

REINHOLD ENVIRONMENTAL Ltd.



2010 APC Round Table & Expo Presentation

July 18-20, 2010, in Concord, NC / Hosted by Duke Energy

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Wet-to-Dry Conversions; Bottom Ash & Fly Ash

*APC Round Table
July 20, 2010*

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Wet to Dry Conversions



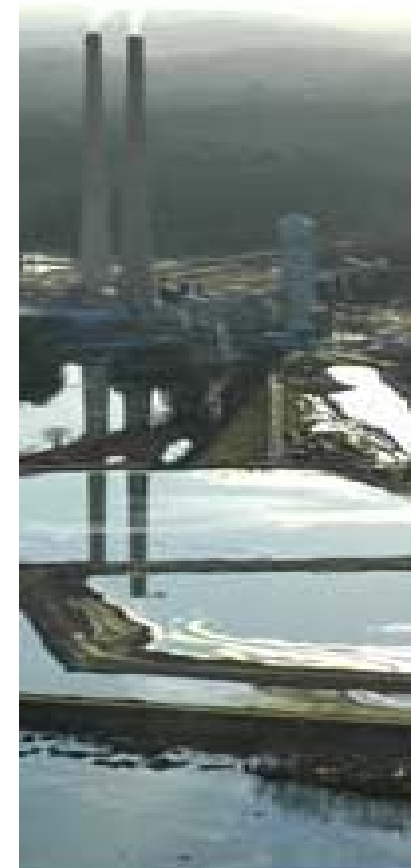
GOAL:

- Eliminate **ALL** Ash Ponds
 - Pulverized Coal (PC) Fired Utility Boilers

Two Parts:

- Bottom Ash** (~20% of PC Boiler Ash)
 - Plus Mill Rejects (1-2% of Coal Burn Rate)
- Fly Ash** (~80% of PC Boiler Ash)
 - Plus Air Heater Ash (~5% PC Ash)

(Plus Economizer Ash (~5%) in either Part)



From TVA web site:



This photo shows the Kingston Plant coal ash retention pond in July, 2006, two years before the dike failure on **December 22, 2008.**

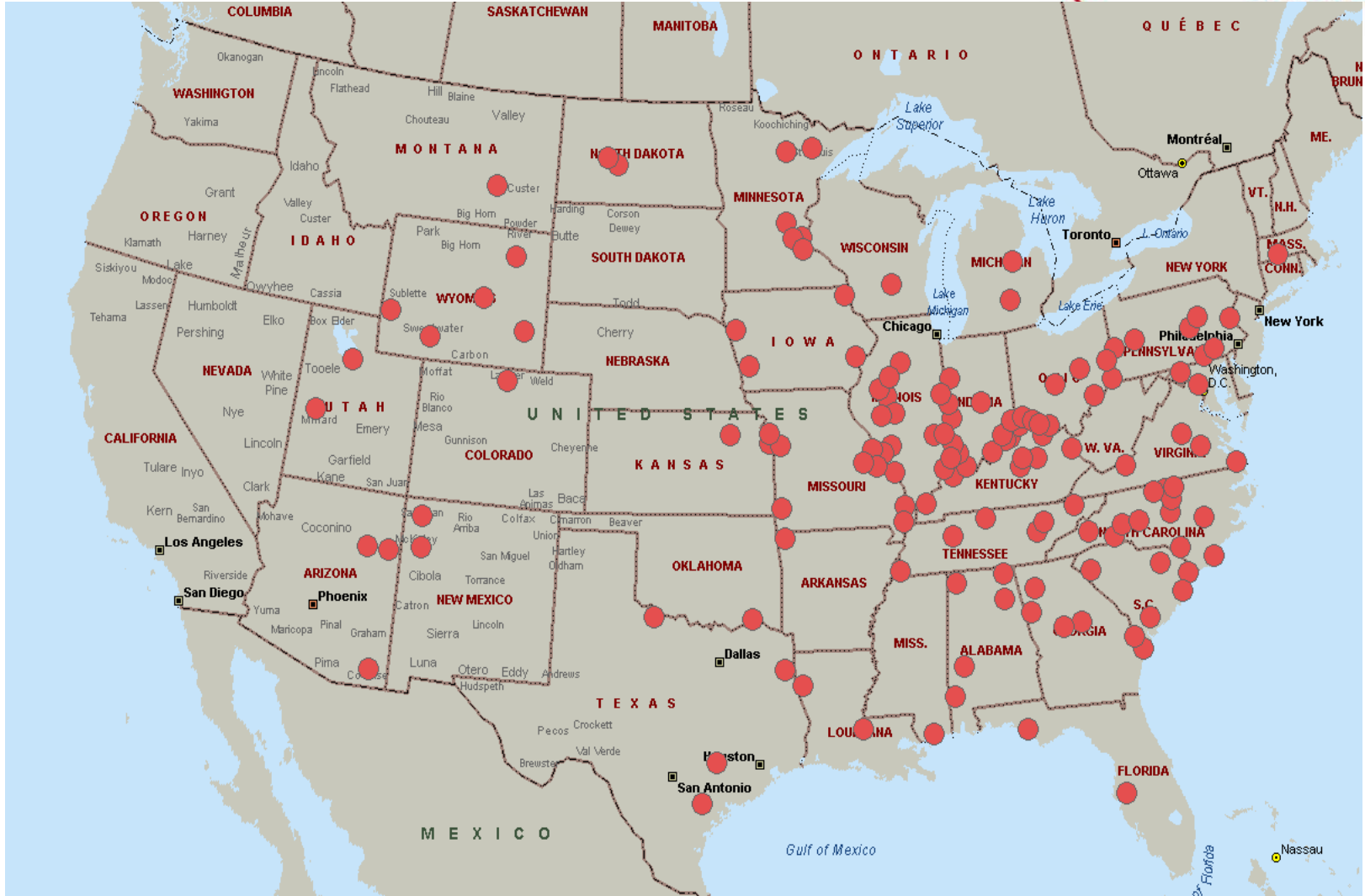


This photo shows the Kingston Plant following the coal ash retention pond failure.

[Photos: U.S. Environmental Protection Agency]

EPA LISTED SURFACE IMPOUNDMENTS

(i.e. POTENTIAL WET TO DRY ASH SYSTEM CONVERSIONS)



The EPA Master List of 162 Plants



CLYDE BERGEMANN DELTA DUCON	PLANT_NAME	Facility City	Facility State		OWNER	PARENT COMPANY	Plant Nameplate Capacity	Units and In-Service Dates
93	HHP Asheville Power Station	Arden	NC		Progress Energy Carolinas Inc.	Progress Energy	414	207 MW (1964), 207 MW (1971)
94	HHP Belews Creek Power Station	Walnut Cove	NC		Duke Energy	Duke Energy	2,160	1,080 MW (1974), 1,080 MW (1975)
95	HHP Buck Power Station	Spencer	NC		Duke Energy	Duke Energy	370	80 MW (1941), 40 MW (1942), 125 MW (1953), 125 MW (1953)
96	Cape Fear Power Station	Moncure	NC		Progress Energy Carolinas Inc.	Progress Energy	329	141 MW (1956), 188 MW (1958)
97	Cliffside Power Station	Mooresboro	NC		Duke Energy	Duke Energy	781	40 MW (1940), 40 MW (1940), 65 MW (1948), 65 MW (1948), 571 MW (1972)
98	HHP Dan River Power Station	Eden	NC		Duke Energy	Duke Energy	290	70 MW (1949), 70 MW (1950), 150 MW (1955)
99	HHP G. G. Allen Power Station	Belmont	NC		Duke Energy	Duke Energy	1,155	165 MW (1957), 165 MW (1957), 275 MW (1959), 275 MW (1960), 275 MW (1961)
100	L. V. Sutton Power Station	Wilmington	NC		Progress Energy Carolinas Inc.	Progress Energy	672	113 MW (1954), 113 MW (1955), 447 MW (1972)
101	Lee Power Station	Goldsboro	NC		Progress Energy Carolinas Inc.	Progress Energy	402	75 MW (1951), 75 MW (1952), 252 MW (1962)
102	HHP Marshall Power Station	Terrell	NC		Duke Energy	Duke Energy	1,996	350 MW (1965), 350 MW (1966), 648 MW (1969), 648 MW (1970)
103	Mayo Power Station	Roxboro	NC		Progress Energy Carolinas Inc.	Progress Energy	736	736 MW (1983)
104	HHP Riverbend Power Station	Mount Holly	NC		Duke Energy	Duke Energy	466	100 MW (1952), 100 MW (1952), 133 MW (1954), 133 MW (1954)
105	Roxboro Power Station	Semora	NC		Progress Energy Carolinas	Progress Energy	2,558	411 MW (1966), 657 MW (1968), 745 MW (1973), 745 MW (1980)
106	W. H. Weatherspoon Power Station	Lumberton	NC		Progress Energy Carolinas	Progress Energy	166	46 MW (1949), 46 MW (1950), 74 MW (1952)

CLYDE BERGEMANN DELTA DUCON	PLANT_NAME	Facility City	Facility State		OWNER	PARENT COMPANY	Plant Nameplate Capacity	Units and In-Service Dates
141	Kingston Power Station	Kingston	TN		Tennessee Valley Authority	Tennessee Valley Authority	1,700	175 MW (1954), 175 MW (1954), 175 MW (1954), 175 MW (1954), 200 MW (1955), 200 MW (1955), 200 MW (1955), 200 MW (1955), 200 MW (1955)
136	Allen Steam Plant	Memphis	TN		Tennessee Valley Authority	Tennessee Valley Authority	990	330 MW (1959), 330 MW (1959), 330 MW (1959)
137	Bull Run Power Station	Clinton	TN		Tennessee Valley Authority	Tennessee Valley Authority	950	950 MW (1967)
138	Gallatin Power Station	Gallatin	TN		Tennessee Valley Authority	Tennessee Valley Authority	1,255	300 MW (1956), 300 MW (1957), 328 MW (1959), 328 MW (1959)
139	John Sevier Power Station	Rogersville	TN		Tennessee Valley Authority	Tennessee Valley Authority	800	200 MW (1955), 200 MW (1955), 200 MW (1956), 200 MW (1957)
140	Johnsonville Power Station	New Johnsonville	TN		Tennessee Valley Authority	Tennessee Valley Authority	1,485	125 MW (1951), 125 MW (1951), 125 MW (1952), 125 MW (1952), 147 MW (1952), 147 MW (1953), 173 MW (1958), 173 MW (1959), 173 MW (1959), 173 MW (1959)

44 Ponds with "High Hazard Potential"



Company	Facility Name	Unit Name	Location/State Contact
Allegheny Energy	Pleasants Power Station	McElroy's Run Embankment	Willow Island, W VA
American Electric Power	Big Sandy	Fly Ash	Louisa, KY
American Electric Power	Cardinal	Fly Ash Reservoir 2	Brilliant, OH
American Electric Power	General James M Gavin	Fly Ash Pond	Cheshire, OH
American Electric Power	General James M Gavin	Bottom Ash Pond	Cheshire, OH
American Electric Power	John E Amos	Fly Ash Pond	St. Albans, W VA
American Electric Power	Mitchell	Fly Ash Pond	Moundsville, W VA
American Electric Power	Muskingum River	Unit 5 Bottom Ash Pond (Lower Fly Ash Pond)	Waterford, OH
American Electric Power	Muskingum River	Upper Fly Ash Pond	Waterford, OH
American Electric Power	Muskingum River	Middle Fly Ash Pond	Waterford, OH
American Electric Power	Philip Sporn	Fly Ash Pond	New Haven, WV
American Electric Power	Tanners Creek	Fly Ash Pond	Lawrenceburg, IN
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Ash Pond 4	Cochise, AZ
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Ash Pond 1	Cochise, AZ
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Ash Pond 3	Cochise, AZ
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Scrubber Pond 2	Cochise, AZ
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Scrubber Pond 1	Cochise, AZ
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Evaporation 1	Cochise, AZ
Arizona Electric Pwr Coop Inc	Apache Station Combustion Waste Disposal Facility	Ash Pond 2	Cochise, AZ

