UNITED STATES DEPARTMENT OF ENERGY

CLEAN COAL TECHNOLOGY PROGRAM

FINAL DESIGN REPORT

VOLUME 1 - PUBLIC DESIGN REPORTS

for

Pure Air's

Advanced Flue Gas Desulfurization Process
Clean Coal Demonstration Project
DE-FC22-90PC89660

at

Northern Indiana Public service Company
Bailly Power Generating Station
Chesterton, Indiana

Pure Air on the Lake, L.P.
7201 Hamilton Blvd.
Allentown, Pa. 18195-1501

Federal Energy Technology Center
626 Cochrans Mill Rd.
P.O. Box 10940
Pittsburgh Pa. 15236-0940

March 1, 1990

United States Department of Energy

Clean Coal Technology - 2

DE-FC22-90PC89660

PURE AIR

Advanced Flue Gas Desulfurization Process

For

Northern Indiana Public Service Company

600 MW

Bailly Power Generating Station

Units 7 & 8

Public Design Reports

Date: 01 March 1990 Revision: 0

1. SECTION 100 ABSORPTION SECTION

Major Equipment
Absorber/Mist Eliminator
Absorber Recirculation Pump
Absorber Bleed Pump
Oxidation Air Blower
Arm Rotary Sparger
Fixed Air Sparger

1.1 Absorber and Ancillaries

The single 100 percent absorber is a co-current grid packed tower with an intergrated reaction tank at the bottom. It is designed to accomplish several process steps (quenching, absorption of SO_2, reaction with limestone, oxidation to gypsum) in a single vessel, resulting in a simple configuration of the plant. The co-current absorber is designed for higher flue gas velocities than conventional countercurrent towers, which results in a compact absorber size.

The flue gas enters the top of the absorber where it contacts recirculating slurry. Quenching and absorption of SO_2 occur simultaneously. This “wet/dry” interface is washed intermittently with fresh water to prevent the formation and growth of any deposits.

A grid packing (made of a plastic polymer) is located at an intermediate height in the tower to provide a large surface area for gas/liquid contact and to enhance SO_2 removal efficiency. The SO_2 in the flue gas is absorbed into the slurry and the SO_2 concentration in the gas phase is reduced as it flows downward through the absorber.

The absorbed SO_2 is partially oxidized in the tower by oxygen in the flue gas. Oxidation is completed in the reaction tank. After flowing through the absorber tower, the flue gas passes through the top of the reactor vessel tank and turns upward toward the mist eliminator, which is located vertically in the horizontal gas flow outlet duct.

The reaction tank is designed to hold enough liquid volume to ensure efficient utilization of limestone, desupersaturation of calcium sulfate, and oxidation of the remaining calcium sulfite. The reaction tank is located beneath the absorber tower so that recirculation slurry, which absorbs SO_2 from the flue gas, falls into the reaction tank. Three arm rotary spargers and a fixed air sparger system are incorporated in the reaction tank to ensure complete oxidation of the calcium sulfite to calcium sulfate.

The arm rotary sparger (ARS) is an innovative and unique design which combines agitation and oxidation. The ARS is composed of a hollow shaft, with arms and holes for air sparging. Fine bubbles are formed as the sparging air contacts the rotating arms. This increases the contact area between air and slurry and results in high 02 utilization efficiency. The majority of the slurry is oxidized by the three ARS's and the remainder is oxidized by the fixed air sparger.

The fixed air sparger, located near the bottom of the tank, is composed of a piping network and high—velocity nozzles that produce fine bubbles. The fixed air sparger ensures uniform distribution of air bubbles throughout its service area. In combinination, the ARS and fixed air sparger force complete oxidation of the slurry before it passes through the reaction tank.

The exact chemistry of absorbing SO_2 from the flue gas and converting it to gypsum is as follows.

