FAILURE MODE ANALYSIS FOR LIME/LIMESTONE FGD SYSTEMS

VOLUME III - PLANT PROFILES
Part 2 of 3

By
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H. S. Rosenberg
L-I. O. Nilsson
J. H. Oxley

August 1984

For
U. S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Battelle
Columbus Laboratories
Columbus, Ohio

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Price: Printed Copy A99
Microfiche A01

Codes are used for pricing all publications. The code is determined by the number of pages in the publication. Information pertaining to the pricing codes can be found in the current issues of the following publications, which are generally available in most libraries: *Energy Research Abstracts (ERA)*; *Government Reports Announcements and Index (GRA and I)*; *Scientific and Technical Abstract Reports (STAR)*; and publication NTIS-PR-360 available from NTIS at the above address.

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Under Contract No.: W-7405-Eng-92-122

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INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

Indianapolis Power & Light
Petersburg 3

SECTION 1

BACKGROUND

The Petersburg Power Station, owned and operated by the Indianapolis Power and Light Company (IPALCO), is located near Petersburg, Indiana, approximately 100 miles southwest of Indianapolis. The station consists of three coal-fired, steam-turbine generating units which have a combined generating capacity of 1180 MW (net). Each boiler fires Indiana bituminous coal with an average sulfur content of 3.25%. Of the three operational units, only Petersburg 3, rated at 532 MW (gross), is required to comply with the 1971 Federal NSPS. Because of this, a contract was awarded to the Air Correction Division, UOP in early 1975 to supply a wet limestone FGD system. Research Cottrell was contracted to supply two parallel ESP's for primary particulate matter control.

The original FGD system design included four parallel mobile bed packed towers. These were operated such that the recirculating absorber slurry was maintained in the 5.6 to 5.9 range. Because of recurring problems centering around the packing material (10 to 12 inch thick layers of 1.25 inch diameter balls), the material was removed in January 1981. At present the gas contacting area is limited to that supplied by the grids

Indianapolis Power & Light
Petersburg 3

which had supported the packing. To improve SO₂ removal efficiency, which dropped as a result of the packing material removal, the pH operating level was increased to 6.2 and the limestone slurry grind was increased from about 65 to 90⁺% through a 200 mesh. To further improve SO₂ removal efficiency and gas distribution IPALCO is considering the installation of sieve trays in the absorbers.

SECTION 2

PROCESS DESCRIPTION

The Petersburg emission control system consists of two parallel, cold-side ESP's for primary particulate control and a wet limestone FGD system for control of SO₂ emissions. The FGD system consists of four turbulent contact absorber (TCA) modules, each designed to handle 25% of the boiler flue gas flow of 2,250,000 ACFM at 279°F.

The flue gas enters the two ESP's, which remove 99.3% of the inlet particulate matter. Two forced draft fans then boost the gas through the four absorbers. In each module, gas rises through three grid levels (originally installed to support mobile bed packing). Limestone slurry is sprayed down on the grids so that it contacts the flue gas in a countercurrent fashion. The scrubbed, saturated gas then passes through an irrigation type-trapout tray for the removal of the bulk of the entrained solids followed by two chevron mist eliminators. The gas is then reheated to approximately 148°F by an indirect hot air injection reheater. The gases pass to a common plenum and are then discharged to a 616 foot stack.

Spent scrubbing slurry is discharged from the absorbers to a reaction tank, where chemical reactions are completed. Flue

Indianapolis Power & Light
Petersburg 3

gas cleaning wastes are bled from the reaction tank to a waste slurry tank. A continuous stream is bled from the waste slurry tank and discharged to a thickener, where the waste solids settle out. Thickener overflow is returned to the process and thickener underflow is discharged to an IUCS installation for chemical fixation. Clarified water from the vacuum filters at the IUCS facility is returned to the process for further use. The fixated sludge is transported by conveyor to trucks that deliver the material to an onsite, unlined, side-hill landfill.

A flow diagram for the Petersburg 3 FGD system is shown on the next page.

Flow Diagram: Petersburg 3

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

GENERAL PLANT INFORMATION

COMPANY NAME: INDIANAPOLIS POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: PETERSBURG
UNIT NUMBER: 3
PLANT ADDRESS: P.O. BOX 436
CITY: PETERSBURG
COUNTY: PIKE
STATE: INDIANA
ZIP CODE: 47567

EPA REGION: 5

RIVER BASIN/LAKE REGION: WHITE

REGULATORY CLASSIFICATION: NSPS (12/71)

PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1

SO2 EMISSION LIMITATION - LB/MM BTU: 1.2

NOX EMISSION LIMITATION - LB/MM BTU: 0.7

NET PLANT GENERATING CAPACITY - MW: 1180

GROSS UNIT GENERATING CAPACITY - MW: 532

NET UNIT GENERATING CAPACITY WITH FGD - MW: 515

NET UNIT GENERATING CAPACITY W/O FGD - MW: 528

A EQUIVALENT SCRUBBED CAPACITY - MW: 532

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING

FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL

FURNACE FIRING METHOD: TANGENTIAL

WET BOTTOM/DRY BOTTOM: WET BOTTOM

FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED

SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE

COMMERCIAL SERVICE DATE: 1977

DESIGN BOILER FLUE GAS FLOW - ACFM: 2,250,000

FLUE GAS TEMPERATURE - F: 279

FLUE GAS OXYGEN - %: 5

HEAT RATE - BTU/KWH: 10,000

DESIGN FIRING RATE - TPH: 223

EXCESS AIR - %: >25

CAPACITY FACTOR - %: 68 (1980)

STACK HEIGHT - FT: 616

SHELL MATERIAL: CONCRETE

FLUE MATERIAL GENERIC TYPE: CARBON STEEL

FLUE MATERIAL SPECIFIC TYPE: AISI 1110

FLUE MATERIAL TRADE/COMMON NAME: N/A

FLUE LINER MATERIAL GENERIC TYPE: ORGANIC

FLUE LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER

B FLUE LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

FLUE INNER DIAMETER - FT: 20

STACK GAS INLET TEMPERATURE - F: 150

STACK GAS OUTLET VELOCITY - FT/SEC: 89

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: PEABODY COAL CO.

C MINE NAME/AREA: LYNVILLE

MINE LOCATION - COUNTY: WARRICK

MINE LOCATION - STATE: INDIANA

AVERAGE HEAT CONTENT - BTU/LB: 10,750

RANGE HEAT CONTENT - BTU/LB: 10,200-11,100

AVERAGE ASH CONTENT - %: 10.5

RANGE ASH CONTENT - %: 8-12

AVERAGE MOISTURE CONTENT - %: 10.5-11

RANGE MOISTURE CONTENT - %: 10.5-16.5

AVERAGE SULFUR CONTENT - %: 3.25

RANGE SULFUR CONTENT - %: 2.8-4.5

D AVERAGE CHLORIDE CONTENT - %: _____

RANGE CHLORIDE CONTENT - %: _____

FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL

FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED

SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE

NUMBER OF SPARES:

TYPE:

SUPPLIER:

INLET FLUE GAS CAPACITY - ACFM:

INLET FLUE GAS TEMPERATURE - F:

PRESSURE DROP - IN. H2O:

PARTICLE OUTLET LOAD - GR/SCF:

PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2

NUMBER OF SPARES: 0

TYPE (HOT SIDE/COLD SIDE): COLD SIDE

SUPPLIER: RESEARCH-COTTRELL

E INLET FLUE GAS CAPACITY - ACFM: 983,500

INLET FLUE GAS TEMPERATURE - F: 279

PRESSURE DROP - IN. H2O: 1.72

PARTICLE OUTLET LOAD - GR/SCF: 0.03

PARTICLE REMOVAL EFFICIENCY - %: 99.3

FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE

NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIMESTONE
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: AIR CORRECTION DIVISION, UOP
A-E FIRM: GIBBS & HILL
CONSTRUCTION FIRM: AIR CORRECTION DIVISION, UOP
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.3
SO₂ DESIGN REMOVAL EFFICIENCY - %: 85
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

COMMERCIAL START-UP: 12/77
INITIAL START-UP: 12/77
CONSTRUCTION COMPLETION: 5/77
CONSTRUCTION INITIATION: 10/75
CONTRACT AWARDED: 1/75
LETTER OF INTENT SIGNED: 5/75
INITIATED BID REQUEST: 5/75
INITIATED PRELIMINARY DESIGN: 5/75

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.5
DESIGN COAL HEAT CONTENT - BTU/LB: 10,750
DESIGN COAL ASH CONTENT - %: 8-15
DESIGN COAL MOISTURE CONTENT - %: 12
DESIGN COAL CHLORIDE CONTENT - %: 0.06
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
F FGD SYSTEM TURNDOWN RATIO: 3.3:1
FGD SYSTEM TURNDOWN METHOD: TAKE TRAINS OFF LINE
FGD SYSTEM PRESSURE DROP - IN. H2O: 17
FGD SYSTEM OXIDATION - %: 12
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 7-15
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): LOWER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 120
G FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 5
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE H PERSONNEL/SHIFT): 14
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1
I FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): 2400
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): DEDICATED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
J ROTATION TO FGD SYSTEM: EVERY 6 MONTHS
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): DEDICATED
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
K RESTRICTIONS TO USING BYPASS: THERE IS NO RESTRICTION AS LONG AS THE UNIT REMAINS IN COMPLIANCE
L TIME SCHEDULE FOR REDUCED BOILER LOAD: FROM MIDNIGHT TO 5:00 A.M. EVERY NIGHT
TIME SCHEDULE FOR BOILER SHUTDOWNS: 2 WEEKS EVERY 6 MONTHS
PLANNED MAINTENANCE DURING REDUCED BOILER LOAD (TYPE AND FREQUENCY): MODULES ARE CLEANED AS REQUIRED. THIS TYPICALLY INCLUDES SPRAY NOZZLES AND INSIDE DAMPERS.
PLANNED MAINTENANCE DURING BOILER SHUTDOWNS (TYPE AND FREQUENCY): MAINTENANCE IS PERFORMED ON AN AS-NEEDED BASIS. DAMPER SEALS ARE USUALLY REPAIRED AT EVERY BOILER OUTAGE.
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE): MODULE CLEANING

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: 4
NUMBER OF SPARES: 0
TYPE: HORIZONTAL SPRAY CHAMBER
LOCATION: AT THE INLET TO THE ABSORBER
SUPPLIER: AIR CORRECTION DIVISION, UOP
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
M LINER MATERIAL GENERIC TYPE: INORGANIC
LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED CONCRETE
LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8
INLET GAS FLOW - ACFM: 562,500
INLET GAS TEMPERATURE - F: 280-286
PRESSURE DROP - IN. H2O: _____
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER,
ABSORBER SLURRY, ETC.): RECLAIMED WATER (THICKENER SUPERNATANT)
LIQUID RECIRCULATION RATE - GPM: 250
L/G RATIO - GAL/1000 ACF: 0.4
NUMBER OF SPRAY HEADERS: 20
NOZZLE MATERIAL: CARPENTER 20
NOZZLE PRESSURE DROP - PSI: _____

ABSORBER

NUMBER OF ABSORBERS: 4
NUMBER OF SPARES: 0
GENERIC TYPE: PACKED TOWER
SPECIFIC TYPE: MOBILE BED PACKING
TRADE/COMMON NAME: TURBULENT CONTACT ABSORBER
SUPPLIER: AIR CORRECTION DIVISION, UOP
DIMENSIONS - FT: 18 X 30 X 100
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: SYNTHETIC RUBBER
LINER MATERIAL TRADE/COMMON NAME: NEOPRENE LS-576
BOILER LOAD PER ABSORBER - %: 25
N GAS/LIQUID CONTACT DEVICE TYPE: GRIDS
NUMBER OF GAS CONTACTING ZONES: 3
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: 12
NUMBER OF SPRAY HEADERS: 24
NOZZLE MATERIAL: SILICON CARBIDE
NOZZLE PRESSURE DROP - PSI: _____
LIQUID RECIRCULATION RATE - GPM: 22,000
L/G RATIO - GAL/1000 ACF: 50 TO 55
GAS-SIDE PRESSURE DROP - IN. H2O: 8.5
SUPERFICIAL GAS VELOCITY - FT/SEC: 14.5
ABSORBER TURNDOWN RATIO: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM: 375,000
INLET GAS TEMPERATURE - F: 118
O INLET SO2 LEVEL - PPM: 2600
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: 0.03
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 118
P OUTLET SO2 LEVEL - PPM: <350
OUTLET SO2 LEVEL - LB/MM BTU: <1.2
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: <0.01
SO2 REMOVAL EFFICIENCY - %: >80
PARTICLE REMOVAL EFFICIENCY - %: ~99 (OVERALL)

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: (A) 4 (B) 8
NUMBER OF SPARES: 0
NUMBER PER MODULE: (A) 1 (B) 2
GENERIC TYPE: (A) KNOCK-OUT (B) IMPINGEMENT
SPECIFIC TYPE: (A) TRAP OUT TRAY (B) RAFFIE
COMMON DESIGN: (A) IRRIGATION TRAY (B) CLOSED VANE CHEVRON
MANUFACTURER: STRUCTURE-LITE (UOP HAS PATENT)
CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): Z-SHAPE
NUMBER OF STAGES: (B) N/A
NUMBER OF PASSES/STAGE: (B) 3 AND 4 RESPECTIVELY
Q FREEBOARD DISTANCE - FT: (B) 3
R DISTANCE BETWEEN STAGES - IN.: 24
DISTANCE BETWEEN VANES - IN.: _____
VANE ANGLES - DEGREES: 90
PRESSURE DROP - IN. H2O: _____
SUPERFICIAL GAS VELOCITY - FT/SEC: _____
CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC (BOTH)
CONSTRUCTION MATERIAL SPECIFIC TYPE: FIBER REINFORCED POLYESTER (BOTH)
CONSTRUCTION MATERIAL TRADE/COMMON NAME: HETRON® 197 RESIN (BOTH)
S WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): THICKENER OVERFLOW,
MAKEUP, AND TRAP-OUT
TRAY RETURN BLEND
POINT OF WATER COLLECTION: WASH WATER TANK BETWEEN EVERY TWO ABSORBER
MODULES
T WASH DIRECTION (OVERSPRAY/UNDERSPRAY,
FRONTSpray/BACKSPRAY): (A) UNDERSPRAY
(B) UNDERSPRAY AND OVERSPRAY FOR FIRST STAGE
WASH FREQUENCY: (A) EVERY 30 MINUTES (B) CONTINUOUS
WASH DURATION: (A) 2 MINUTES (B) N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