Company	Facility Name	Unit Name	Location/State Contact
Arizona Public Service Co	Cholla	Bottom Ash Pond	Joseph City AZ
Arizona Public Service Co	Cholla	Fly Ash Pond	Joseph City, AZ
Duke Energy Corp	Allen Steam Plant	Active Ash Pond	Belmont, NC
Duke Energy Corp	Belews Creek Steam Station	Active Ash Pond	Walnut Cove, NC
Duke Energy Corp	Buck	New Primary Pond	Spencer, NC
Duke Energy Corp	Buck	Secondary Pond	Spencer, NC
Duke Energy Corp	Buck	Primary Pond	Spencer, NC
Duke Energy Corp	Dan River	Secondary Pond	Eden, NC
Duke Energy Corp	Dan River	Primary Pond	Eden, NC
Duke Energy Corp	Marshall Steam Station	Active Ash Pond	Terrell, NC
Duke Energy Corp	Riverbend	Secondary Pond	Mount Holly, NC
Duke Energy Corp	Riverbend	Primary Pond	Mount Holly, NC
Dynegy Midwest Generation Inc	Havana	East Ash Pond	Havana, IL
Dynegy Midwest Generation Inc	Wood River	East Ash Pond (2 cells)	Alton, IL
First Energy Generation Corp	Bruce Mansfield	Little Blue Run Dam	Shippingport, PA
Georgia Power	Plant Branch	E	Milledgeville, GA
Kentucky Utilities Co	E W Brown	Auxiliary Pond	Harrodsburg, KY
Kentucky Utilities Co	E W Brown	Ash Pond	Harrodsburg, KY
Kentucky Utilities Co	Ghent	Gypsum Stacking Facility	Ghent, KY
Kentucky Utilities Co	Ghent	Ash Pond Basin 1	Ghent, KY
Kentucky Utilities Co	Ghent	Ash Pond Basin 2	Ghent, KY
Louisville Gas & Electric Co	Cane Run	Ash Pond	Louisville, KY
PPL Montana LLC	Colstrip Steam Electric Station	Units 1 & 2 Stage Evaporation Ponds (STPEO)	Colstrip, MT
Progress Energy Carolinas Inc	Asheville	1982 Pond	Arden, NC
Progress Energy Carolinas Inc	Asheville	1964 Pond	Arden, NC



Latest Industry News



From Recent Conference:

Electric Utility Consultants, Inc: Future of Coal Combustion Products, CCP

Regulatory **OPTIONS**: *Relative to Resource Conservation & Recovery Act, RCRA*

- EPA can Classify Ash as **Non Hazardous** under RCRA Subtitle **D**
 - Allows beneficial use
 - Stays more with **State Control**
- EPA can Classify Ash as **Hazardous** under RCRA Subtitle **C**
 - Adverse impact on Beneficial Use alternatives (some allowed, others not)
 - Becomes more of a **Federal** enforcement issue
 - Or Classify under a Combination of RCRA Subtitles **C & D**
- Proposed Rules sent to Office of Management and Budget, **OMB**: October 2009
Rule **was** to be published December 2009,*now December 2010??*

Final Ruling “expected” **2011**

Implementation **2013-2015**



● **Bottom Ash**

→ Stay with “wet” systems:

- Add **Water Recirculation Tanks**

 - *Same water usage – just no Pond*

- **Submerged Scraper Conveyors, SSC**

 - *Also lowers water usage & horsepower*

→ Convert to **DRYCON** Dry Conveyors/Systems

● **Fly Ash** – *all “Dry” , with no water*

→ Vacuum Systems

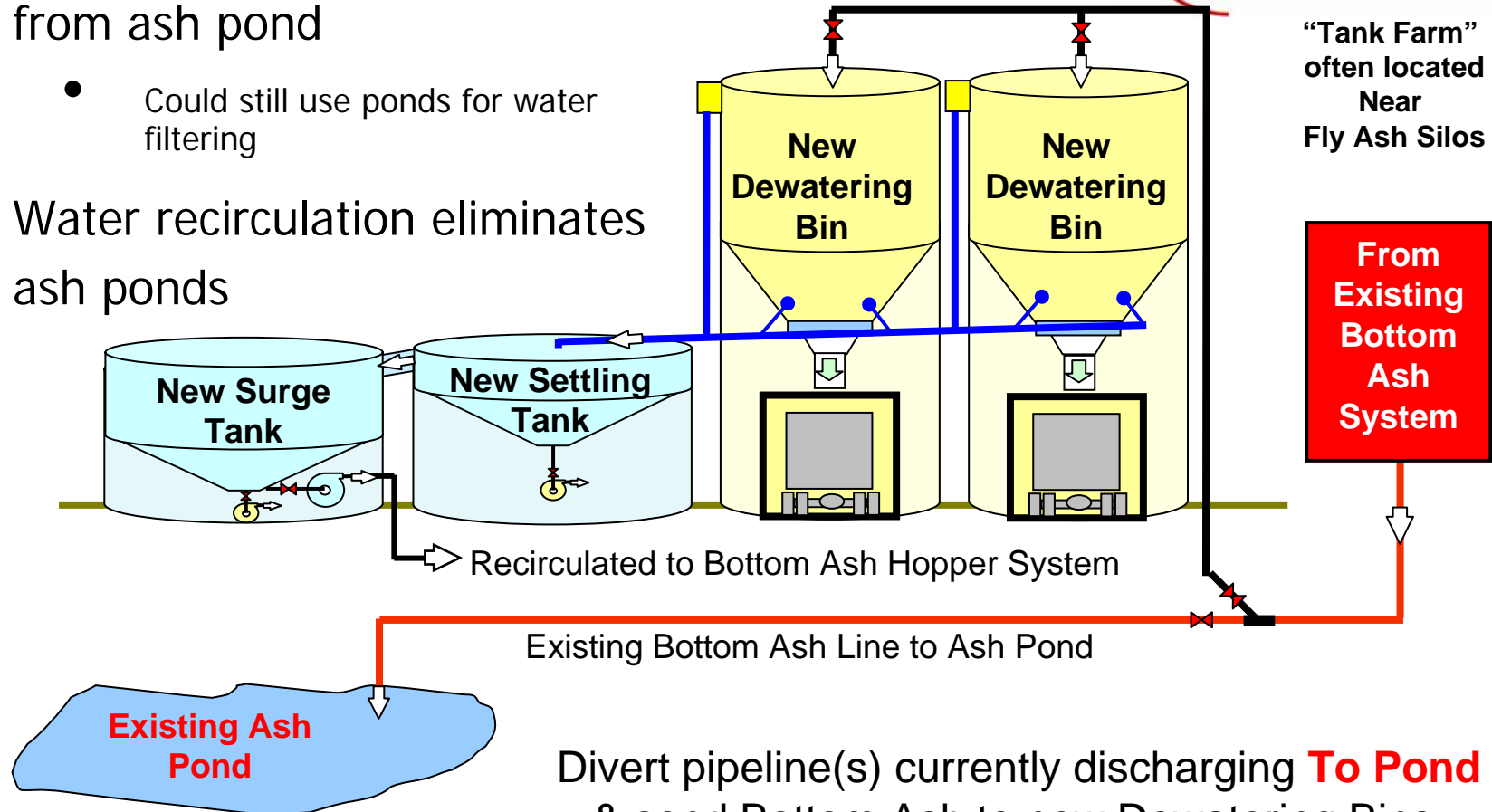
→ Pressure Systems

→ Vacuum-Pressure Systems

- Ideal for many Retrofits

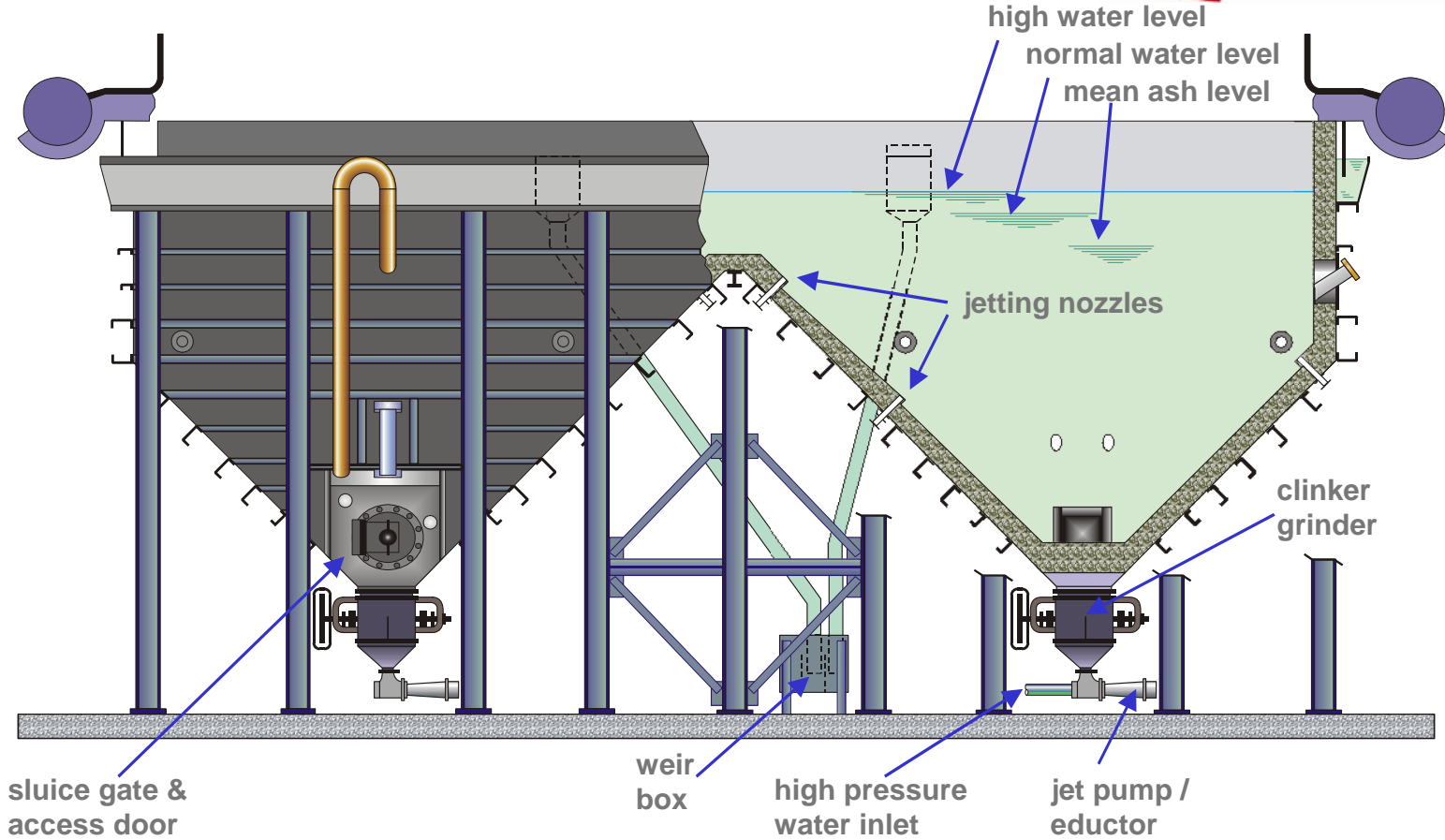
Bottom Ash Recirculation Systems

- Divert bottom ash flow away from ash pond
 - Could still use ponds for water filtering
- Water recirculation eliminates ash ponds



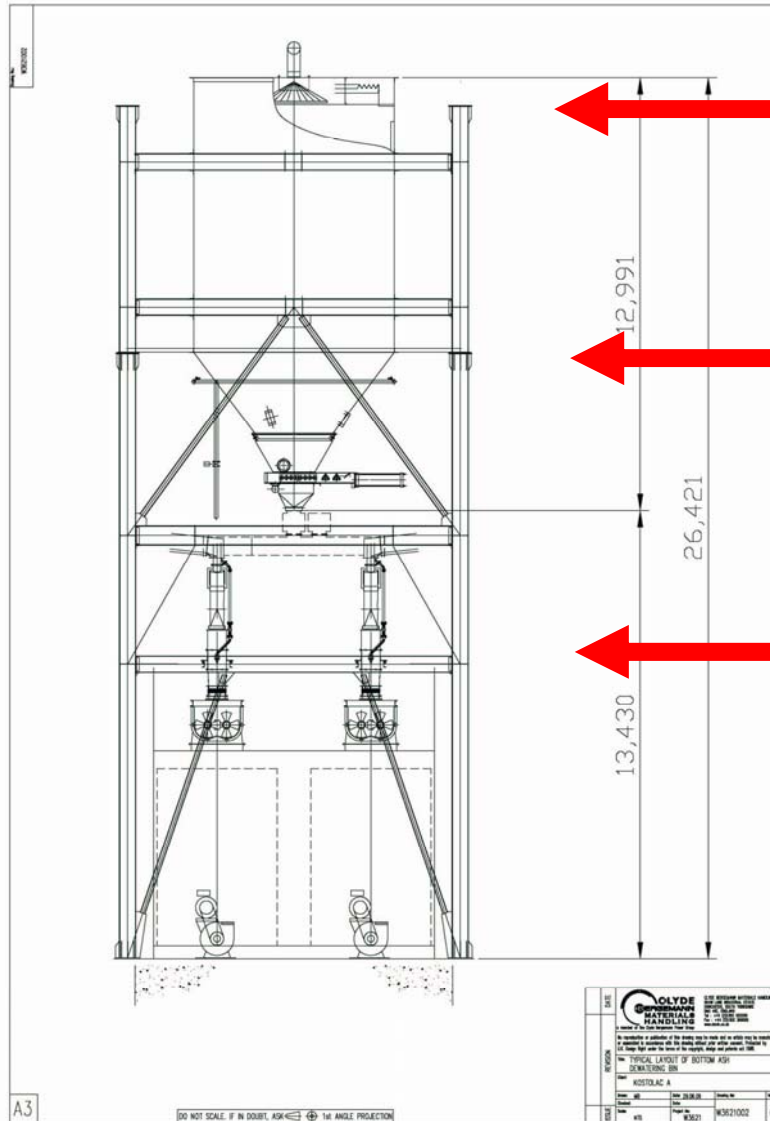
Divert pipeline(s) currently discharging **To Pond** & send Bottom Ash to new Dewatering Bins. Then send water on to Recirculation Tanks