First, in the absorber tower:

$SO_2 + H_2O = H_2SO_3$

$H_2SO_3 = H^+ + HSO_3^-$

$(H^+ + HSO_3^- + \frac{1}{2} O_2 = H + S0_4^{-2})$

$(2H^+ + SO_4^{-2} + CaCO_3 + Aq = CaSO_4{\bullet}2H_2O + CO_2)$

The SO_2 is absorbed into H_2O, then dissociates from H_2SO_3 to H^+ + HSO_3^-. A portion of the HSO_3^- is oxidized in the absorber tower and converted to H_2SO_4. Calcium carbonate in the slurry neutralizes a portion of the 2504, helping to balance the slurry pH. In the reaction tank, the conversion to gypsum is completed:

$H^+ + HSO_3^- + ½\ O_2 = H^+ + SO_4^{-2}$
$2H^+ + SO_4^{-2} + CaCO_3 + Aq = CaSO_4{\bullet}H_2O{+}CO_2$

All remaining HSO_3^- in the slurry is oxidized by air, either from the ARSs or the fixed air sparger and converted to H_2SO_4. The H_2SO_4 is neutralized with $CaCO_3$ to form $CaSO_4{\bullet}2H_2O$ The resultant slurry, in which the concentration of SO_2 or SO_3 components becomes nil, is pumped to the top of the absorber and sprayed into the flue gas. The chemical reaction of absorption is then repeated.

In order to compensate for consumed calcium carbonate, pulverized limestone is injected into the neutralizing tank by a pneumatic forced transportation method through piping from the limestone feed facility. Duplicate limestone injection nozzles are provided in the tank.

The SO_2 content in the flue gas at the absorber outlet is monitored and controlled by regulating the quantity of limestone injected into the reaction tank. The gypsum slurry content in the reaction tank is maintained around 20-25 percent by weight to ensure stable operation of the centrifuges.

Water in the reaction tank is consumed by evaporation into the flue gas during the quenching and saturation of the flue gas. The loss of water via evaporation and addition of limestone solid increases the slurry concentration in the reaction tank. To compensate for this, the slurry concentration is monitored and fresh make-up water is supplied into the tank to maintain the desired solids concentration. To maintain tank level, the gypsum slurry is drawn off by the absorber bleed pump and sent to the dewatering section.

During an upset of the upstream electrostatic precipitator (ESP), large amounts of fly ash can be introduced to the absorber. This fly ash will be captured by the recirculating slurry. A significant reduction of both limestone reactivity and SO_2 removal efficiency can result from increasing the fly ash content in the slurry.

This condition will not be improved by continued injection of limestone even after the operation of the ESP returns to normal. To prevent such a condition, a pulverized hydrated lime injection system is provided. Hydrated lime is pneumatically transferred from the hydrated lime silo and injected through the limestone injection nozzle into the absorber. Recovery from this upset condition will be confirmed by the return of the absorber slurry pH value to its normal range.

1.2 Mist Eliminator

A two-stage Chevron type mist eliminator is located vertically in the outlet duct leading from the reaction tank. Entrained mist reaching the mist eliminator is minimized by the use of a horizontal run between the reaction tank and the mist eliminator. Collected entrainment is drained back to the reaction tank. A washing spray header system is installed in front of the mist eliminator elements to intermittently wash down the element surface thus minimizing any buildup of deposits. After passing through the mist eliminators, the scrubbed flue gas exists through the outlet duct to a stack.

2. SECTION 300 DEWATERING SECTION

Major Equipment
Gypsum Centrifuge
Filtrate Sump & Pump
Centrifuge Feed Tank & Pump
Filtrate Thickener

The gypsum slurry removed from the absorber by the absorber bleed pump is fed to the centrifuge feed tank. It is then pumped by the centrifuge feed pump to the centrifuge head tank. The centrifuge head tank is located sufficiently higher than the centrifuge feed slurry header to ensure stable back pressure and constant feed rate to the centrifuges. The centrifuge feed pump is sized to feed gypsum slurry to two centrifuges at the same time, plus to maintain minimum flow to the centrifuge head tank. Overflow from the head tank is returned to the centrifuge feed tank.

