800 ACFM
Material of Construction	Carbon Steel
Award	2008
Guarantee	0.012 lb/MMBtu
Schedule	Startup in 2010

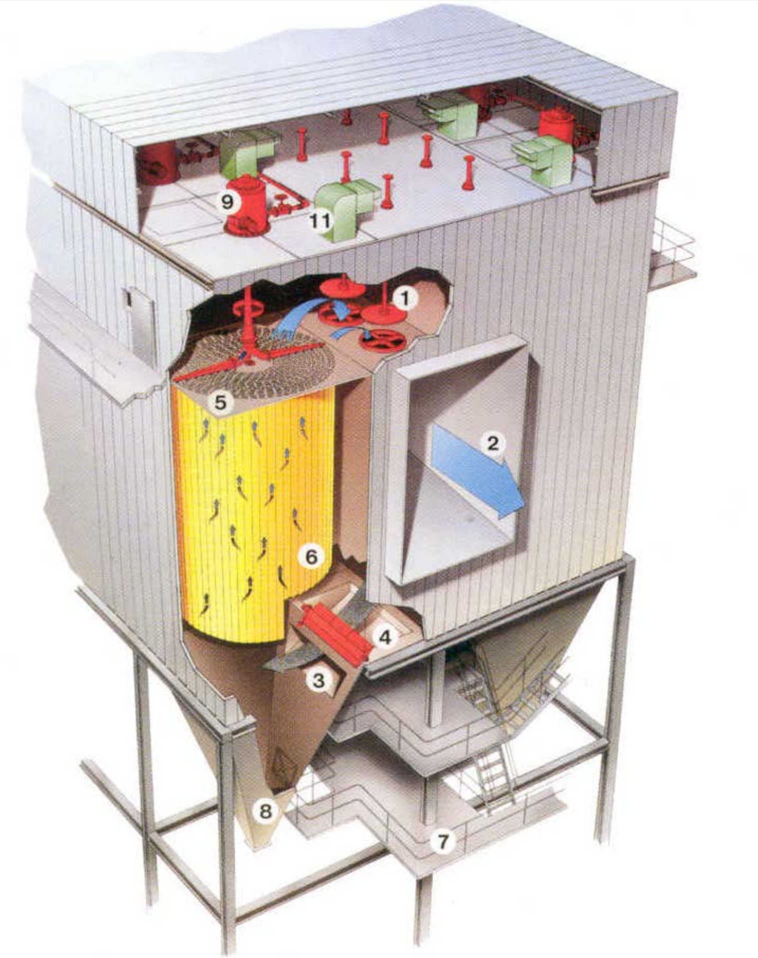
10 Compartment Fabric Filter with Inlet and Outlet Ductwork

Description

Hamon Research-Cottrell designed and furnished one (1) Low Pressure Pulse Jet Fabric Filter for installation on the boiler at a Western USA Power Generation Station. The Hamon Research-Cottrell LPHV design services the Station in the collection of flyash particulate. The Unit in particular, consists of 10 compartments with 2,128 bags per compartment. Each compartment houses filter bags, which are oblong in shape and with an approximate 2 ½” x 6” (4.9” equivalent diameter) x 26’- 3” long, mounted on bag cages and suspended from a tube sheet.

The flue gas leaving the boiler enters the Fabric Filter through interconnecting ductwork. The inlet manifold distributes the gas into the compartments where the filter bags are held. As flue gas enters the compartments, the gas velocity decreases and some larger particles will settle into the hopper. The remainder of the particulate will continue to the filter bag area, and accumulate on the outside surface of the filter fabric. As the flue gas passes through the filter bags and exits the bag at the tube sheet, the particulate remains. The filtered gas leaves each compartment into the clean side outlet plenum and through the outlet ductwork to the unit ID fans for discharge to atmosphere at the stack.

LPHV FF Overview

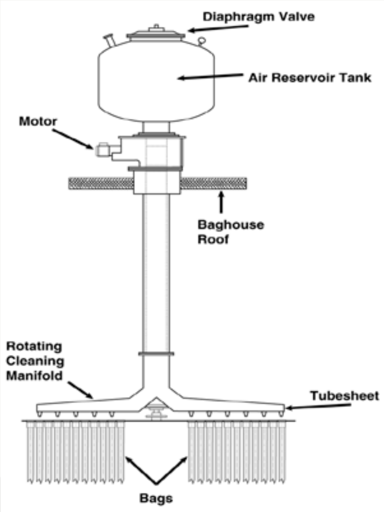


A cutaway section showing Gas Flow, Filtration and Dust collection in Twin Cell

1. **Outlet Poppet Dampers**
2. **Outlet Ductwork**
3. **Hopper Entrance**
4. **Inlet Butterfly Dampers**
5. **Tube Sheet**
6. **Filter Bags**
7. **Hopper Access**
8. **Hopper Discharge**
9. **Cleaning Air Reservoir Tank**