WASH RATE - GAL/MIN: _____

WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

U NUMBER OF REHEATERS: 2

NUMBER OF SPARES: 0

NUMBER PER MODULE: 1 PER 2 MODULES

V GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): INDIRECT
HOT AIR

SPECIFIC TYPE (STEAM, HOT WATER, ETC.): EXTERNAL HEAT EXCHANGER

COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): STEAM TUBE BUNDLE

COMBUSTION FUEL SULFUR CONTENT - %: N/A

LOCATION: EXTERNAL

AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE

TEMPERATURE INCREASE - F: 30

INLET FLUE GAS FLOW RATE - ACFM: 317,000

INLET FLUE GAS TEMPERATURE - F: 118

W OUTLET FLUE GAS FLOW RATE - ACFM: 158,500

OUTLET FLUE GAS TEMPERATURE - F: 148

ENERGY REQUIREMENT - MM BTU/HR:

NUMBER OF HEAT EXCHANGER BANKS: ~~1~~ PER 2 MODULES

NUMBER OF BUNDLES PER BANK: 1

NUMBER OF TUBES PER BUNDLE: 565

STEAM OR WATER PRESSURE - PSIG: 187

STEAM OR WATER TEMPERATURE - F: 365

SELF CLEANING DEVICE TYPE: NONE

MATERIAL GENERIC TYPE: CARBON STEEL

MATERIAL SPECIFIC TYPE: AISI 1110

MATERIAL TRADE/COMMON NAME: N/A

FANS

NUMBER OF FANS: 2

NUMBER OF SPARES: 0

DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL

SUPPLIER: STURTEVANT DIV., WESTINGHOUSE

FUNCTION (UNIT/BOOSTER): BOOSTER

APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT

SERVICE (WET/DRY): DRY

TYPE OF WASH: NONE

LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND QUENCHER

X FLUE GAS FLOW RATE - ACFM: 475,000

FLUE GAS TEMPERATURE - F: 279

PRESSURE DROP - IN. H2O: _____

MATERIAL GENERIC TYPE: CARBON STEEL

MATERIAL SPECIFIC TYPE: AISI 1110

MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: INLET, OUTLET, AND BYPASS

Y NUMBER OF DAMPERS: 16

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

FUNCTION (CONTROL/SHUT-OFF): SHUT-OFF (EXCEPT BYPASS WHICH IS CONTROL)
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): GUILLOTINE
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): BYPASS IS HORIZONTAL
SIDE-ENTRY

TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER):
MANUFACTURER: MODULE OUTLETS ARE MOSSER; ALL OTHERS ARE ANDCO
MODULATION (OPEN/CLOSED, ETC.): OPEN/CLOSED
SEAL AIR - ACFM:

SERVICE CONDITIONS (MAX GAS TEMP/TIME):
MATERIAL GENERIC TYPE: CARBON STEEL WITH HIGH ALLOY SEALS
MATERIAL SPECIFIC TYPE: AISI 1110; IRON BASE/NICKEL-CHROMIUM-COPPER-
MOLYBDENUM

Z MATERIAL TRADE/COMMON NAME N/A; CARPENTER 20
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) CIRCULAR (B) CIRCULAR
(C) RECTANGULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.): (A) 16 FT DIA (B) 18 FT DIA
(C) 16 FT X 20 FT

SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) NONE
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) GLASS FLAKE-FILLED POLYESTER
(C) GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: (A) N/A
(B) RESISTA-FLAKE 1150AR
(C) RIGIFLAK 4850

EXPANSION JOINTS

LOCATION: AT STACK
AA TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS
PRESSURE (NEGATIVE/POSITIVE): POSITIVE
OPERATING TEMPERATURE - F: <200 F
DESIGN CONFIGURATION (V-SHAPED, ETC.): U-SHAPED
MANUFACTURER: RAYBESTOS-MANHATTAN
MATERIAL: RUBBER

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIMESTONE GRINDING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): WET BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): COMPARTMENTED
MANUFACTURER: KENNEDY VAN SAUN
MATERIALS: CARBON STEEL WITH RUBBER LINING
NUMBER OF DEVICES: 1

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NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: 42
PRODUCT QUALITY - % SOLIDS: 35
BB FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM:
PREPARED REAGENT POINT OF ADDITION: RECYCLE TANK
ON-SITE STORAGE CAPABILITY - DAYS: 90

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) SLURRY
(B) RECLAIMED WATER AND ME WASH
(C) SMALLER SIZED PIPING IN SCRUBBER AREA

DIMENSIONS - IN.: (A) 24 DIA (B) 6 AND 8 DIA (C) <6

MANUFACTURER:

CC MATERIAL: (A) RUBBER-LINED CARBON STEEL (B) FRP
(C) KELOLITE POLYPROPYLENE-LINED CARBON STEEL

MAJOR VALVES

LOCATION: (A) GENERAL (B) ME WASH (C) RECLAIMED AND MAKE UP WATER

FUNCTION (ISOLATION, CONTROL, ETC.): (A) _____ (B) _____
(C) ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): (A) KNIFEGATE (B) ECCENTRIC PLUG
(C) BUTTERFLY

DD CONTROL MODE (AUTOMATIC/MANUAL): MANUAL

DIMENSIONS - IN.:

MANUFACTURER: (A) HILTON (B) DEZURIK (C) KEYSTONE

MATERIAL: (A) STAINLESS STEEL (B) CAST STEEL (C) RUBBER-LINED

THICKENERS

NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 165 DIA X 12

CAPACITY - GAL: 2,000,000

SHELL MATERIAL GENERIC TYPE: CARBON STEEL WALLS AND INORGANIC BOTTOM

SHELL MATERIAL SPECIFIC TYPE: AISI 1110; HYDRAULICALLY-BONDED CONCRETE

SHELL MATERIAL TRADE/COMMON NAME: N/A; PORTLAND CEMENT

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: COAL TAR EPOXY

EE LINER MATERIAL TRADE/COMMON NAME: CARBOMASTIC 14

RAKE MATERIAL:

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 7-15%
SOLIDS

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FF OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 28%
SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: TO VACUUM FILTER

GG OVERFLOW STREAM DISPOSITION: TO QUENCHER, ME WASH TANK, BALL MILL, AND
RECYCLE TANK

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): DRUM

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): ROTARY DRUM

NUMBER OF DEVICES: 2

HH NUMBER OF SPARES: 0

CONFIGURATION: HORIZONTAL

DIMENSIONS - FT: 10 DIA X 20.5

CAPACITY:

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: COAL TAR EPOXY

II LINER MATERIAL TRADE/COMMON NAME: CARBOMASTIC

BELT MATERIAL GENERIC TYPE: ORGANIC

JJ BELT MATERIAL SPECIFIC TYPE: POLYPROPYLENE

BELT MATERIAL TRADE/COMMON NAME: N/A

FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.): THICKENER
UNDERFLOW

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 28% SOLIDS

KK OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 55%
SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: SLUDGE STABILIZATION

OVERFLOW STREAM DISPOSITION: RETURNED TO SYSTEM

SLUDGE

LL FULL LOAD QUANTITY - TPH/DRY: 42

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAO2 - DRY: _____

PERCENT CACO3 - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

MM METHOD: POZ-O-TEC

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): VACUUM FILTER PRODUCT

DEVICE (OXIDATION TANK, PUG MILL, ETC.): PUG MILL

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): IUCS

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INLET FLOW RATE - GPM: _____
INLET QUALITY - % SOLIDS: 55-65

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): LANDFILL
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): SIDE HILL
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): N/A
LOCATION (ON-SITE/OFF-SITE): ON-SITE
NN TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): TRUCK
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE
SITE DIMENSIONS - AREA/DEPTH: _____
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
OO SITE SERVICE LIFE - YEARS: 7-8