The centrifuge is a basket type which reduces the gypsum slurry to a dewatered cake containing less than 10 percent moisture by weight. Centrifuge operation (start and stop) is initiated by a level controller located at the centrifuge feed tank.

The cake is washed with process water to reduce the chlorine content to less than 120 ppm, which meets the requirement of wall board manufacturers. The gypsum cake is then raked out of the centrifuges and transferred by enclosed conveyor to a remote site where the customer's gypsum storage building is located.

During the feed, dewatering, and washing cycles, filtrate water is drained from the centrifuges. The filtrate water is collected in the filtrate sump. Hydrated lime is added to the filtrate sump to neutralize the dissolved impurities. The filtrate water is sent from the filtrate sump to the filtrate thickener where suspended fly ash and gypsum are settled out, and supernatant and sediment are then separated.

The supernatant flows through the thickener overflow weir and is collected in the thickener overflow tank. T he filtrate collected in the thickener overflow tank is recycled to the absorber tank as make-up process water. If required, this stream can also be purged from the plant to Northern Indiana's waste water treatment facility and/or a portion of the thickener overflow can be used for the waste water evaporation system (WES). In so doing, the chlorine concentration of the recirculating slurry is maintained at a level so as to avoid any corrosion problems in the system.

The sediment is raked out and pumped to the centrifuge feed tank via the thickener underflow pump. In this manner, fly ash is recovered as an impurity component of the by-product gypsum. By recovering fly ash in the by-product gypsum and/or discharging fly ash in the waste water, the concentration of fly ash in the recirculating slurry is controlled so as to maintain proper SO_2 removal performance in the absorber.

3. SECTION 350 WASTE WATER TREATMENT AND EVAPORATION SECTION

Major Equipment
Waste Water Pump
Spray Nozzles

The waste water taken from a portion of the thickener overflow is sent to the waste water evaporation system (WES) and/or Northern Indiana's waste water treatment system. Waste water sent to Northern Indiana's waste water treatment system is taken as a slip stream off the discharge of the thickener overflow pump.

Waste water sent to the WES is pressurized by the waste water pump and then fed to the WES. The WES nozzles are located inside the flue gas duct between the air heater and electrostatic precipitator (ESP) of the No. 8 boiler. Waste water is sprayed through the WES nozzles, forming a fine mist which is mixed with flue gas. The fine mist is evaporated by the thermal energy of the flue gas. Both suspended and dissolved particles are dried to solids. The solids are removed by the ESP together with other fly ash particles.

Since the spray water uses the thermal energy of flue gas during evaporation, the quantity of spray water is controlled so that the temperature of the gas downstream of the WES is high enough to protect against sulfuric acid attack.

The total quantity of waste water is determined by the total chlorine content in the recirculating slurry. If the total quantity of waste water is equal to or less than the quantity sprayed through the WES, no disposal through the thickener overflow pump is required. If the total waste water quantity is greater than the quantity sprayed through the WES, the balance of waste water is disposed via the thickener overflow pump to Northern Indiana's waste water treatment system.

In the event that fly ash captured at the absorber is not completely recovered in the by-product gypsum, fly ash may accumulate in the dewatering loop. This will have an adverse effect on dewatering performance or gypsum quality. To avoid this condition, a portion of the thickener underflow slurry can be pumped to Northern Indiana's waste water treatment system by the thickener underflow pump.

However, when the flue gas condition of sulfur, chlorine and flyash content are such that the waste water discharge requirements are met by the WES and 100% of the fly ash is recovered in the by-product gypsum, a closed-loop operation will be demonstrated.