Retain Existing Ash Hoppers under Boiler



Typical-Impounded Hopper System

Add a Dewatering Bin

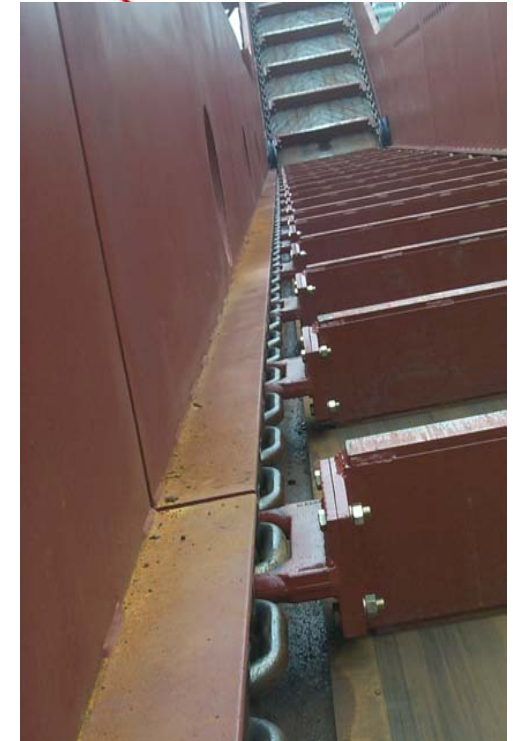


**Upper Section handles
Large Incoming Flow
During Conveying**

**Lower Section handles
Decanting during
Non Conveying
times**

**Final Product is
20% Water By Weight
After
Several Hours
of Decanting**

Submerged Scraper Conveyor (SSC)



Still “Wet” Bottom Handling with much less water and much less horsepower

Submerged Scraper Conveyor (SSC) - Video



Submerged Scraper Conveyor (SSC)



SSC Hydraulic Motor Drives



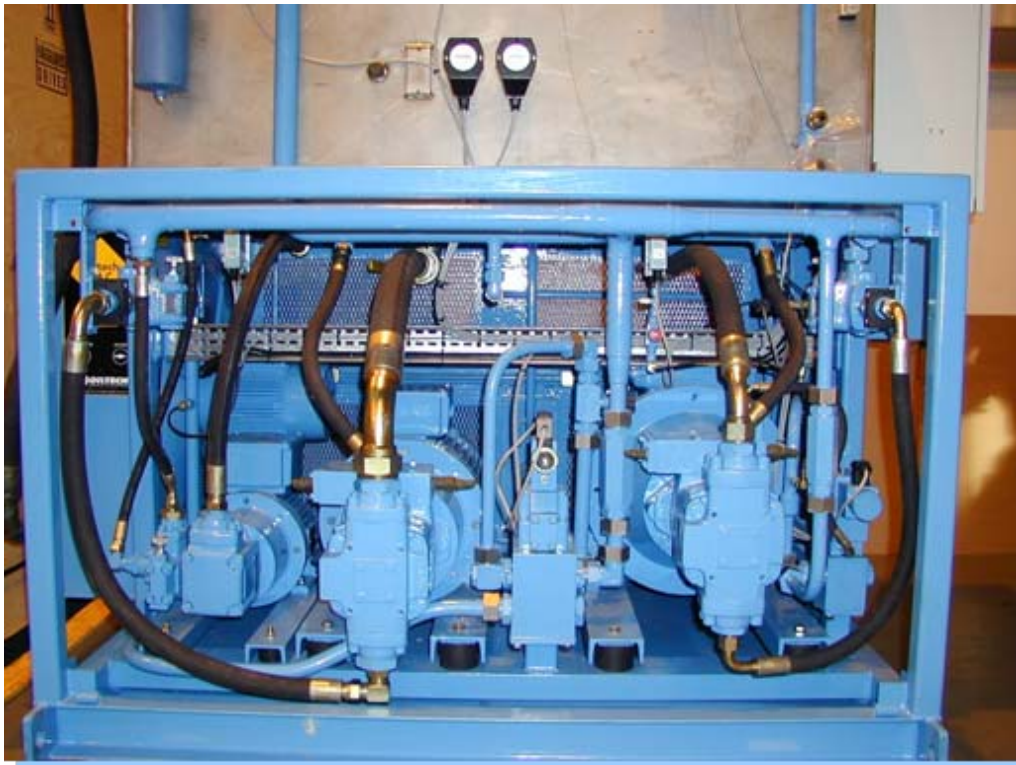
Twin hydraulic motors fitted to the SSC provide smooth efficient transfer of power and can generate high torque at low speed.



The crusher can also be driven by a hydraulic drive, utilizing the same powerpack as the SSC drives.

Submerged Scraper Conveyor (SSC)

SSC Hydraulic Power Pack



Submerged Scraper Conveyor (SSC)

SSC Automatic Chain Tensioning System



- Fully automatic, **SEPARATE**, chain tensioning system
- Correctly tensions the chain under all load conditions



Submerged Scraper Conveyor (SSC)

SSC Motorized Drive Wheels



The SSC can be moved on rails into a maintenance position from under the boiler.

If required the guide wheels can be motorized to simplify moving.

Submerged Scraper Conveyor (SSC)

SSC Basalt Linings



The SSC bottom return deck is fully covered with basalt tiles for protection

Chevron pattern is used on the discharge slope to assist with drainage of the water from the ash



Submerged Scraper Conveyor (SSC)

Dewatering Incline



SSC with Dewatering Bins

*Normally located
Directly Under the Boiler*



Drain Box



Submerged Scraper Conveyor to a Dewatering Bin

What if an SSC doesn't fit under Boiler?



**Bottom Ash
Hopper Discharge
Gate**

**Bottom Ash
Clinker Grinder**

**Bottom Ash Sluice
Line**

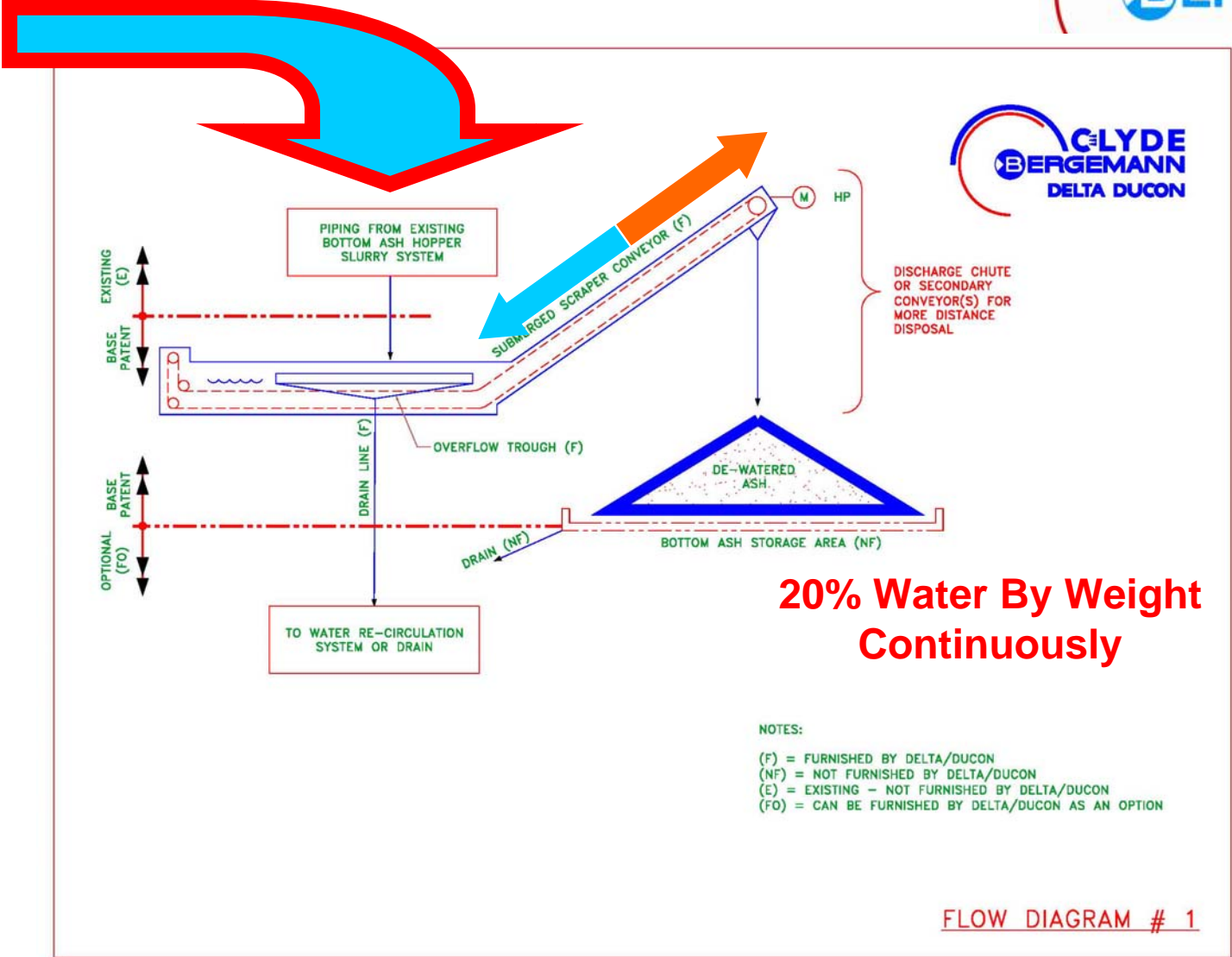
This photo is an example of a water impounded bottom ash hopper. Located below grade and surrounded by boiler support columns, this unit would be difficult or impossible to retrofit with a Submerged Scraper Conveyor (SSC).