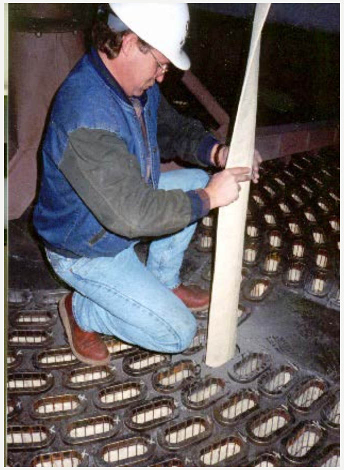
LPHV Cleaning System Design

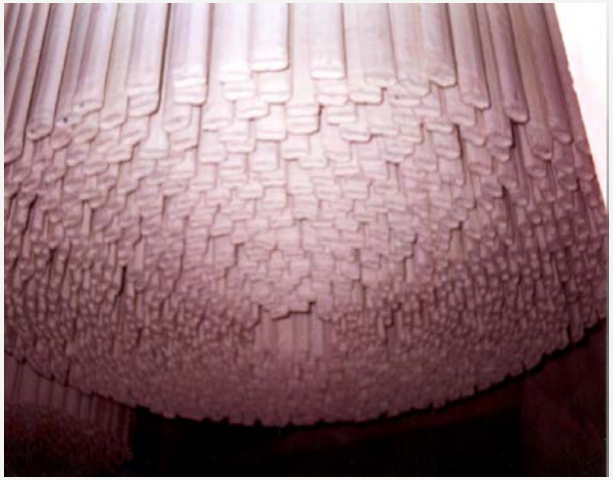
- <u>Internal clean air manifold</u>
  - Three arm arrangement
  - Continuous rotation at 1 rpm
  - Clean up to 40 bags per pulse
- One manifold per bundle
  - Up to 1,600 bags per bundle
- Direct access to bags/cages
  - NO pulse pipes to remove



Filter Bag Installation

- Faster
  - Worker accessible tube sheet
  - Individual bags easily changed
  - Bag sets easily installed
- Safer
  - No pulse pipes to avoid
  - No pulse pipes to lift/reassemble





LPHV FF Advantages

Low Pressure High Volume Cleaning Air	• Eliminates need for instrument air and air dryers. • Low pressure blowers are used with pressure control valve
	• Single air tanks per group of bags • Single pulse valve instead of multiple pulse valves.
Rotating Cleaning Manifold (s)	• Random cleaning of filter bags
	• Easier to remove replace bags than stationary pulse pipes
Oblong filter bag design	• Utilizes more filter bag area smaller tube sheet area

Installations

Utility	Plant Name	Location	Unit Boiler Rating	Type of Fabric Filter
Alliant Energy	Lansing Generation Station	Lansing, IA	283 MW	LPHV Pulse Jet FF
Alabama Power*	E.C. Gaston Steam Plant Unit #2	Wilsonville, AL	272 MW	LPHV Pulse Jet FF
Alabama Power*	E.C. Gaston Steam Plant Unit #3	Wilsonville, AL	272 MW	LPHV Pulse Jet FF
American ReFuel	SEMASS Unit #1	Rochester, MA	25 MW	LPHV Pulse Jet FF
American ReFuel	SEMASS Unit #2	Rochester, MA	25 MW	LPHV Pulse Jet FF
Arizona Public Service*	Cholla Unit #3	Joseph City, AZ	260 MW	LPHV Pulse Jet FF
Arizona Public Service	Cholla Unit #4	Joseph City, AZ	380 MW	LPHV Pulse Jet FF
Bechtel Austrailia	Millmerran Project Unit #1	Australia	425 MW	LPHV Pulse Jet FF
Bechtel Austrailia	Millmerran Project Unit #2	Australia	425 MW	LPHV Pulse Jet FF
City of Gainesville	Deerhaven Generation Station Unit #2	Gainesville, FL	238 MW	LPHV Pulse Jet FF
Consumers Energy	Karn 1 Generating Station	Hampton Township, MI	250 MW	LPHV Pulse Jet FF
Consumers Energy	Karn 2 Generating Station	Hampton Township, MI	265 MW	LPHV Pulse Jet FF
Consumers Energy	Campbell Unit #1	Holland, MI	260 MW	LPHV Pulse Jet FF
Consumers Energy	Campbell Unit #2	Holland, MI	360 MW	LPHV Pulse Jet FF
Consumers Energy	Campbell Unit # 3	Holland, MI	820 MW	LPHV Pulse Jet FF
CLECO	Rodemacher Unit 2	Lena, LA	523 MW	LPHV Pulse Jet FF
Dairyland Genoa	Genoa Unit #3	Genoa, WI	365 MW	LPHV Pulse Jet FF
Dairyland Power	J.P. Madget Unit #6	Genoa, WI	400 MW	LPHV Pulse Jet FF
Dominion Power	Chesterfield Unit #6	Chesterfield, VA	680 MW	LPHV Pulse Jet FF
EPCOR	Genesee Unit #3	Edmonton, AB, Canada	495 MW	LPHV Pulse Jet FF
KCP&L	La Cygne Unit 1	Lacygne, KS	700 MW	LPHV Pulse Jet FF
KCP&L	La Cygne Unit 1	Lacygne, KS	700MW	LPHV Pulse Jet FF