5. SECTION 500 LIMESTONE FEED SYSTEM

Major Equipment
Limestone Silo/Hydrated Lime Silo
Limestone Rotary Screw Pump
Limestone Pneumatic Blower/Limestone Unloading Blower

Limestone used as absorbent by the Flue Gas Desulfurization (FGD) system is supplied in a pulverized form and stored in two limestone silos. The limestone is fluidized by air and gravity feeds the rotary limestone feeders which are located at the bottom of each silo. The rotary feeders will meter the flow of limestone to an air slide conveying system.

The discharge of the air slide conveyors will gravity feed a rotary screw pump. The screw pump will in turn discharge material into a transfer line which will pneumatically convey the limestone to the absorber. Pressurized air for pneumatic transportation of limestone is produced by pneumatic air blowers.

Two independent limestone transfer systems, including piping, limestone rotary screw pumps, and limestone injection nozzles at the reaction tank, are supplied to each silo. This establishes a completely redundant system.

The feed quantity of limestone to the reaction tank is regulated by varying the rotating speed of the limestone feeder. The actuating signal is sent from the process control system by computing essential plant conditions, i.e. content of the absorber outlet flue gas, boiler load, and pH value of the recirculating slurry.

One hydrated lime silo is located adjacent to the limestone silos. Hydrated lime is fed to the reaction tank during upset conditions through the hydrated lime feeder, by the same pneumatic transport system. The feed pipes, injection nozzles, and air source for pneumatic transport are used in common with the limestone feed system by interconnecting the feed pipes.

6. SECTION 600 UTILITY SECTION

6.1 Process Water

Process water is supplied by Northern Indiana at a terminal point for process water make—up, by—product gypsum cake washing, and washing of the system during outages. Process water is also used for pump sealing. Consumption of process water is measured at the terminal point.

6.2 Closed Cycle Cooling System

Glycol coolant is supplied to the oxidation air blower, instrument air compressors and their cooler and dryers. The heat gained by glycol is heat exchanged with cooling water supplied by Northern Indiana. The cooled glycol is recycled to the cooling system.

6.3 Instrument Air

Two sets of instrument air compressor and dryer units (one is in service and the other is on stand-by) are installed to supply plant operating and control air.

6.4 Fire-Protection Water

Fire protection water is supplied by Northern Indiana at a terminal point and piped to the hose station and hydrant.

6.5 Emergency Quench Water System

The emergency quench water system protects the absorber during a total loss of power to the FGD system.

7. SECTION 700 SUMP SECTION

Major Equipment
Absorber Hold Tank
Absorber Sump
Thickener Sump
Absorber Hold Tank Sump

7.1 Absorber Hold Tank/Absorber Hold Tank Sump

The absorber hold tank is provided to receive and hold slurry in the event that

a) the reaction tank is drained, or
b) the waste water from the thickener overflow or underflow cannot be sent to Northern Indiana’s waste water treatment system, because the plant is operating, or
c) other situations when large amounts of slurry need to be transferred and stored.

Adjacent to the absorber hold tank, the absorber hold tank sump is provided to collect the hold tank drain and other drains around the sump.

7.2 Absorber Sump

The absorber sump is located near the reaction tank. When the reaction tank is drained, its contents are collected in the absorber sump and then pumped to the absorber hold tank simultaneously. All sealing water drains, washing water drains, and all other process drains for the absorber tank area are collected in the absorber sump and pumped to the reaction tank.

7.3 Thickener Sump

The thickener sump is located beneath the filtrate thickener. The sump is sized to hold the full volume of the filtrate thickener. Process drains around the dewatering area are collected in this sump and pumped to the filtrate thickener.