Introducing our **ASHCON™** Conveyor

For **Remote** Locations away from Boiler Island



Patent Pending: Remote SSC

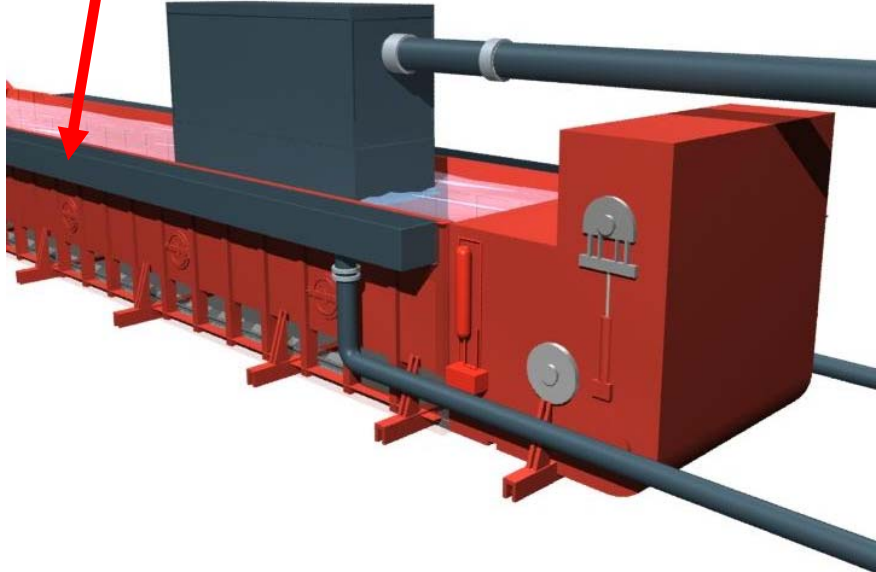


Remote SSC: ASHCON™

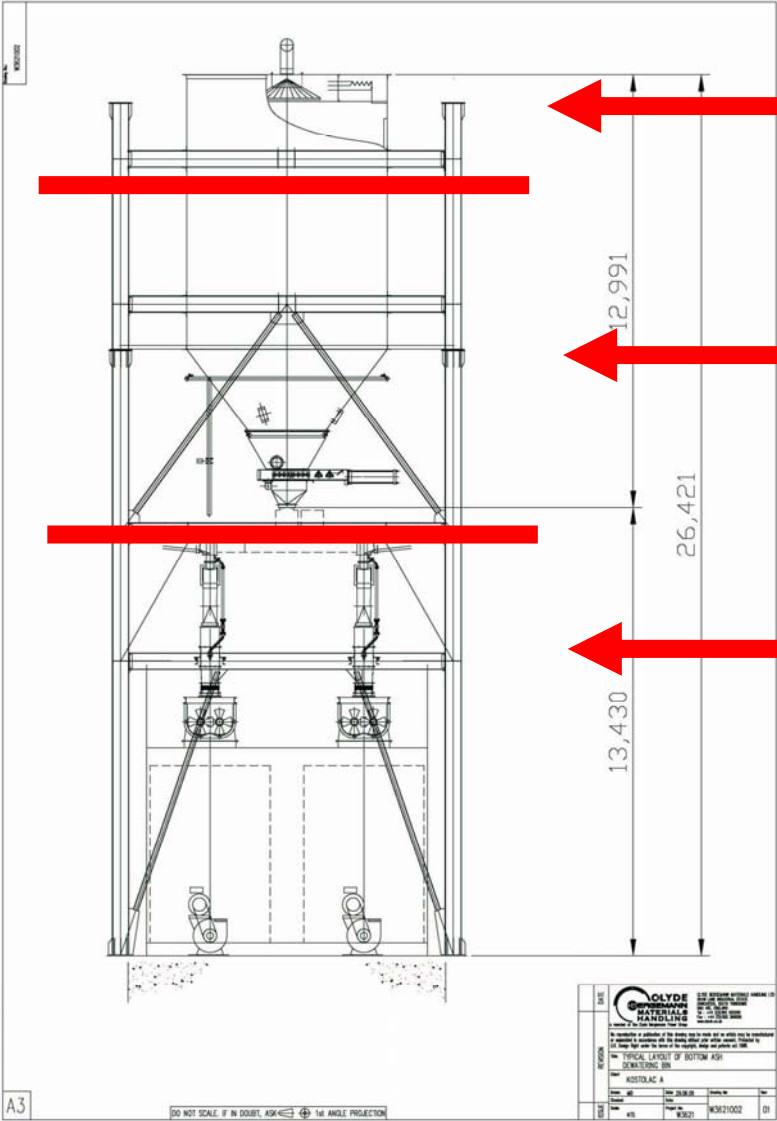


Incoming Sluice Pipe

Run Overflow Troughs Down Both Sides of SSC



Thinking Outside "The Bin"

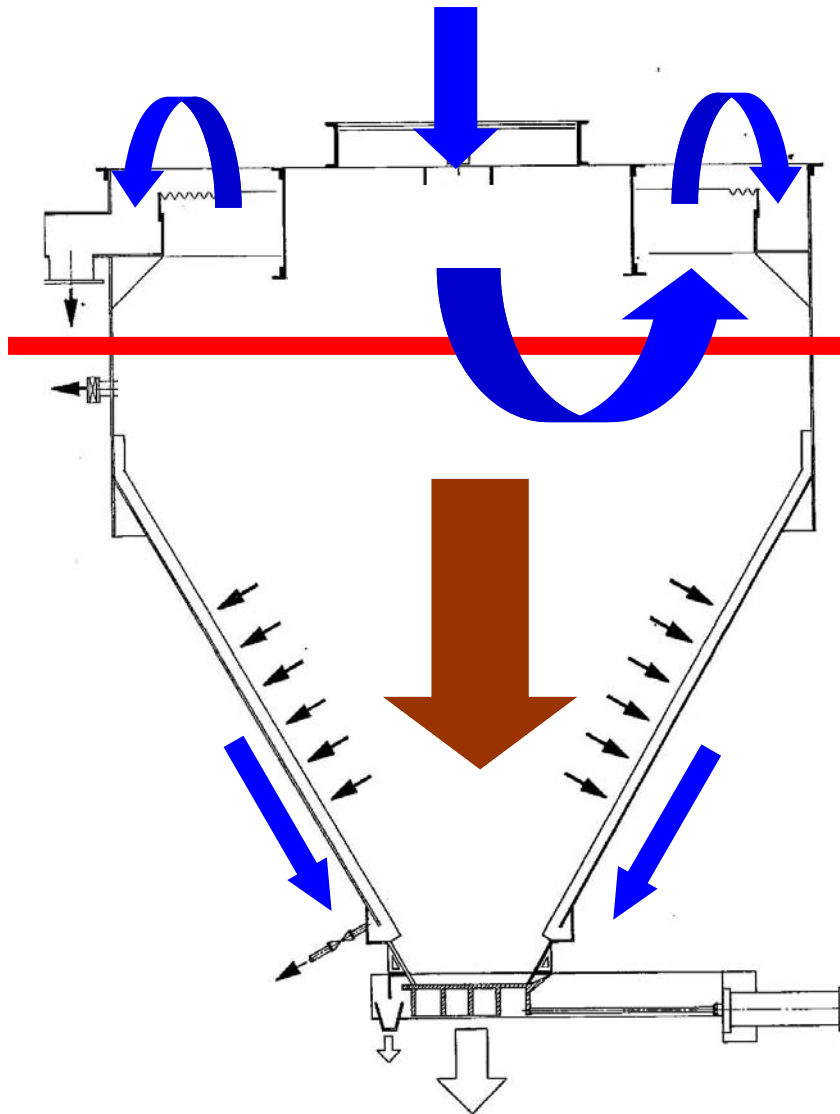


Upper Section handles Large Incoming Flow During Conveying

Lower Section handles Decanting during Non Conveying times

Final Product is 20% Water By Weight After Several Hours of Decanting

The Two Parts of a Dewatering Bin



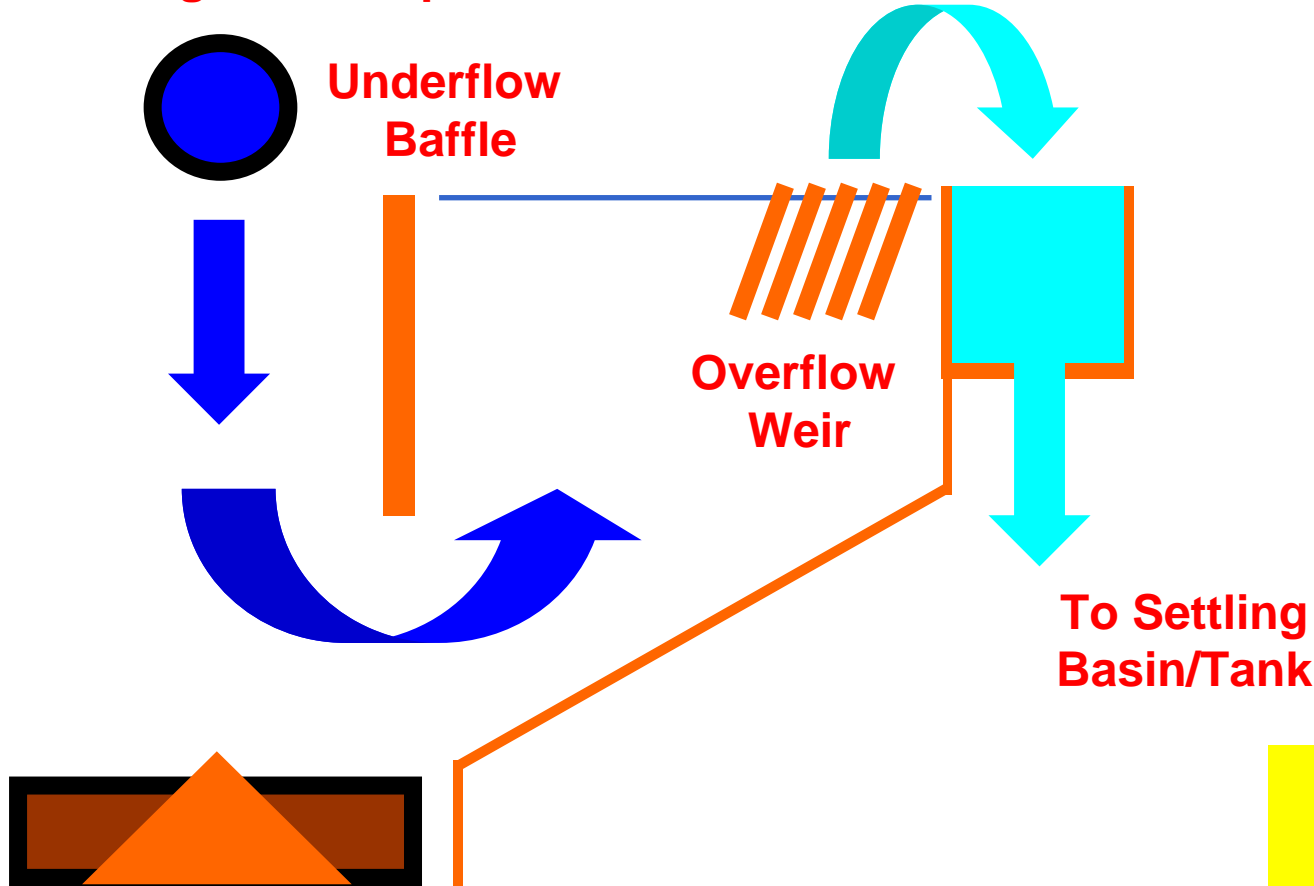
Upper Section:
Underflow Baffle
Overflow Weir