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: ABSORBER RECYCLE
CHEMICAL PARAMETERS (PH, ETC.): PH, INLET SO₂, OUTLET SO₂ AT STACK
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): FLUE GAS OUTLET FLOW
PP CONTROL LEVELS: PH 5.5-5.9 IN SCRUBBING LIQUOR
MONITOR TYPE (MANUFACTURER, ETC.): LEEDS & NORTHRUP
MONITOR LOCATION: RECYCLE SLURRY LINE
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): MANUAL
QQ PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN
TYPE (OPEN/CLOSED): CLOSED
RR EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
SS RECEIVING WATER STREAM NAME: NONE
TT MAKEUP WATER ADDITION - GPM: 882
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): RIVER WATER
MAKEUP WATER ADDITION POINTS & AMOUNTS: MIST ELIMINATOR WASH TANK
MAKEUP WATER PRE-TREATMENT TYPE: SCREENED

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIMESTONE
PRINCIPAL CONSTITUENTS: 96% CaCO₃, 3% MgCO₃
SOURCE/SUPPLIER: SOUTHERN INDIANA QUARRY
SUPPLIER LOCATION: SOUTHERN INDIANA
UU CONSUMPTION (SPECIFY UNITS): 500 TPD
UTILIZATION - %: 83
POINT OF ADDITION: BALL MILL

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ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 79,100,000
CAPITAL COST - \$/KW: 149
OPERATING COST - MILLS/KWH: 5.15
MAINTENANCE COST: \$3,640,000/YR
LABOR COST: \$290,000/YR
UTILITIES COST: \$4,300,000/YR
CHEMICALS COST: \$1,680,000/YR
WASTE DISPOSAL COST: \$2,120,000/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: 0
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: _____
VACUUM FILTER - %: ~50
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: 0
SLAKER: N/A
EFFLUENT HOLD TANK: 0
VV RECIRCULATION PUMP: 0.5
THICKENER: 0
VACUUM FILTER: 0
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): LIMESTONE SLURRY STORAGE

NUMBER OF TANKS: 2

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): OPEN

LOCATION: LIMESTONE PREPARATION AREA

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 26 DIA X 35

CAPACITY - GAL: 139,000

WW RETENTION TIME - MIN: 480

XX NUMBER OF AGITATORS: 1

AGITATOR CONFIGURATION: TOP ENTRY

AGITATOR MATERIALS: RUBBER CLAD CARBON STEEL

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): WASTE SLURRY

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): OPEN

LOCATION: ABSORBER AREA

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 12 DIA X 12

CAPACITY - GAL: 10,000

RETENTION TIME - MIN: 6.5

YY NUMBER OF AGITATORS: 1

AGITATOR CONFIGURATION: TOP ENTRY

AGITATOR MATERIALS: RUBBER-LINED CARBON STEEL

SHELL MATERIAL GENERIC TYPE: INORGANIC

SHELL MATERIAL SPECIFIC TYPE: HYDRAULICALLY-BONDED CONCRETE

SHELL MATERIAL TRADE/COMMON NAME: PORTLAND CEMENT

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECYCLE

NUMBER OF TANKS: 4

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): COVERED

LOCATION: ABSORBER AREA

CONFIGURATION: CIRCULAR

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DIMENSIONS - FT: 40 DIA X 26
CAPACITY - GAL: 245,000
RETENTION TIME - MIN: 9
ZZ NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: RUBBER CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
AAA LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): THICKENER OVERFLOW (RECLAIM WATER)
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: THICKENER AREA
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 24 DIA X 8
CAPACITY - GAL: 27,000
RETENTION TIME - MIN: 18
NUMBER OF AGITATORS: NONE
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: COAL TAR EPOXY
LINER MATERIAL TRADE/COMMON NAME: CARBOMASTIC 14

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY TRANSFER
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: NEAR BALL MILL
CONFIGURATION: RECTANGULAR
DIMENSIONS - FT: 5 X 6 X 6
CAPACITY - GAL: 11,000
RETENTION TIME - MIN: 1.5
BBB NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: STAINLESS STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110

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SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ME WASH
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: ABOVE CENTER OF SCRUBBER MODULE AREA
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 12 DIA X 12
CAPACITY - GAL: 10,000
RETENTION TIME - MIN: 5
NUMBER OF AGITATORS: 0
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: ORGANIC
SHELL MATERIAL SPECIFIC TYPE: FIBER REINFORCED POLYESTER
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 12

NUMBER OF SPARES: 4

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

MANUFACTURER: DENVER

CCC PUMP MODEL NUMBER: SRL-C

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 11,800

MOTOR BRAKE HP: 375

SPEED - RPM: _____

HEAD - FT: 100

DDD SERVICE (PH, SOLIDS): PH 5.6-5.9, 7-15% SOLIDS

CASING MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)

CASING MATERIAL SPECIFIC TYPE: AISI 1110

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: CAST IRON (RUBBER-LINED)

IMPELLER MATERIAL SPECIFIC TYPE: DUCTILE IRON

IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLURRY TRANSFER

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

MANUFACTURER: GALIGHER

PUMP MODEL NUMBER: 4VRG-200

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 570

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: 130

SERVICE (PH, SOLIDS): PH 7, 49% SOLIDS

CASING MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)

CASING MATERIAL SPECIFIC TYPE: AISI 1110

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)

IMPELLER MATERIAL SPECIFIC TYPE: AISI 1110

IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): WASTE SLURRY

EEE NUMBER OF PUMPS: 4

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NUMBER OF SPARES: 2
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 8-R-193 MN
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 1050 (2100 PER SET)
MOTOR BRAKE HP: 100
SPEED - RPM: 925
HEAD - FT: 100 (200 PER SET)
SERVICE (PH, SOLIDS): PH 5.6-5.9, 7-15% SOLIDS
CASING MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)
CASING MATERIAL SPECIFIC TYPE: AISI 1110
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)
IMPELLER MATERIAL SPECIFIC TYPE: AISI 1110
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLURRY MAKE-UP
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 4-R-122
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 550
MOTOR BRAKE HP: _____
SPEED - RPM: 1175 MAX
HEAD - FT: 70
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)
CASING MATERIAL SPECIFIC TYPE: AISI 1110
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)
IMPELLER MATERIAL SPECIFIC TYPE: AISI 1110
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: WORTHINGTON

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PUMP MODEL NUMBER: 4-R-122
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 550
MOTOR BRAKE HP: _____
SPEED - RPM: 1175
HEAD - FT: 70
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)
CASING MATERIAL SPECIFIC TYPE: AISI 1110
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL (RUBBER-LINED)
IMPELLER MATERIAL SPECIFIC TYPE: AISI 1110
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED,
ABSORBER RECIRCULATION, ETC.): RECLAIMED WATER (THICKENER OVERFLOW)
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS

FFP PUMP MODEL NUMBER: 3175M
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 1554
MOTOR BRAKE HP: 250
SPEED - RPM: 1780
HEAD - FT: 300
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: STAINLESS STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: STAINLESS STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ME WASH
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3196-LT
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 2547
MOTOR BRAKE HP: 150

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SPEED - RPM: 1780

HEAD - FT: 155

SERVICE (PH, SOLIDS):

GGG CASING MATERIAL GENERIC TYPE: STAINLESS STEEL

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: STAINLESS STEEL

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SEAL WATER

HHH NUMBER OF PUMPS: 3

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM:

MOTOR BRAKE HP:

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE:

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE:

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED,

ABSORBER RECIRCULATION, ETC.): REHEATER CONDENSATE RETURN

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER: 2 X 10

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT

CAPACITY - GPM: 320

MOTOR BRAKE HP: 40

SPEED - RPM: 3535

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: CAST IRON

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: STAINLESS STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