PURE AIR

Advanced Flue Gas Desulfurization Process

For

Northern Indiana Public Service Company

600 MW

Bailly Power Generating Station

Units 7 & 8

Public Design Reports

Section 6.6.1
Process Flow Diagram

DOE-CCT-2

PURE AIR

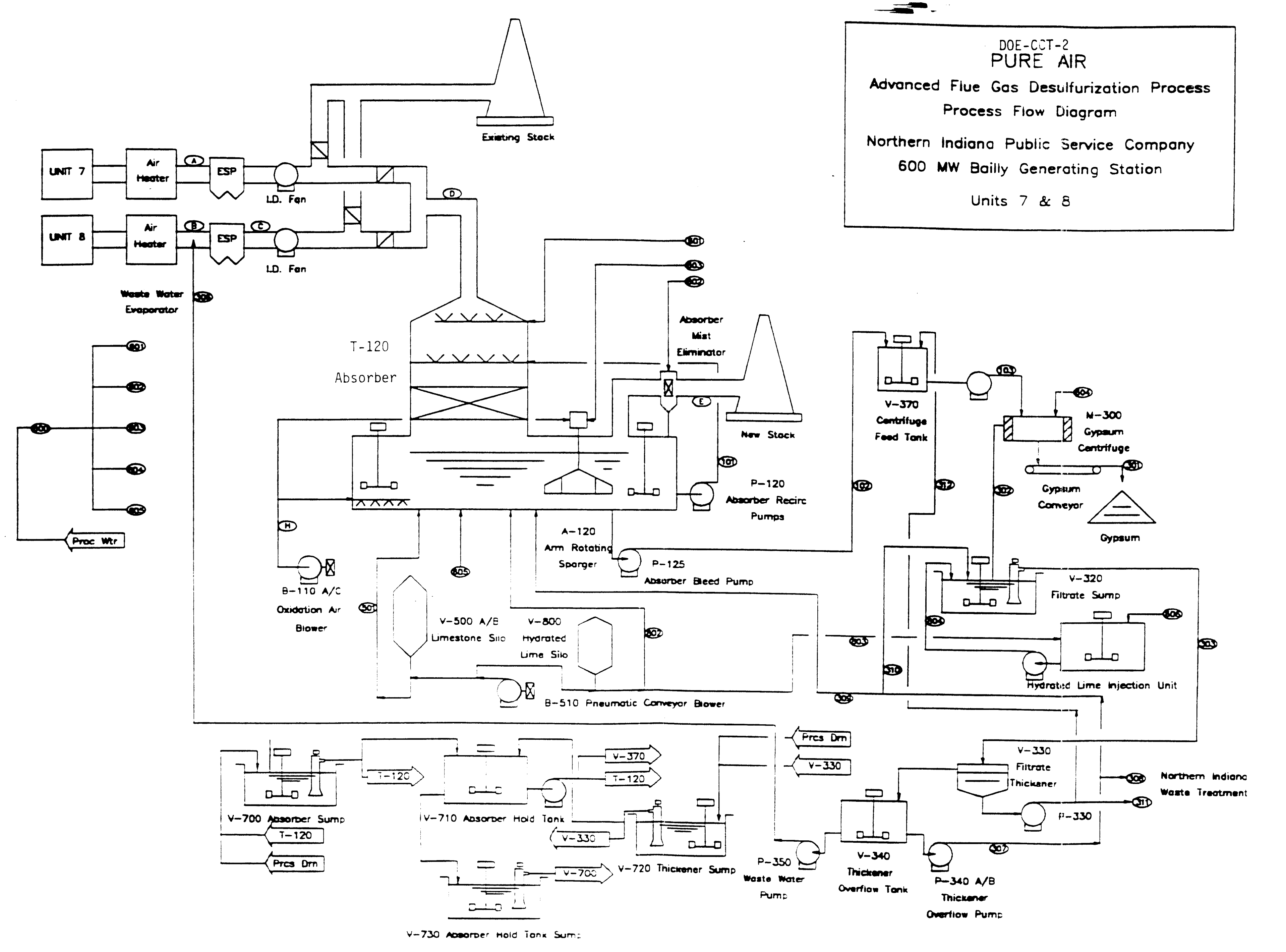
Advanced Flue Gas Desulfurization Process