Lower Section:
Decanting Screens
Collection Ring Header

The **Remote SSC** Design Concept



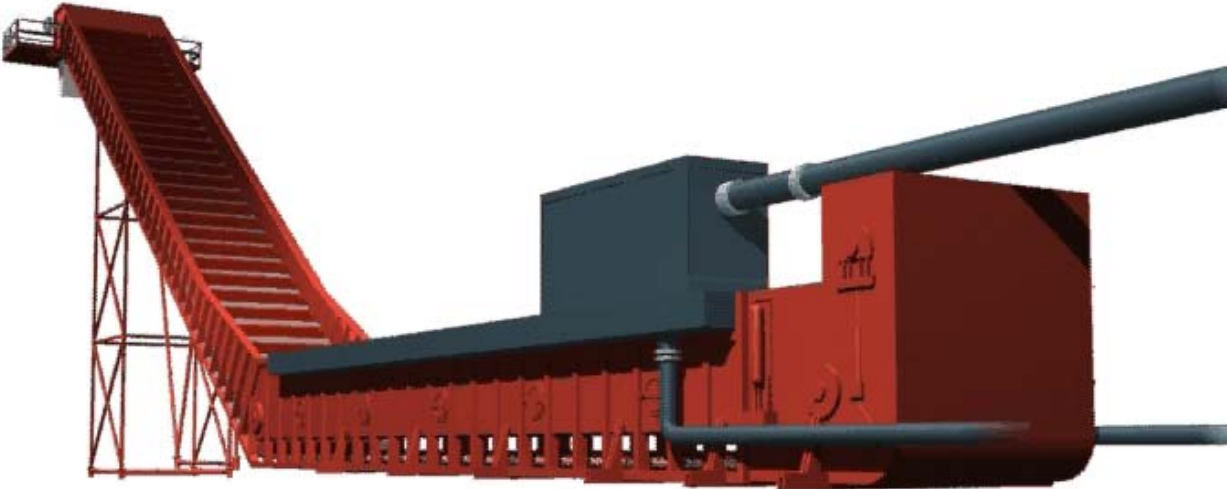
Incoming Sluice Pipe



*Same as
Upper Section
of a
Dewatering Bin*

*Lower Section
of a
Dewatering Bin
Not Needed with SSC*

ASHCON™ Video



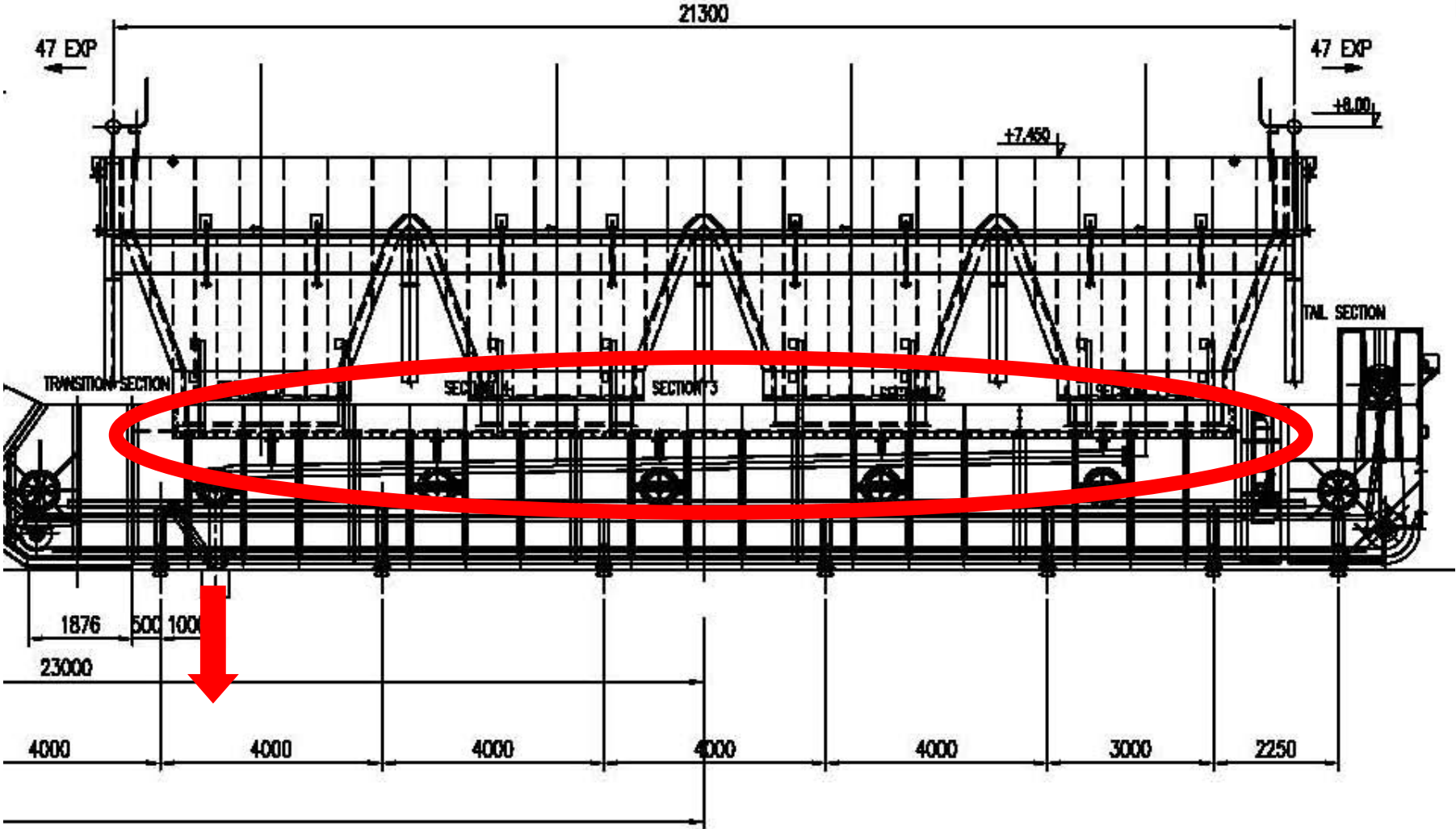
THE BASIC CONCEPT:

A basic **ASHCON™** system will accept the flow of bottom ash slurry line(s) and discharge dewatered ash for loading into dump trucks. Overflow water from the **ASHCON™** can drain into a settling sump or settling pond. A water recirculation system can also be added.



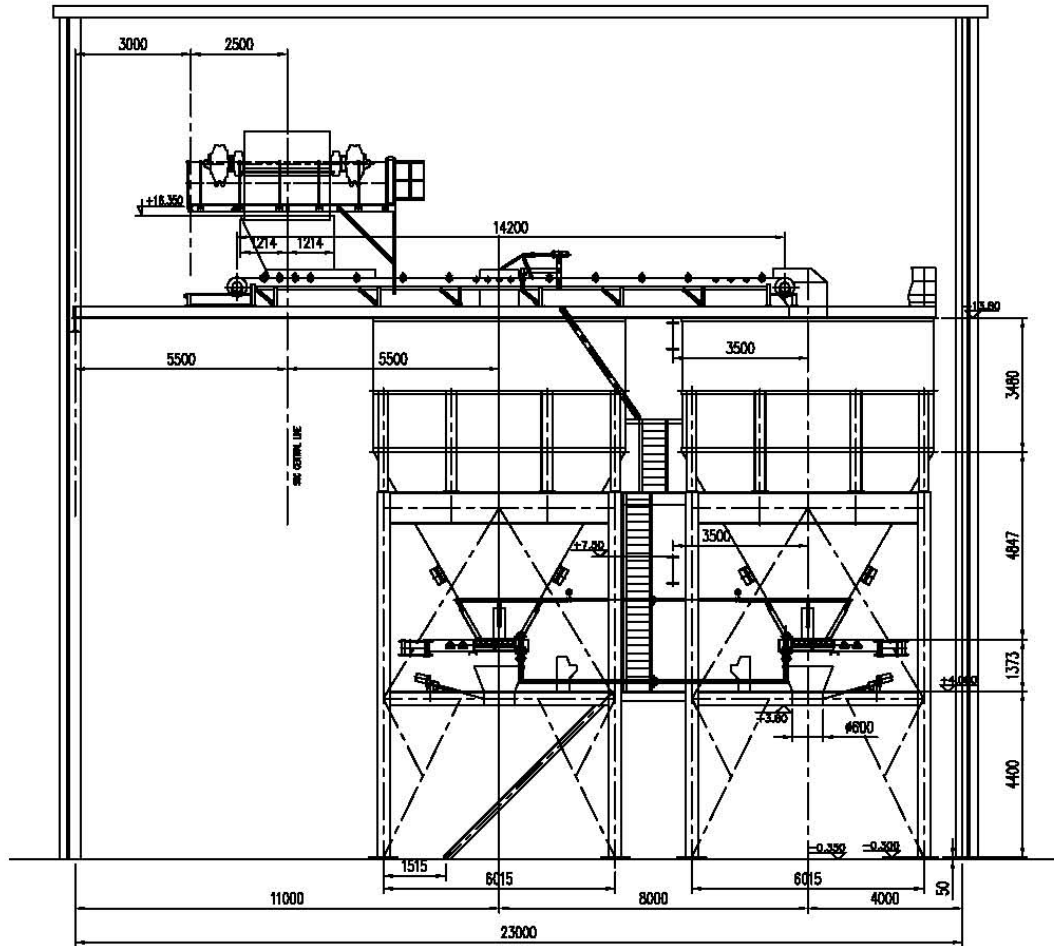
Example from Past SSC Contract

Overflow Drain along entire side of SSC



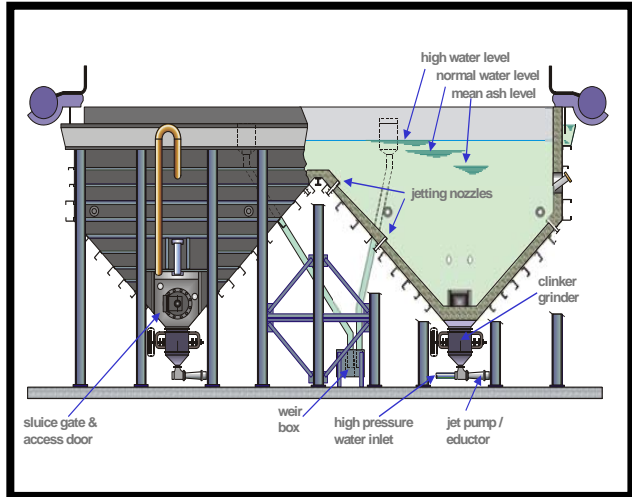
Example from Past SSC Contract

Two Dewatering Bins Receive SSC Discharge



END ELEVATION OF ASH SILOS AND BELT CONVEYOR

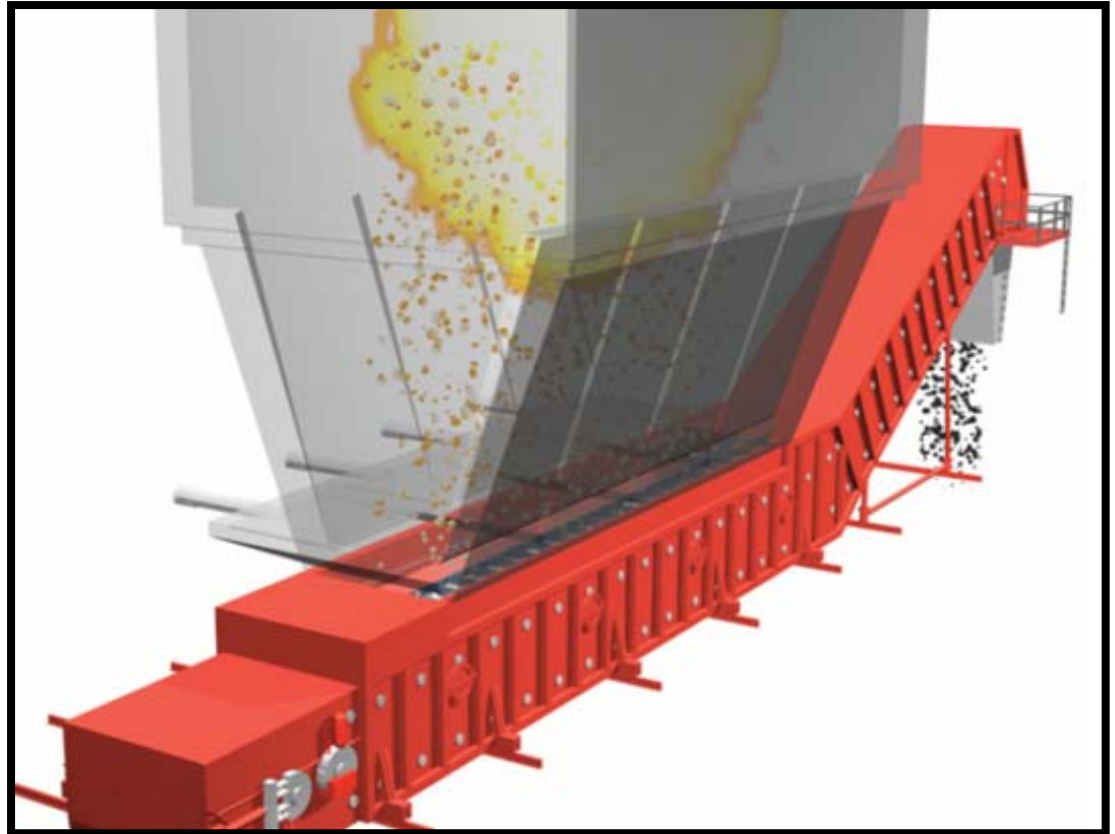
Wet-to-Dry **Bottom Ash** Conversion: *ALL Dry*



FROM – AN EXISTING WATER
IMPOUNDED BOTTOM ASH HOPPER

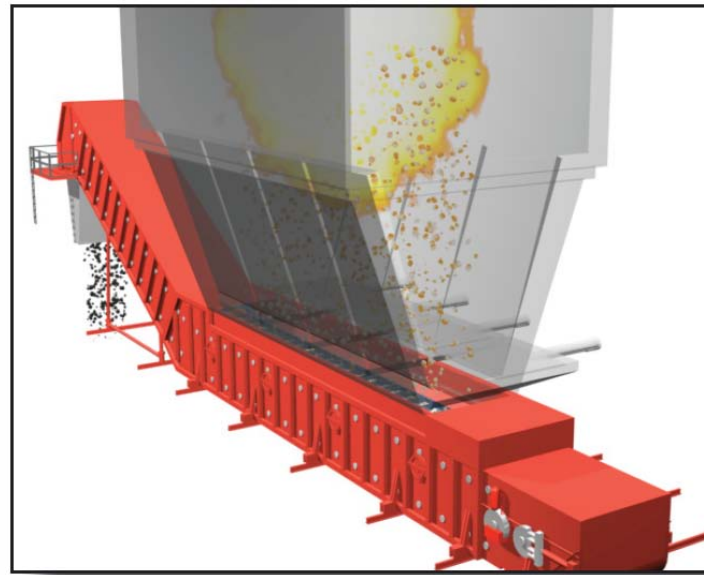
- No water requirement
- No water treatment
- Improvement in boiler efficiency

DRYCON



TO – A COMPLETELY DRY BOTTOM
ASH CONVEYING SYSTEM - DRYCON

DRYCON™ Video



Benefits To Be Considered

Environmental Protection

- Elimination of (all) water usage
- Elimination of water effluent & treatment
- Easier compliance with environmental protection regulations
- Fully enclosed system

Cost Reduction

- Reduced maintenance costs
- Reduction in materials handling costs
- No Water usage
- No Water treatment costs

Increased Efficiency

- Reduction of thermal energy losses
- Reduction of unburned carbon
- Increased boiler efficiency
- Reduction in CO₂ Emissions

Increased Revenue

- Improved boiler efficiency
- Saleable bottom ash quality

Why **Dry** Bottom Ash Conveying?