COMMENTS/FOOTNOTES

- A THE SCRUBBING SYSTEM IS DESIGNED TO SCRUB 100% OF THE FLUE GAS; HOWEVER, THE SYSTEM IS OPERATED WITH THE BYPASS DAMPERS OPEN. IT IS ESTIMATED THAT LESS THAN 10% OF THE FLUE GAS BYPASSES THE FGD SYSTEM.
- B THE RIGIFLAK 4850 LINER FAILED TWICE. THE FIRST TIME THE FAILURE WAS ATTRIBUTED TO MISAPPLICATION (SPRAYED ON INSTEAD OF TROWELED). THE CARBON STEEL FLUE IS PROTECTED AT PRESENT BY MAINTAINING A CONTINUOUS HOT AIR INJECTION REHEAT IN ADDITION TO THE BYPASS FLUE GAS ENTERING THROUGH THE OPEN BYPASS DAMPERS.
- C 35% OF THE COAL IS FROM THE LYNVILLE MINE--THE REST IS SPOT PURCHASE. THE SPOT MARKET COAL VARIES FROM 1.6 TO 5.2% SULFUR.
- D THE COAL CHLORIDE CONTENT IS REPORTEDLY VERY LOW. NO FIGURES WERE AVAILABLE.
- E 983,500 ACFM IS THE DESIGN GAS FLOW RATING. 1,125,000 ACFM IS MORE TYPICAL.
- F IPALCO HAS A 12-HR OPACITY VARIANCE FOR START-UPS TO PROTECT THE ESP'S AND COAL MILLS. THE SCRUBBER IS NOT OPERATED UNTIL THE UNIT REACHES A LEVEL OF ABOUT 150 MW. THIS IS BECAUSE THE ESP'S BECOME FOULED AT VERY LOW GAS FLOWS.
- G THE SCRUBBER OPERATOR BREAKDOWN IS AS FOLLOWS:
1 SUPERINTENDENT
1 BOARD OPERATOR
1 AUXILIARY OPERATOR (FGD)
1 AUXILIARY OPERATOR (IUCS FACILITY)
1 CLEAN-UP MAN (IUCS FACILITY)
5 TOTAL
THESE POSITIONS ARE FILLED 3 SHIFTS PER DAY 7 DAYS PER WEEK.
- H THE SCRUBBER MAINTENANCE PERSONNEL/SHIFT BREAKDOWN IS AS FOLLOWS:
1 WELDER
6 MAINTENANCE MEN
4 INSTRUMENTATION & ELECTRICAL MEN
11 TOTAL MAINTENANCE

2 FOREMEN
1 SUPERVISOR
3 TOTAL MAINTENANCE/SUPERVISORY
14 GRAND TOTAL
THIS CREW IS EMPLOYED FOR ONE SHIFT PER DAY. THERE IS ALSO A GROUP OF 8 TO 10 PERSONS IN THE STATION HELPER CLASS WHO CAN BE USED IN EMERGENCIES.
- I APPROXIMATELY 10-15 OUTSIDE CONTRACTORS ARE USED TWICE PER YEAR FOR TWO WEEKS AT A TIME. THESE INDIVIDUALS PERFORM "BOILER MAKER" TYPE WORK (E.G., DUCT AND DAMPER REPAIR, STRUCTURAL STEEL WORK, ETC.) AND PUMP WORK.
- J EVERY 6 MONTHS 1/3 TO 1/2 OF THE FGD SYSTEM CREW IS ROTATED TO THE BOILER SIDE.
- K THE BYPASS IS USED AS A PRESSURE RELIEF DUCT. THE BOILER IS OPERATED WITH THE DAMPERS WIDE OPEN. THE BOOSTER FAN VANES ARE ADJUSTED TO MAINTAIN THE 1.2 LB/MM BTU SO₂ EMISSION LIMITATION.

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

COMMENTS/FOOTNOTES (CONTINUED)

- L THE BOILER DROPS TO ABOUT 75% OF FULL LOAD AT NIGHT AND ONE MODULE IS USUALLY TAKEN OUT OF SERVICE FOR MAINTENANCE.
- M ORIGINALLY PRE-KRETE G-8 WAS USED IN THIS AREA. IT HAS BEEN REPLACED WITH A MATERIAL SIMILAR TO THE RIGIFLAK 4850 USED IN THE STACK.
- N A NUMBER OF BALL TYPES WERE USED IN THESE MODULES. THE MORE REPRESENTATIVE CONFIGURATION WAS THE USE OF 1.5-INCH-DIAMETER SPONGE RUBBER-LIKE BALLS IN THE LOWER TWO STAGES AND PLASTIC "PING PONG" BALLS IN THE UPPER STAGE. THE BALLS WERE REMOVED IN JANUARY OF 1981 SO THAT ONLY THE RUBBER COATED CARBON STEEL GRIDS USED TO SUPPORT THE BALLS REMAIN.
- O THE 2600 PPM FIGURE IS A DESIGN VALUE WHICH WOULD BE SEEN WHEN BURNING 4.5% SULFUR COAL. 1800 PPM IS A MORE REALISTIC INLET SO₂ CONCENTRATION VALUE.
- P THE DESIGN OUTLET SO₂ CONCENTRATION WAS 400 TO 500 PPM. THE ACTUAL VALUE WAS REPORTED AS LESS THAN 350 PPM. THE OUTLET FROM THE STACK CANNOT EXCEED 386 PPM.
- Q THE DISTANCE FROM THE TOP STAGE OF THE ABSORBER TO THE BOTTOM OF THE PRE-MIST ELIMINATOR IS APPROXIMATELY 3 FEET.
- R THIS IS THE DISTANCE BETWEEN THE TWO MIST ELIMINATORS IN EACH MODULE.
- S THE CURRENT BLEND IS 70% TRAP-OUT TRAY RETURN, 20% MAKE-UP WATER, AND 10% THICKENER SUPERNATANT. THE UTILITY IS CONSIDERING THE REMOVAL OF THE TRAP-OUT TRAY RETURN FROM THE BLEND.
- T THE TRAP-OUT TRAY IS SPRAYED FROM BELOW FOR TWO MINUTES EVERY 30 MINUTES. THE FIRST MIST ELIMINATOR IS SPRAYED CONTINUOUSLY FROM ABOVE AND BELOW. THE SECOND MIST ELIMINATOR IS NOT SPRAYED.
- U THERE IS ONE REHEATER FOR EACH SIDE (2 MODULES/SIDE) OF THE FGD SYSTEM. THE REHEATERS ARE KEPT OPERATING AT ALL TIMES TO MINIMIZE THE ACCUMULATION OF FLY ASH IN THE DUCTWORK.
- V THE REHEATER SYSTEM ON THIS UNIT IS UNUSUAL IN THAT IT IS PART OF THE BOILER FEED WATER CYCLE. THE STEAM SUPPLY IS HIGH QUALITY EXTRACTION STEAM DIRECTLY OFF THE TURBINE. THE CONDENSATE IS RETURNED TO THE BOILER DEAERATOR WITH HIGH PRESSURE (300 LB) PUMPS. ALTHOUGH THIS SAVES IN ENERGY CONSUMPTION/LOSS THE HIGH PRESSURE PUMPS ARE A HIGH MAINTENANCE PROBLEM AREA. UNIT 4 WILL NOT USE THIS DESIGN.
- W THE REHEATER FANS ARE RATED AT 158,000 ACFM. TOGETHER THEY TYPICALLY PUMP AIR THROUGH THE REHEATER AT 227,000 ACFM.
- X THERE IS 1 BOOSTER FAN FOR 2 MODULES SUPPLYING ROUGHLY 237,500 ACFM TO EACH.