Process Flow Diagram

Northern Indiana Public Service Company

600 MW Bailly Generating Station

Units 7 & 8



PURE AIR

Advanced Flue Gas Desulfurization Process

For

Northern Indiana Public Service Company

600 MW

Bailly Power Generating Station

Units 7 & 8

<u>Public Design Reports</u>

<u>Section 6.6.2</u>

<u>Stream Data</u>

Stream Data

Case No. 1 (Design Case With WES)

Conditions:

Fuel:	Coal	
S02:	95	% removal
S In Coal:	4.5	%
Load:	Full	
WES	In	Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	481,100	350.0	9.41	2932
B	923,000	350.0	9.75	3119
C	938,100	308.7	11.20	3119
D	1,419,200	322.7	10.60	3055
E	1,583,600	136.6	18.01	149

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	242,154.00	67,477.30	136.6	20.00	9.29
102	957.20	266.70	136.6	20.00	9.29
301	291.50	58.40	123.6	90.00	6.68
306	83.20	20.60	123.6	0.30	8.26
308	51.50	12.80	123.6	0.30	8.26
311	0.00	0.00	123.6	40.00	10.71
600	930.50	232.80	59.0	0.00	8.34
501	136.90	30.90	68.0	100.00	7.51
801	0.00	0.00	68.0	100.00	7.51

Stream Data

Case No. 2 (Design Case without WES)

Conditions:

Fuel:	Coal	
S02:	95	% removal
S In Coal:	4.5	%
Load:	Full	
WES	Out	Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	481,100	350.0	9.41	2932
B	923,000	350.0	9.75	3119
C	923,000	350.0	9.75	3119
D	1,404,100	350.0	9.63	3055
E	1,582,700	136.6	17.96	149

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	242,154.00	67,477.30	136.6	20.00	9.29
102	956.90	266.60	136.6	20.00	9.29
301	291.50	58.40	123.6	90.00	6.68
306	0.00	0.00	123.6	0.30	8.26
308	135.00	33.40	123.6	0.30	8.26
311	0.00	0.00	123.6	40.00	10.71
600	1,009.40	252.60	59.0	0.00	8.34
501	136.90	30.90	68.0	100.00	7.51
801	0.00	0.00	68.0	100.00	7.51

Stream Data

Case No. 3 (Normal Operation Case)

Conditions:

Fuel:	Coal	
S02:	95	% removal
S I n Coal:	3.6	%
Load:	Full	
WES	In	Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	502,100	350.0	8.81	2226
B	963,000	350.0	9.13	2368
C	978,100	310.3	10.53	2368
D	1,480,200	323.8	9.65	2319
E	1,638,900	135.0	17.23	114

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	220,140.00	61,398.10	135.00	20.00	9.30
102	763.90	213.00	135.00	20.00	9.30
301	232.90	46.60	122.20	90.00	6.68
306	83.20	20.60	122.20	0.30	8.26
308	51.70	12.80	122.20	0.30	8.26
311	0.00	0.00	122.20	40.00	10.71
600	919.30	230.00	59.00	0.00	8.34
501	109.20	24.60	68.00	100.00	7.51
801	0.00	0.00	68.00	100.00	7.51

Stream Data

Case No. 4 (Optimum Case)

Conditions:

Fuel:	Coal	
S02:	95	% removal
S In Coal:	3.1	%
Load:	Optimum	
WES	In	Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	399,200	350.00	9.74	2334
B	825,300	350.00	9.74	2335
C	838,800	308.70	11.19	2335
D	1,238,000	322.20	10.72	2335
E	1,369,300	136.20	17.85	115

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	220,140.00	61,343.00	136.20	20.00	9.29
102	636.60	177.40	136.20	20.00	9.29
301	194.20	38.90	123.30	90.00	6.68
306	74.40	18.40	123.30	0.30	8.26
308	42.90	10.60	123.30	0.30	8.26
311	0.00	0.00	123.30	40.00	10.71
600	766.10	191.70	59.00	0.00	8.34
501	90.70	20.50	68.00	100.00	7.51
801	0.00	0.00	68.00	100.00	7.51