Wet ash conveyor (SSC)

- Cooling water requirements
- Water treatment & environmental issues
- Significant energy loss
- Corrosion damage
- Steam explosions
- Higher disposal costs
- Maintenance intensive
- Significant energy consumption

Dry ash conveyor (**DRYCON**)

- No water requirement or treatment
- Reduced thermal energy losses
- Reduction of unburned carbon and contribution to energy recovery
- Improvement in boiler efficiency
- Reduced boiler area corrosion
- Easier compliance with the environmental protection regulations
- Marketable ash quality → better ash sales

DRYCON is a Steel Plate Conveyor




- 🌐 Closed plate (apron, pan) conveyor
- 🌐 Small gap between the plates
- 🌐 Lowest overall height
- 🌐 Robust and simple design
- 🌐 Easy assembly and disassembly
- 🌐 High resistance to temperature
- 🌐 Ash inlet area is supported by impact tables



Steel Belt Elements: Chain & Attachment

RUD Chain (**Larger PC Units**)

-  **25 x 95** mm 40cG-S3 Case hardened wear resistant chain (*unique to CB*)
 - Case depth 1.25mm Hardness 820 HV
 - Minimum breaking strength 392 kN
 - **88,125 lbs - force**



Connecting pin – plate to chain

- Case hardened for durability



RUD Connecting Link

- Has the same dimensions and characteristics as the chain
- can be assembled using a hammer.



Guaranteed 5 Years

Steel Belt Elements: Sprocket Wheel



- For extreme duty conditions with highly wear resistant, exchangeable pocket disc

- Same Basic Design as an SSC!



The Drive Station

- 🌐 Electro mechanical or hydraulic drive
- 🌐 Variable speed – VFD controlled - 0-6 m per minute
- 🌐 Blockage detection and alleviation:

Should a blockage occur:

- The motor stops immediately.
- Reverses into the opposite direction.
- Reverses again. Drives again slowly back in the conveying direction to check if the blockage no longer exists.
- The system is set with a pre-determined number of sequences before actuating an alarm to the control room.



The Tension Station

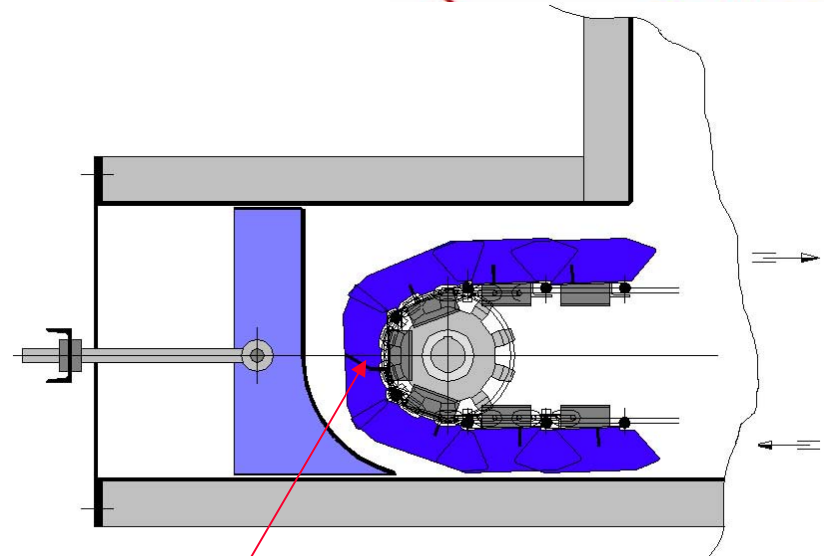


- Integration of fine ash recirculation.
- Redirection linked with the tensioning station (option).
- Alternative automatic tension units also available.
- Measured equalized take up position (<math><5\text{ mm}</math>)
- Long life lubrication bearing.
- Maximum tension travel 600 mm. (24")



Fines Recirculation

- 🌐 Fines re-circulation plate fitted every 6th pan.
- 🌐 Allows for self cleaning of fines accumulation.
- 🌐 The fines re-circulation is integral to the primary conveyor.
- 🌐 Deflector connected to tensioning system



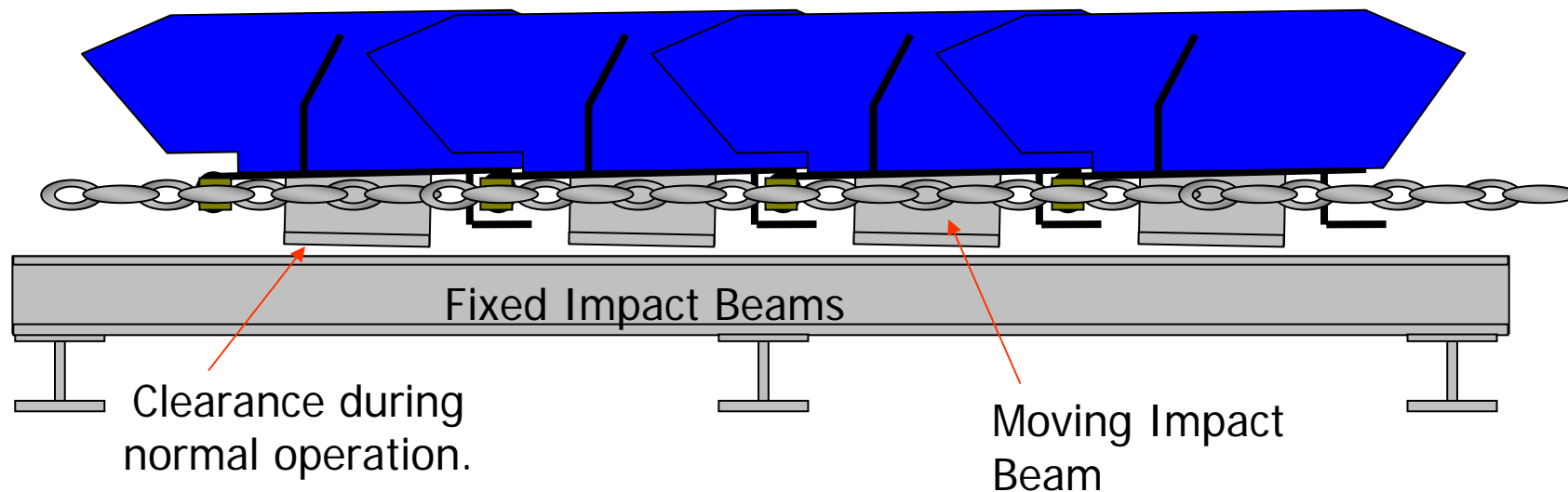
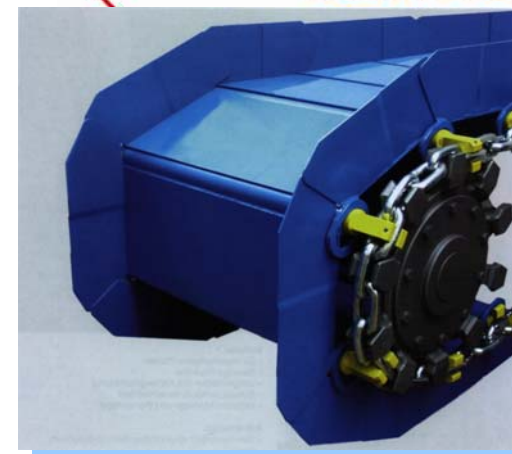
Fines re-circulation plate



Impact Of Large Slag Falls



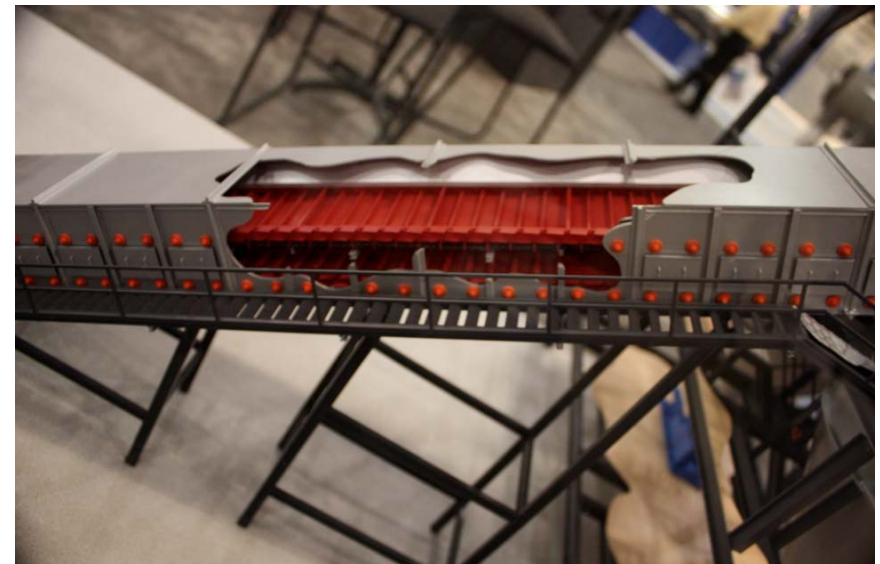
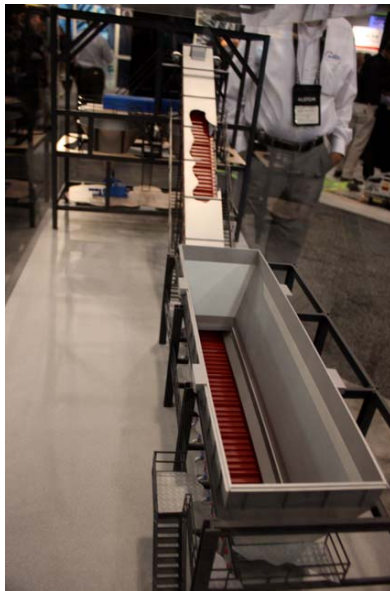
The impact of large ash lumps are directed onto Impact Beams, not onto the supporting idlers.