Y THE BREAKDOWN OF THE DAMPERS IS AS FOLLOWS:

NO.	LOCATION	MANUFACTURER
2	BYPASS	ANDCO
2	BOOSTER FAN INLET	ANDCO
2	BOOSTER FAN OUTLET	ANDCO
4	MODULE INLET	ANDCO
4	MODULE OUTLET	MOSSER
2	REHEATER	ANDCO
TOTAL 16		

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/30/81

INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

COMMENTS/FOOTNOTES (CONTINUED)

- THE BYPASS DAMPERS ARE EFFECTIVELY INOPERATIVE AND ARE FIXED IN THE OPEN POSITION. THESE DAMPERS SLIDE HORIZONTALLY INTO A VERTICAL DUCT RUN. THEY ARE LARGE DAMPERS (ROUGHLY 10 FT ACROSS) AND TEND TO WARP FROM THE WEIGHT OF THE GUILLOTINE ITSELF.
- Z THE CARPENTER 20 IS BEING REPLACED WITH INCONEL 625.
- AA THE EXPANSION JOINTS WERE ORIGINALLY A FIBERGLASS COMBINATION MATERIAL THAT WAS DESIGNED TO WITHSTAND A FULL RANGE OF TEMPERATURES; HOWEVER, THEY COULD NOT WITHSTAND THE WET SCRUBBING ENVIRONMENT. THE NEW EXPANSION JOINTS ARE MADE OF A VITON® MATERIAL. THESE SHOULD HOLD UP WELL; HOWEVER, THEY WILL NOT WITHSTAND TEMPERATURES ABOVE 350 F. THE UTILITY REPORTED THAT SHOULD AN AIR PREHEATER FAILURE OCCUR THE EXPANSION JOINTS WOULD FAIL AS WELL.
- BB THE BALL MILL CAN PROCESS 500 TONS OF LIMESTONE PER DAY.
- CC THE RECLAIMED WATER PIPING WAS ORIGINALLY FRP AS WAS MUCH OF THE OTHER PIPING. THE FRP FAILED AS A RESULT OF FREEZING, POOR ANCHORING, AND PROBLEMS RELATED TO USING A NUMBER OF DIFFERENT SUPPLIERS (PARTICULARLY AT PIPING JOINTS AND CURVES). PIPE REPLACEMENTS ARE AND HAVE BEEN MADE WITH KELOLITE PIPING AS NECESSARY. THIS IS A POLYPROPYLENE-LINED CARBON STEEL PIPE.
- DD THE VALVES WERE ORIGINALLY ALL AUTOMATIC. THEY WERE OPERATED FROM THE BOARD. THE ELECTRIC OPERATORS HAVE SINCE BEEN REMOVED. THEY ARE NOW OPERATED MANUALLY.
- EE THIS MATERIAL FAILED ON THE CONCRETE BASE OF THE THICKENER WHICH WAS COATED AS AN AFTERTHOUGHT ANYWAY. THE MATERIAL ON THE CARBON STEEL WALLS STILL SEEMS TO BE INTACT. THERE ARE NO PLANS TO RECOAT THE BASE.
- FF THE DESIGN VALUE FOR THE SETTLED SOLIDS WAS 35%.
- GG THICKENER OVERFLOW IS ONLY SENT TO THE RECYCLE TANK IN EMERGENCIES. THE UTILITY IS NOW TESTING A LIQUID POLYMER FLOCCULANT FOR POSSIBLE USE IN THIS CIRCUIT.
- HH BOTH VACUUM FILTERS ARE REQUIRED FOR FULL LOAD OPERATION BUT EACH IS RATED AT 70 TO 80% CAPACITY. ALTHOUGH THE CAPACITY HAS DROPPED SOMEWHAT, BEING LIMITED BY VACUUM PUMP SEALS AND OTHER WEAR PARTS, THE CAPACITY OF THE TWO TOGETHER STILL EXCEEDS 100% SO THAT OFTEN ONLY ONE HAS TO BE IN SERVICE AT A TIME. THE VACUUM FILTERS ARE SUPPLIED BY IUCS.
- II THIS MATERIAL HAS FAILED PROBABLY AS A RESULT OF POOR APPLICATION (WOULD NOT DRY PROPERLY--APPLIED TOO THICK). THE MATERIAL WILL BE REPLACED WITH A NEW MATERIAL ANYWAY. IPALCO INDICATED THAT IF IT HAD TO DO IT OVER AGAIN IT WOULD HAVE SPECIFIED A RUBBER-LINED DRUM.
- JJ THE POLYPROPYLENE MATERIAL REPLACED THE EARLIER NYLON BELT MATERIAL.
- KK 55% SOLIDS IS THE GUARANTEED PERCENT SOLIDS OF THE DISCHARGE. IT ACTUALLY RANGES FROM 55 TO 65% SOLIDS.
- LL IPALCO REPORTED THAT APPROXIMATELY 1000 TPD IS DEPOSITED IN THE LANDFILL.
- MM THE POZ-O-TEC MIXTURE IS 1 PART FLY ASH TO 1 PART FILTER CAKE. QUICK LIME IS ADDED TO THIS MIXTURE SO THAT IT CONSTITUTES LESS THAN 2.0% OF THE TOTAL MASS. IUCS GUARANTEES THAT THE QUICK LIME ADDITION WILL NOT EXCEED THIS LEVEL.

UTILITY EMISSION CONTROL SYSTEM DATA
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INDIANAPOLIS POWER & LIGHT
PETERSBURG 3

COMMENTS/FOOTNOTES (CONTINUED)

NN THE MATERIAL IS DELIVERED TO TRUCKS VIA A CONVEYOR BELT. IPALCO'S MAIN COMPLAINT WITH IUCS IS THAT IT USES FARM-GRADE EQUIPMENT SUCH AS THE CONVEYOR. THIS GRADE EQUIPMENT DOES NOT HOLD UP WELL IN THE UTILITY ENVIRONMENT.

OO THERE IS ABOUT 7 TO 8 YEARS OF DISPOSAL AREA LEFT ON SITE. AFTER THIS TIME AN ALTERNATE LANDFILL OFF THE PLANT SITE WILL HAVE TO BE FOUND.

PP THE DESIGN PH CONTROL LEVEL IS 5.5-5.9. SINCE JANUARY 1981 WHEN THE DALLS WERE REMOVED FROM THE ABSORBERS THE UTILITY HAS INCREASED THE PH CONTROL LEVEL TO 6.2 TO IMPROVE SO_2 REMOVAL EFFICIENCY. THIS MAY BE CHANGED IF ABSORBER GAS CONTACTING AREA CAN BE INCREASED WITH THE INSTALLATION OF TRAYS OR GRIDS.

QQ A FEED FORWARD SYSTEM WAS INCLUDED IN THE ORIGINAL DESIGN BUT IT NEVER WORKED.

RR THE EVAPORATION AND SLUDGE HYDRATION WATER LOSS IS 500 TO 800 GPM TOGETHER.

SS DURING EMERGENCY SITUATIONS WASTE SLURRY IS PUMPED TO THE ASH POND.

TT 882 GPM IS A DESIGN FIGURE. 500 TO 800 GPM IS MORE REALISTIC WITH 600 GPM BEING A TYPICAL VALUE. THE 882 GPM VALUE IS ONLY APPROACHED WHEN LIMESTONE IS BEING SLURRIED.