Stream Data

Case No. 5 (Minimum Sulfur Case)

Conditions:

Fuel:	Coal	
S02:	95	% removal
S In Coal:	2.07	%
Load:	Full	
WES	In	Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	446,400	350.00	8.35	1228
B	851,100	350.00	8.68	1311
C	866,200	305.10	10.27	1311
D	1,312,600	320.40	9.62	1283
E	1,433,600	133.20	16.43	64

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	176,112.00	49,162.60	133.20	20.00	9.30
102	373.80	104.40	133.20	20.00	9.30
301	114.00	22.90	120.70	90.00	6.68
306	83.20	20.60	120.60	0.30	8.26
308	51.70	12.80	120.60	0.30	8.26
311	0.00	0.00	120.60	40.00	10.71
600	754.00	188.70	59.00	0.00	8.34
501	52.80	11.90	68.00	100.00	7.51
801	0.00	0.00	68.00	100.00	7.51

Stream Data

Case No. 6 (Minimum Load Case)

Conditions:

Fuel:	Coal	
S02:	95	% removal
S In Coal:	2.07	%
Load:	50 % Load on Unit 7	
WES	Out	Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	179,100.00	350.00	9.58	1560
B	0	32.00	0.00	0
C	0	32.00	0.00	0
D	179,100	350.00	9.58	1560
E	198,500	135.30	14.42	77

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	88,056.00	24,559.20	135.30	20.00	9.30
102	62.20	17.30	135.30	20.00	9.30
301	18.90	23.40	122.50	90.00	6.68
306	0.00	0.00	122.50	0.30	8.26
308	19.20	4.80	122.50	0.30	8.26
311	0.00	0.00	122.50	40.00	10.71
600	118.00	29.50	59.00	0.00	8.34
501	8.80	2.00	68.00	100.00	7.51
801	0.00	0.00	68.00	100.00	7.51

Stream Data

Case No. 7 (Permit (Worst) Case)

Conditions:

Fuel:	Coal
S02:	84.60 % removal
S In Coal:	4.5 %
Load:	Full
WES	Out Service

1. Gas Streams

Stream No.	Flow Rate (SCFM)	Temp (Deg F)	Water (Vol %)	S02 (ppm-D)
A	468,300.00	280.00	9.41	2932
B	898,200	280.00	9.75	3119
C	898,200	280.00	9.75	3119
D	1,366,500	280.00	9.63	3055
E	1,494,000	131.90	15.93	462

2. Liquid and Solids

Stream No.	Flow Rate (GPM)	Flow Rate (TPH)	Temp (Deg F)	Slurry Conc (wt%)	Density (lb/gal)
101	242,154.00	24,559.20	131.9	20.00	9.30
102	846.80	17.30	131.9	20.00	9.30
301	243.50	23.40	115.9	90.00	6.68
306	0.00	0.00	115.9	0.30	8.26
308	116.60	29.80	115.9	0.30	8.26
311	0.00	0.00	115.9	40.00	10.71
600	747.90	187.10	59.0	0.00	8.34
501	118.90	26.70	68.0	100.00	7.51
801	0.00	0.00	68.0	100.00	7.51

PURE AIR

Advanced Flue Gas Desulfurization

For

Northern Indiana Public Service Company

600 MW

Bailly Power Generating Station

Units 7 & 8

Public DesignReports

Section 6.6.3

Equipment List

Section 100 Absorption

Item	Service	No. Req'd	Description
A-120 A/C	Air Sparger	3	Type: Arm Rotary Sparger Capacity: 13,200 SUM
A-120D	Stationery Air Sparger	1	Capacity: 18,300 SUM
B-100 A/D	Oxidation Air Blower	3 + 1	Type: Centrifuges Capacity: 10,500 SUM
E-120	Absorber Mist Eliminator	1	Type: 1st) Chevron 2nd) Chevron Size: 561 - 5"W x 36’ - 1”H No of Stage: 2
P-120 A/L	Absorber Recircu-lation Pump	11 + 1	Type: Centrifugal Capacity: 22,000 GPM
P-125 A/B	Absorber Bleed Pump	1 + 1	Type: Centrifugal Capacity: 1,760 GPM
T-120	Absorber	1	Type: Vertical Co-current Grid Tower Size: Tower: 56’ - 5"W x 26’ - 11"L Tank: 92’ - 6”D x 23’ - 11”H