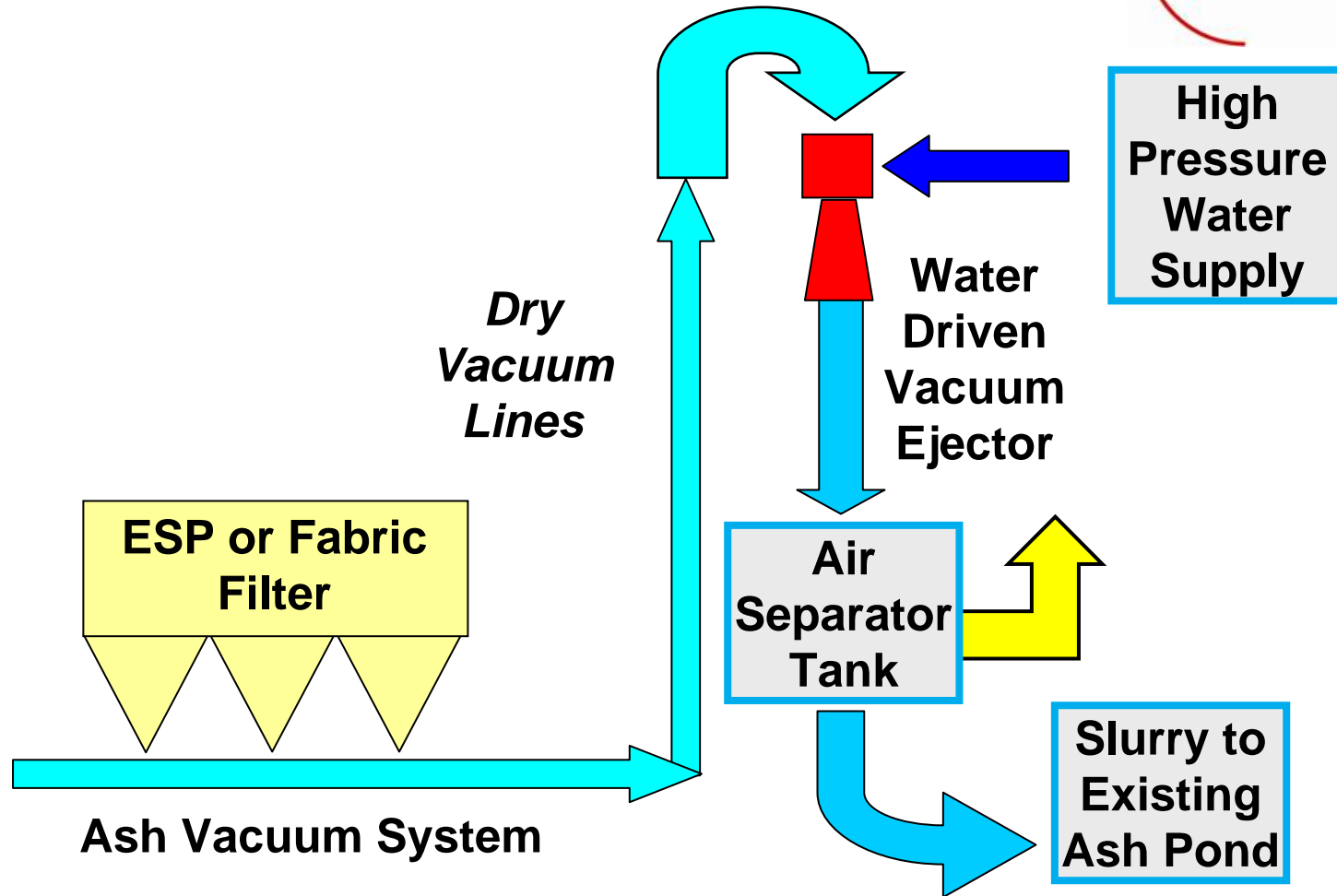
Slag Lump Fall & Impact Beam - Video



DRYCON Model @ PowerGen 2009



Wet to Dry Fly Ash Conversions



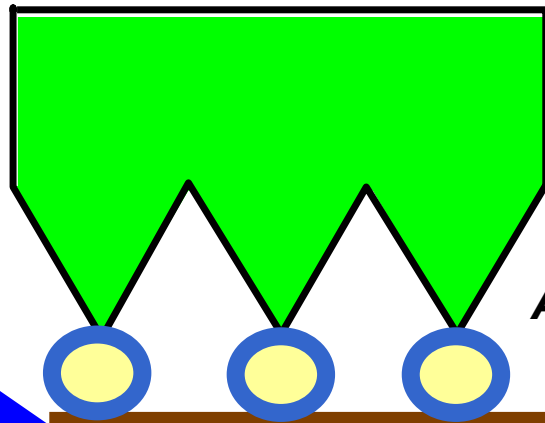
Basic **Water** Powered Vacuum System ("**Wet**")

Dry Vacuum Fly Ash System

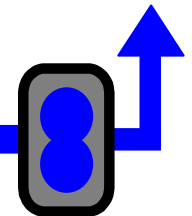
A Filter-Receiver is used to separate material from the conveying air stream.

**Combination
Filter-Receiver**

**To Wet
System**



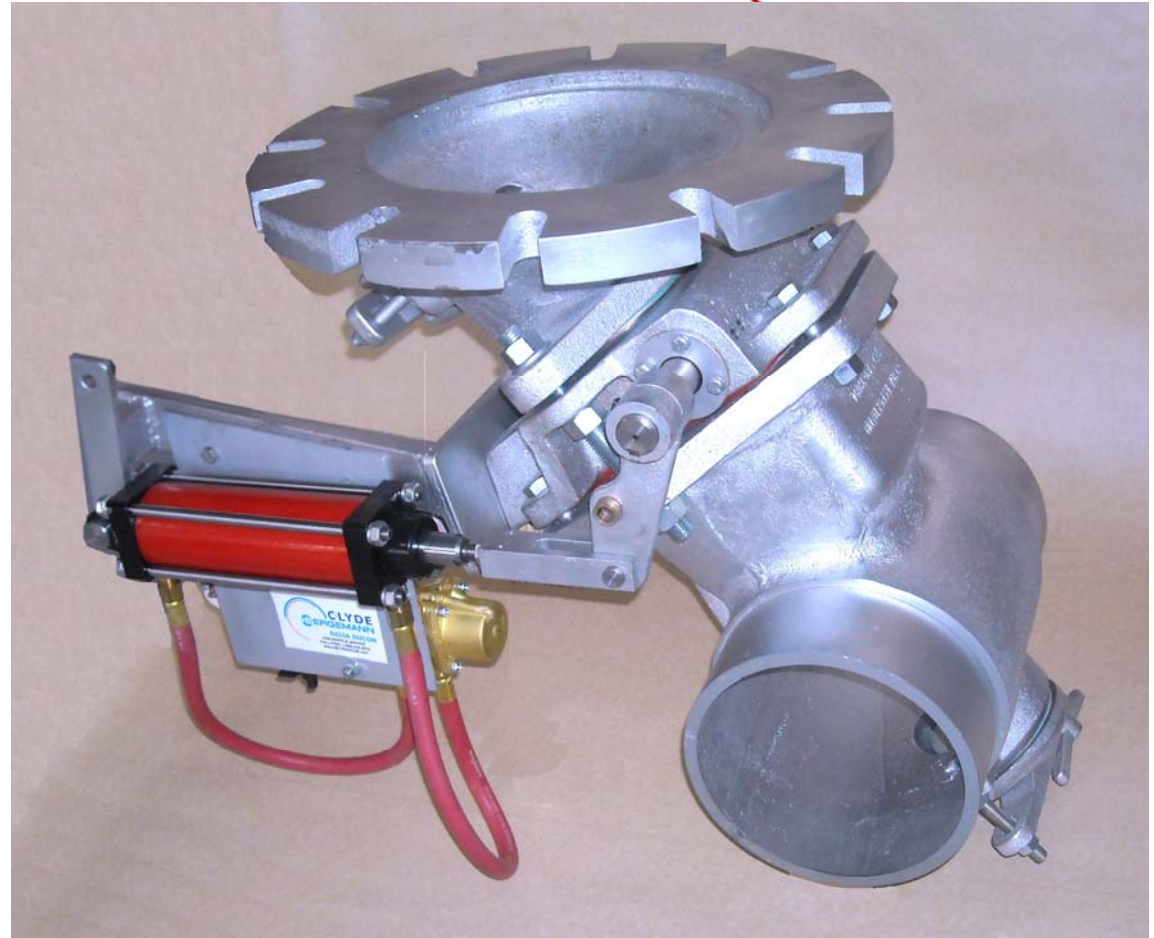
**Ash Intake
Valves**



**Dry Vacuum
Blower**

Dry Vacuum Fly Ash System: Ash Intake Valve

Retain Existing Ash Intake Valves unless PRB type Coal is used

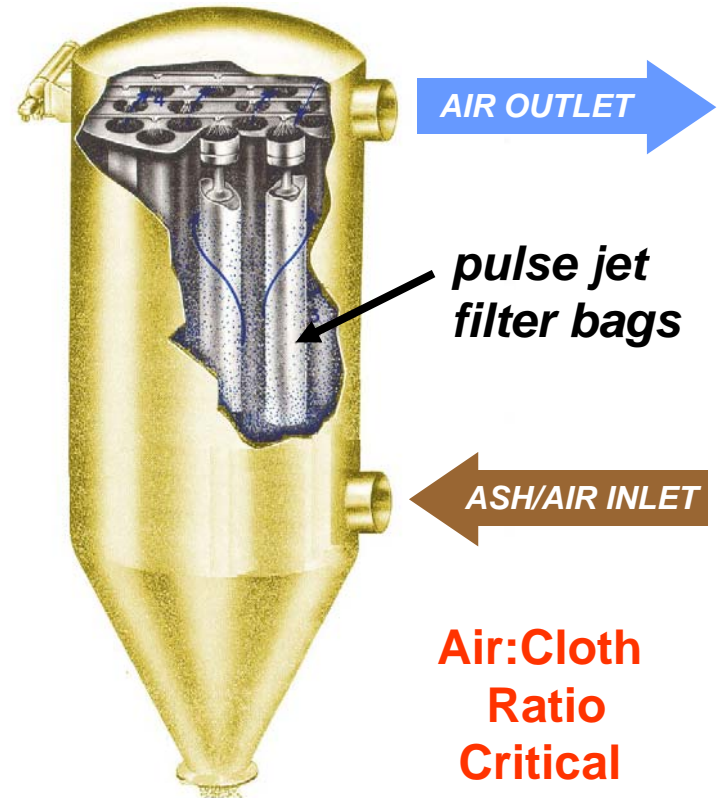
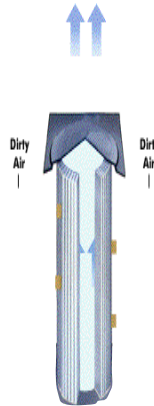
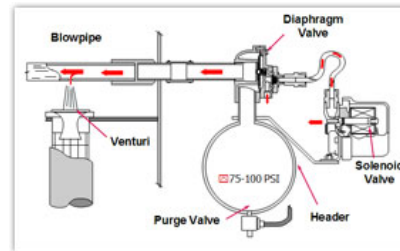


CBDD Type "HC" Material Handling Valve

Dry Vacuum Fly Ash System: Filter-Receiver



The Filter-Receiver separates ash from the conveying air stream for discharge into the storage silo. Final dust collection is via a pulse jet fabric filter.



Filter-Receivers on a Silo roof

Dry Vacuum Fly Ash System: Blowers

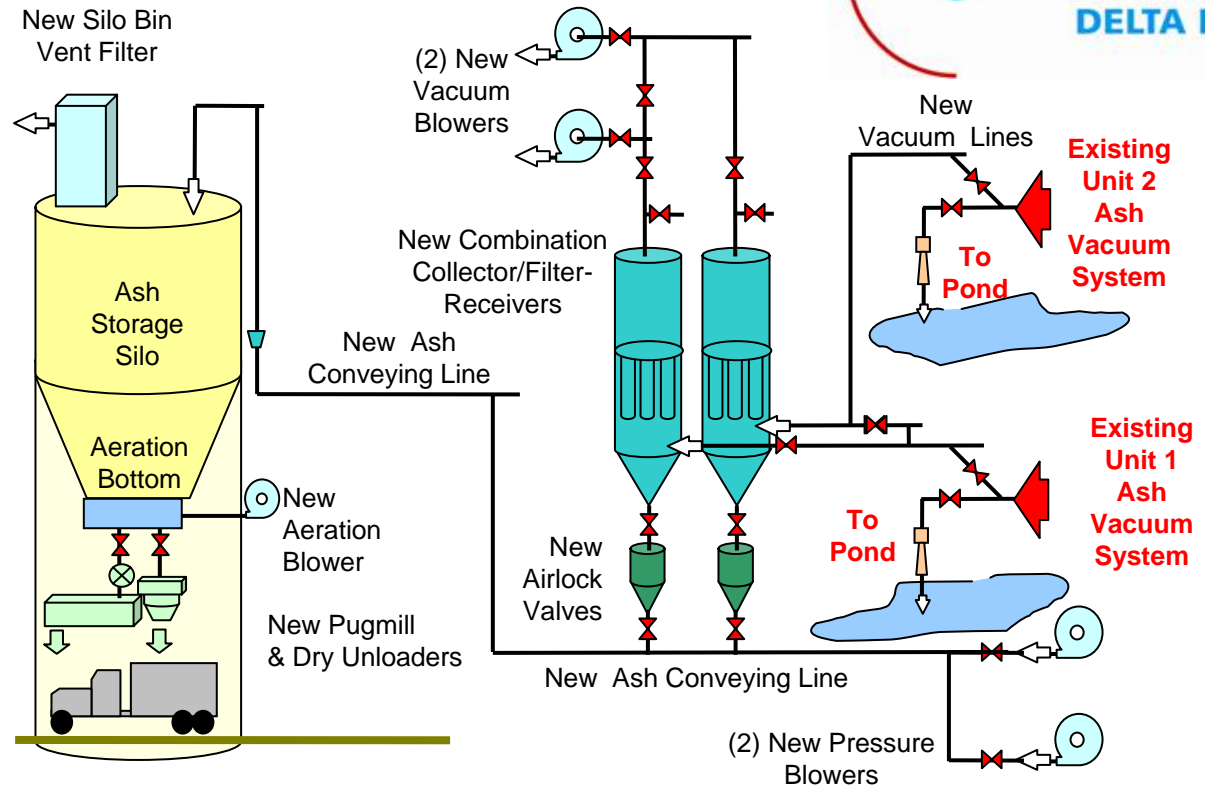


The system uses a PD blower as it's motive air source. For each revolution there is a positive displacement (PD) of air. Blowers are shop assembled into skids to reduce field labor.