UU THE BALL MILL CAPACITY IS 500 TPD OF LIMESTONE INPUT.

VV THE RECYCLE PUMPS ARE INSTALLED AT 3 PER MODULE. ONLY 2 ARE REQUIRED FOR FULL LOAD OPERATION. ALL OTHER PUMPS ARE INSTALLED IN NUMBERS YIELDING 100% SPARE CAPACITY EXCEPT FOR THE BALL MILL SUMP PUMP WHICH HAS NO SPARE CAPACITY.

WW THE TANKS HOLD ABOUT AN 8-HOUR SUPPLY OF LIMESTONE SLURRY WHEN THE UNIT OPERATES AT FULL LOAD. CURRENTLY THEY HOLD A 14-16 HOUR SUPPLY.

XX 40 HP PHILADELPHIA GEAR MOTOR.

YY 5 HP PHILADELPHIA GEAR MOTOR.

ZZ AGITATOR HAS 4 PADDLES IN THIS TANK. 75 HP PHILADELPHIA GEAR MOTOR.

AAA FIBERGLASS MAT OVER CONCRETE. THE FLOOR HAS AN EMBEDDED CHANNEL IN THE CONCRETE.

BBB 5 HP LIGHTING MIXER AGITATOR MOTOR.

CCC THE PUMP SIZE IS 18 IN. X 16 IN. X 35 IN. WITH AN OVERHEAD MOTOR.

DDD THE PH IS CURRENTLY 6.2 (5.6-5.9 IS DESIGN). THE SOLIDS LEVEL MAY REACH AS HIGH AS 22% (7-15 IS DESIGN AND MORE TYPICAL).

EEE BECAUSE OF THE PUMPS AVAILABLE AT THE TIME NONE COULD SUPPLY SUFFICIENT HEAD TO MOVE THE MATERIAL TO THE IUCS FACILITY; TWO PUMPS WERE USED IN SERIES. THERE ARE TWO SETS OF THESE, ONE OF WHICH IS SPARE.

FFF THE PUMP IS SIZED AT 6" X 8" X 18".

GGG THE CASINGS ARE A DIFFERENT MATERIAL THAN THE IMPELLERS.

HHH THERE IS ONE SEAL WATER PUMP AT THE THICKENER AND THERE ARE TWO IN THE SCRUBBER AREA.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Indianapolis Power & Light Petersburg 3	12/77	744		System				Initial shutdown/commercial operations commenced (recycle tank agitation repaired)
	1/78	744		System	0		System	Unit down entire month in order that heat tracing could be installed
	2/78	672		System	0		Pipes and valve	Cold weather related problems (freeze-up damage repairs)
	3/78	744		System			Dampers	Isolation dampers repaired
							FGD system	Insulation installed on FGD system components
							Thickener	Broken pinion gear repaired
							Flyash handling system	Malfunctioned
	4/78	720		System			Control valves	Returned to manufacturer for modifications
	5/78	744		System			Transformer	System shut down due to transformer failure
	6/78	720		System			Transformer	Transformer repair continued through 6/16
	7/78	744		System			Valves	Many of the valves had to be repaired
	8/78	744		System			Instrumentation	Malfunctioned
							Piping	Cracking of fiberglass piping (solved by replacing sections with rubber-lined steel piping and FRP piping with added supports)

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Petersburg 3 (continued)	9/78	720		System				
	10/78	744		System			Dampers	Bypass dampers malfunctioned
	11/78	720		System			Lime feed lines	Cold weather related problems
							Instrumentation	144 hour outage due to failed power transformer
	12/78	744		System				
	1/79	744		System				FGD system shut down from 1/79 to 3/15 due to severe winter weather
	2/79	672		System				
	3/79	744		System				
	4/79	722		System			Stack	Stack lining peeled away (steel shell was sand blasted and Rigiflake 4850 applied by trowel)
							Mist eliminators	Scaling
							Dampers	Inlet dampers repaired
							Outlet ducts	Lined with Resistiflake 1150
							Absorber	Bonnet corrosion problems
	5/79	744						
	6/79	720					Mist eliminators	Plugging
							Process control	Major problem area of system
	7/79	744		System				
	8/79	744		System				

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Petersburg 3 (continued)	9/79	720	0	System	0			Unit shut down for annual boiler/scrubber overhaul
	10/79	744	0	System	0			Down due to boiler related problems
							Instrumentation	Module pressure monitors, SO ₂ , and pH monitors were all inoperable
	11/79	720	360	System				
	12/79	744		System				
	1/80	744		System				
	2/80	696		System				
	3/80	744		System			Dampers	Bypass dampers failed (guillotine dampers had to be modified)
							Scrubber packing	Entire scrubber packing bed was lost due to excessive wear of the neoprene from packing balls
	4/80	720		System				No information was available for release from 4/80 through 9/80
	5/80	744		System				
	6/80	720		System				
	7/80	744		System				
	8/80	744		System				
	9/80	720		System				

(continued)

Indianapolis Power & Light
Petersburg 3

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Petersburg 3 (continued)	10/80	744		System				<p>During an extended October-November scrubber outage the following work was performed:</p> <ul style="list-style-type: none"> Failed and failing booster fan and absorber inlet dampers seals were replaced (both fans and all 4 absorbers). The booster fan damper seals were redesigned Failing fiberglass seal water piping at the ball mill was replaced with carbon steel piping Rubber lifter bars and a new outlet screen were installed on the ball mill The reclaim water tank (thickener overflow) was sand blasted and recoated The mist eliminator wash pumps and the reclaim water (thickener overflow) pumps were rebuilt Two conveyor belts at the IUCS facility were replaced One reheater fan motor was replaced The thickener rake cables were replaced A new oil seal was installed in one of the booster fan bearings Repairs/replacements were made on a transformer and a bucket wheel bearing on the stacker/reclaimer (used for limestone delivery to the FGD system)
	11/80	720		System			Pug mill	The pug mill paddles at the IUCS facility were replaced
							Programmable controller	24 shorted circuit cards in the programmable controller were repaired/replaced
							Vacuum filter	The valve head for one of the vacuum filters at the IUCS facility was replaced
	12/80	744		System			Scrubber packing	The utility is considering entirely removing the mobile bed packing

KANSAS CITY POWER & LIGHT

HAWTHORN 3, 4

Kansas City Power & Light
Hawthorn 3, 4

SECTION 1

BACKGROUND

The Hawthorn Power Station of KCP&L is located in a heavily industrialized area on the south bank of the Missouri River in East Kansas City, Missouri. The plant operates five coal-fired boilers. Boilers 1 and 2 are considered cyclic boilers, each rated at 80 MW (gross). Boilers 3 and 4 are also cyclic boilers, rated at 90 MW (gross) each when burning coal. Although these boilers have multiple fuel capability, they now burn coal exclusively. These four boilers were built and placed in service between 1950 and 1955. Boiler 5 was placed in service in early 1970; it operates as a base-load boiler at a rated capacity of 500 MW (gross).

The boilers at the Hawthorn Power Station are all dry-bottom, pulverized-coal-fired units designed and manufactured by Combustion Engineering, which also manufactured the FGD systems for this plant.

At the time Hawthorn 3 and 4 were installed, no environmental regulations were in force. However, in the 1970's, Regulation III of the Missouri Air Conservation Commission limited particulate matter emissions to 0.15 pounds per million Btu for both units. Atmospheric emissions for SO₂ were also limited by Regulation XV of the Missouri Air Conservation Commission but this plant is not in a critical area so SO₂ removal

was not mandated by the regulation. However, based on the anticipation of future SO₂ emission limitations that were likely to be imposed by state and local authorities, KCP&L authorized Combustion Engineering in 1971 to install limestone injection and tail-end wet scrubber systems on both Hawthorn 3 and 4 for SO₂ and particulate matter control.