Section 300 Dewatering

Item	Service	No. Req'd	Description
C-310 A/B	No. 1 Gypsum Conveyor	2	Type: Belt Conveyor Capacity: 161 s.ton/h-wet cake
C-311	No.2 Gypsum Conveyor	1	Type: Belt Conveyor Capacity: 161 s.ton/h-wet cake
M-300	Gypsum Centrifuge	8 + 1	Type: Basket Type Capacity: 2,975 lb/batch wet cake
P-320 A/B	Filtrate Sump Pump	1 + 1	Type: Centrifugal Capacity: 1,520 GPM
P-330 A/B	Thickener Underflow Pump	1 + 1	Type: Centrifugal Capacity: 97 GPM
P-340 A/B	Thickener Overflow Pump	1 + 1	Type: Centrifugal Capacity: 1,615
GPM			
P-350	Waste Water Pump	1	Type: Horizontal Centrifugal Capacity: 101 GPM
P-370 A/B	Centrifuge Feed Pump	1 + 1	Type: Vertical Centrifugal Capacity: 1,830 GPM

V-300	Centrifuge Head Tank	1	Type: Vertical Cylindrical Volume: 17CF
V-320	Filtrate Sump	1	Type: Underground pit Volume: 12,124 CF
V-330	Filtrate Thickener	1	Type: Gravity Sedimentation Volume: 12,344 CF
V-340	Thickener Overflow Tank	1	Type: Vertical Cyclindrical Volume: 2,651 CF

Section 500 Limestone Preparation

Item	Service	No. Req'd	Description
B-510 A/B	Limestone Pneumatic Blower	1 + 1	Type: Centrifugal Capacity: 2391 SCFM
M-500 A/B	Limestone Feeder	2	Type: Table Feeder Capacity: 33 ton/H
M-530 A/B	Solid Screw Pump	2	Type: Screw Pump Capacity: 38 ton/h
V-500 A/B	Limestone Silo	2	Type: Vertical Cylindrical Effective Volume: 41,000 CF
B-520 A/C	Limestone Unloading Blower	2 = I	Type: Roots Capacity: 50 TPH

Section 700 Sump

Item	Service	No. Req' d	Description
P-700 A/B	Absorber Sump Pump	1 + 1	Type: Vertical Centrifugal Capacity: 920 GPM (209 m^3/H)
V-700	Absorber Sump	1	Type: Underground Pit Volume: 2,611 CF
V-710	Absorber Hold Tank Pump	1	Type: Centrifugal Capacity: 1,090 GPM
P-710	Absorber Hold Tank Pump	1	Type: Vertical Cyclindrical Volume: 109,500 CF
P-720	Thickener Sump Pump	1 + (1)	Type: Vertical Centrifugal Capacity: 135 GPM
V-720	Thickener Sump	1	Type: Underground Pit Volume: 12,405 CF
P-730	Absorber Hold Tank Sump Pump	1	Type: Vertical Centrifuge Capacity: 90 GPM (21 m3/H)
V-730	Absorber Hold Tank Sump Pump	1	Type: Underground Pit Volume: 352 CF

Section 800 Additive

Item	Service	No. Req'd	Description
B-800	Hydrated Lime Silo Blower	3	Type: Roots
M-800	Hydrated Lime Feeder	1	Type: Table Feeder
			Capacity: 10 s.ton/H
V-800	Hydrated Lime Silo	1	Type: Vertical Cyclindrical
		Volume	