Elevated base mounted vacuum blowers

Wet-to-Dry Fly Ash Conversion

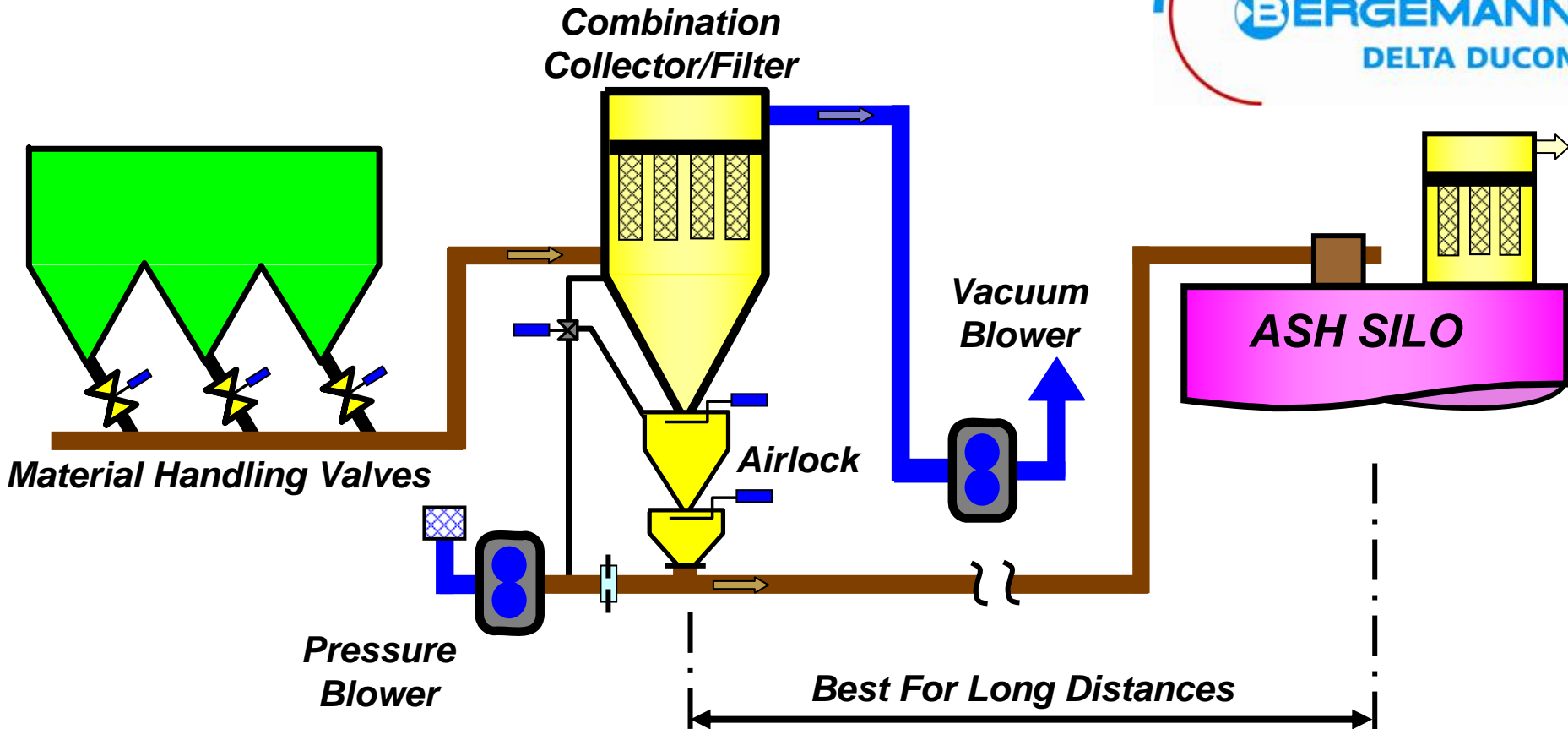


Bypass Water Jet Exhausters currently discharging **To Pond** & send Fly Ash to new Filter-Receivers using DRY vacuum pumps. Then on to Dry Silos via Pressure System.

This illustrates a Vacuum-Pressure System

- **Allow retention of most existing Vacuum system valves and piping under existing Air Quality Control Systems (ESP or Baghouse)**
 - These allowed a “short” run to water jet exhauster
 - Allows quicker “tie-in” during outages
- **Extends distances that Fly Ash can be conveyed to reach new Silos**
 - Often Silos need to be thousands of feet away for traffic reasons
- **Allow more choices in disposal paths**
 - Vacuum systems culminate in Filter-Receiver sets at ***EACH*** location
 - Pressure systems offer more choices with simple valving
 - Reinjection
 - **Sale Silos (especially with higher calcium oxide content ashes e.g. PRB)**
 - Another justification for a Wet-to-Dry Conversion***
 - Non-Sale Silos (economizer ash or ash with high carbon content (LOI))

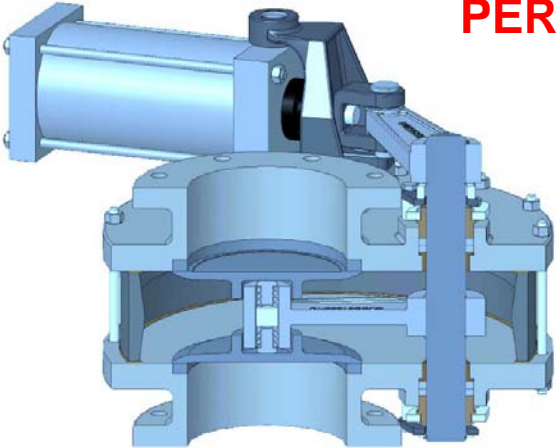
Wet to Dry Fly Ash Conversions



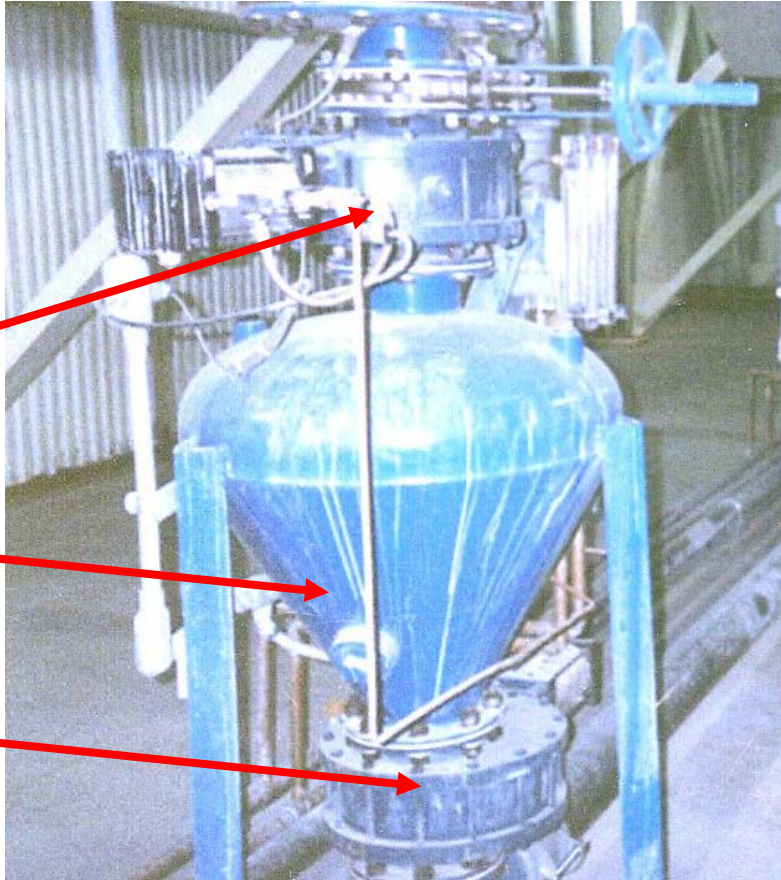
Example – Dynegy Havana 6 – 37 TPH, 3,500 Ft.

Basic Vacuum/Pressure Transfer System

Fly Ash System: Airlocks



PERMA/lok 5 Valve



Top Airlock Valve

Airlock Chamber

Bottom Airlock Valve

Examples of Wet-to-Dry Conversions

ASH VACUUM / PRESSURE SYSTEMS:

- **DYNEGY HENNEPIN:**

 - (2) 15 TPH SYSTEMS

- **DYNEGY HAVANA 6:**

 - 37 TPH (3,600 FT) SYSTEM

- **DYNEGY VERMILION:**

 - (2) 15 TPH SYSTEMS



- **WESTERN KENTUCKY ENERGY – HENDERSON 2:**

 - (2) 15 TPH SYSTEMS

Installation Photos



WKE



Vermilion

Ash Storage Silos



**These silos are examples of field bolted tanks with truck drive through bays.
Notice Height:Diameter ratio**

Summary of Wet-to-Dry Conversion Projects



- Many Choices Exist to Retrofit and Convert Existing Plants
- **Fly Ash** is **80%** of the ash and can **EASILY** be removed from Pond Disposal
 - It starts out “DRY” so it is easy to “KEEP” Dry and use diverter valving
- **Bottom Ash** is **20%** of the ash and typically starts out falling into a wet ash hopper:
 - Retrofits of **Submerged Scraper Conveyors, SSC**, or **DRYCON** Conveyors are a major undertaking but can be accomplished in 6-8 week outages
 - Existing sluice systems to a Pond can be converted to Water Recirculation Systems with Dewatering Bins and Settling & Surge Tanks
 - Tie-in is easier during an outage
 - Tanks can be erected while Unit is on line
 - **OR Apply the Patent Pending Solution with a Remote SSC**

ASHCON™ Conveyor

Turnkey Alliance for Timely Installation



Now there's a better way to handle ash, from top to bottom.



We're bringing new technology and new thinking to the issue of ash handling and ash ponds. Through wet-to-dry fly ash conversion, dry bottom ash handling, and sorbent injection technology, we eliminate the need for ash ponds.

Our turnkey system offers design, supply, construction, installation and project management, all from a single, cost-saving source. It's a winning combination that will lower your operating costs and provide significant environmental benefits.

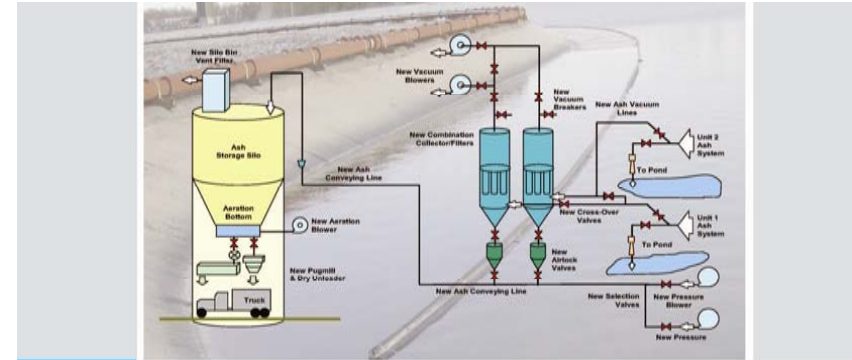
We're Roberts & Schaefer and Clyde Bergemann Delta Ducon. Take advantage of our smart new solutions to your ash handling problems.

We can do the whole job, from top to bottom.

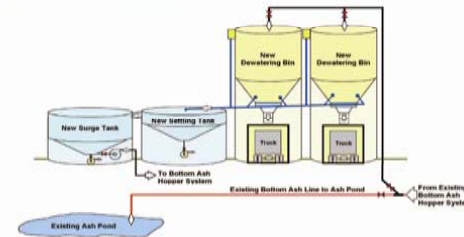
Call 312-846-5910 or 610-695-9700.



Roberts & Schaefer Company



(SSC) Submerged Scraper Conveyor Drycon-Continuous Dry Bottom Ash Handling Wet-to-Dry Pneumatic Fly Ash Conversion Wet-Ash Recirculization System



CLYDE BERGEMANN DELTA DUCON

Thank you for your time and attention.

We hope that you found this presentation to be informative. Please feel free to contact us should you have any questions or require any additional information.



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