Installations

Minnesota Power	Boswell Energy Center Unit #3	Cohasset, MN	355 MW	LPHV Pulse Jet FF
Mirant	Dickerson Unit #1	Poolesville, MD	278 MW	LPHV Pulse Jet FF
Mirant	Dickerson Unit #2	Poolesville, MD	278 MW	LPHV Pulse Jet FF
Mirant	Dickerson Unit #3	Poolesville, MD	278 MW	LPHV Pulse Jet FF
Nevada Power	Reid Gardner Generation Station Unit #1	Moapa, NV	120 MW	LPHV Pulse Jet FF
Nevada Power	Reid Gardner Generation Station Unit #2	Moapa, NV	120 MW	LPHV Pulse Jet FF
Nevada Power	Reid Gardner Generation Station Unit #3	Moapa, NV	120 MW	LPHV Pulse Jet FF
Pacific Corp Energy	Huntington Station Unit #1	Huntington, UT	475 MW	LPHV Pulse Jet FF
Pacific Corp Energy	Huntington Station Unit #2	Huntington, UT	475 MW	LPHV Pulse Jet FF
Pacific Corp Energy	Hunter Station Unit #2	Castle Dale, UT	460 MW	LPHV Pulse Jet FF
Pacific Corp Energy	Wyodak Station	Gillette, WY	450 MW	LPHV Pulse Jet FF
Pacific Corp Energy	Hunter Station Unit #1	Castle Dale, UT	460 MW	LPHV Pulse Jet FF
Reading Energy Company	North East Power Co.	McAdoo, PA	60 MW	LPHV Pulse Jet FF
Rocky Mountain Power	Hardin Unit #1	Hardin, MT	110 MW	LPHV Pulse Jet FF
Texas Utility	Big Brown Power Station Unit #1	Fairfield, TX	600 MW	LPHV Pulse Jet FF
Texas Utility	Big Brown Power Station Unit #2	Fairfield, TX	600 MW	LPHV Pulse Jet FF
Tri-State Gener.	Yampa Valley Unt #1	Craig, CO	455 MW	LPHV Pulse Jet FF
Tri-State Gener.	Yampa Valley Unt #2	Craig, CO	455 MW	LPHV Pulse Jet FF
Sun Coke	Sun Coke Haverhill	Franklin Furnace, OH	Coke Ovens	LPHV Pulse Jet FF
Sun Coke	Sun Coke Granite City	Granite City, IL	Coke Ovens	LPHV Pulse Jet FF
Sun Coke	Sun Coke Middletown	Middletown, OH	Coke Ovens	LPHV Pulse Jet FF

Catalytic Bag Questions

Length	• How long can the Catalytic bags be made? • HRC utility installations typically utilize 29’ long gags as a way to minimize footprint
Structure	• Are the bags solid and required to be kept straight? • Is the catalyst damaged if bent or dented in any way? • Can the catalytic bags be manufactured in an oblong form that matches existing bags?
Weight	• How much do the catalytic bags weigh ? • Is tube sheet stiffening required ? • Are special cages required ?
Permeability	• Bag permeability will have to be understood to ensure pressure drop is appropriate
Sorbent Injection	• What is vendor’s experience with sorbent injection impact on the catalytic bags?
Cleaning Frequency	• What is catalytic bag vendor ‘s experience with cleaning cycle set points? • Is a longer residence time of the sorbent on the filter bags required ?
Installation	• Can bags be installed through FF upper compartment ?

Summary

- Worldwide supplier of Air Pollution Control equipment to multiple industries
- Leader in Fabric Filter utility installations in North America
- Over 25,000 MW of LPHV Fabric Filters installed
- Installed 5 LPHV Fabric Filters for Pacificorp
  - Huntington Station #1 & #2
  - Hunter #1 & #2
  - Wyodak
- Has aftermarket capability with parts, service, upgrades and construction supervisors
- Interested in partnering with catalytic bag supplier