The installation of the FGD systems at Hawthorn did not proceed according to the pattern for typical construction projects. The systems were demonstrational and the supplier was willing to underwrite a considerable portion of the project. Consequently, C-E was chosen in advance as the FGD system supplier. Therefore, bid specifications on the FGD systems were not prepared or requested.

The original FGD systems installed on Hawthorn 3 and 4 were identical and consisted of a dry limestone injection and tail-end wet scrubber modules supplied by Combustion Engineering. The dry limestone was injected directly into the boiler furnace where the limestone was calcined to lime. The furnace calcined limestone and boiler flue gas were then discharged to the tail-end wet scrubbing systems consisting of two marble-bed absorbers (each) where both particulate matter and SO₂ were removed from the gas stream.

The original scrubber design installed on Hawthorn 4 was modified shortly after startup because of boiler tube plugging attributed to the limestone injection. The mode of operation of this system was converted to limestone injection into the flue gas duct near the inlet to the marble-bed absorbers.

The systems operated in the limestone injection and wet scrubbing mode until May 1976 when the utility began conversion of the systems to a lime slurry based scrubbing process. The conversions were completed in January 1977 and February 1977 for units 3 and 4, respectively, and testing for compliance with particulate matter codes revealed that the applicable regulation was being met.

SECTION 2

PROCESS DESCRIPTION

The scrubbing systems installed on Hawthorn 3 and 4 are identical in design. Each system consists of two marble-bed scrubbers for removal of both particulate matter and SO_2 with design efficiencies of 99% and 70%, respectively.

From the boiler air preheater, flue gas enters each scrubbing module at approximately 250,000 acfm and 300°F. In each module, the flue gas passes through a single-stage of marble-bed packing where lime slurry is recirculated via a series of underbed sprays. The gas then continues through a two-stage chevron mist eliminator that originally included on-line wash lances. These have been out of service for approximately two years and, as a result, the mist eliminators are washed manually with fire hoses every other day. From the mist eliminator, the flue gas passes through an in-line hot water reheater that boosts the gas temperature from 120° to 180°F. The reheater is a carbon steel, bare tube heat exchanger that utilizes hot water from the boiler deaerator. The gas exits each module and passes through its respective scrubber ID fan and exits through a 200-foot lined carbon steel stack.

At the bottom of each scrubber module is a reaction tank to which slaked lime is added from the lime slurry tank as needed.

Kansas City Power & Light
Hawthorn 3, 4

The systems operate in an open water loop mode. Blowdown from the reaction tanks is bled to a common thickener. The thickener underflow is pumped to an ash pond and overflow from the ash pond is recycled to the suction of ash sluice pump.

A flow diagram for the Hawthorn 3, 4 FGD systems is shown on the next page.

Kansas City Power & Light
Hawthorn 3, 4

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/12/81

KANSAS CITY POWER & LIGHT
HAWTHORN 3

GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS CITY POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: HAWTHORN
UNIT NUMBER: 3
PLANT ADDRESS: P.O. BOX 679
CITY: KANSAS CITY
COUNTY: JACKSON
STATE: MISSOURI
ZIP CODE: 64141
EPA REGION: /
RIVER BASIN/LAKE REGION: MISSOURI
REGULATORY CLASSIFICATION: STATE STD EQUAL/LESS STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.15, 20% OPACITY
SO2 EMISSION LIMITATION - LB/MM BTU: NONE
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 836
GROSS UNIT GENERATING CAPACITY - MW: 90
NET UNIT GENERATING CAPACITY WITH FGD - MW: 85
NET UNIT GENERATING CAPACITY W/O FGD - MW: 87
EQUIVALENT SCRUBBED CAPACITY - MW: 90

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): CYCLING
COMMERCIAL SERVICE DATE: 1953
DESIGN BOILER FLUE GAS FLOW - ACFM: 500,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: 4.5
HEAT RATE - BTU/KWH: 11,000
DESIGN FIRING RATE - TPH: 50
EXCESS AIR - %: 25
CAPACITY FACTOR - %: 25
STACK HEIGHT - FT: 200
SHELL MATERIAL: CARBON STEEL
FLUE MATERIAL GENERIC TYPE: N/A
FLUE MATERIAL SPECIFIC TYPE: N/A
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: GUNITE
FLUE LINER MATERIAL TRADE/COMMON NAME: _____
FLUE INNER DIAMETER - FT: 18.0
STACK GAS INLET TEMPERATURE - F: 175-185
STACK GAS OUTLET VELOCITY - FT/SEC: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/12/81

KANSAS CITY POWER & LIGHT
HAWTHORN 3

FUEL DATA (ACTUAL)

A FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): (A) BITUMINOUS (B) BITUMINOUS
NAME OF SUPPLIER: (A) ARCH MINERAL (B) PEABODY COAL CO.
MINE NAME/AREA: (A) SEMINOLE 1 & 2 (B) CHELSEY
MINE LOCATION - COUNTY: (A) _____ (B) ROGERS
MINE LOCATION - STATE: (A) WYOMING (B) OKLAHOMA
AVERAGE HEAT CONTENT - BTU/LB: (A) 9800 (B) 11,860
RANGE HEAT CONTENT - BTU/LB: (A) 9500-10,800 (B) 10,500-13,000
AVERAGE ASH CONTENT - %: (A) 11.0 (B) 12.0
RANGE ASH CONTENT - %: (A) 6-15 (B) 9-12
AVERAGE MOISTURE CONTENT - %: (A) 12 (B) 5.7
RANGE MOISTURE CONTENT - %: (A) 9-17 (B) 1.5-12
AVERAGE SULFUR CONTENT - %: (A) 0.60 (B) 3.5
RANGE SULFUR CONTENT - %: (A) 0.2-1.2 (B) 0.6-4.6
AVERAGE CHLORIDE CONTENT - %: (A) 0.04 (B) 0.19
RANGE CHLORIDE CONTENT - %: (A) 0.01-0.06 (B) 0.01-0.4
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: (A) 8/78 (B) 4/72

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED
SPACE REQUIREMENTS - SQ FT: N/A

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE
NUMBER OF SPARES:
TYPE (HOT SIDE/COLD SIDE):
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:
FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

B NUMBER OF PARTICLE SCRUBBERS:
NUMBER OF SPARES:

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HAWTHORN 3

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

C PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: BLACK & VEATCH
CONSTRUCTION FIRM: COMBUSTION ENGINEERING
APPLICATION (NEW/RETROFIT): RETROFIT
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0
SO₂ DESIGN REMOVAL EFFICIENCY - %: 70
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

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KANSAS CITY POWER & LIGHT
HAWTHORN 3

COMMERCIAL START-UP: 11/72
INITIAL START-UP: 11/72
CONSTRUCTION COMPLETION: 11/72 (THE CURRENT LIME SYSTEM WAS COMPLETED IN 1976)
CONSTRUCTION INITIATION: 1/71
CONTRACT AWARDED: 1971
LETTER OF INTENT SIGNED: N/A
D INITIATED BID REQUEST: N/A
INITIATED PRELIMINARY DESIGN: N/A

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 2.8
DESIGN COAL HEAT CONTENT - BTU/LB: 11,350
DESIGN COAL ASH CONTENT - %: 11.8
DESIGN COAL MOISTURE CONTENT - %: 7.3
DESIGN COAL CHLORIDE CONTENT - %: 0.15
E FGD SYSTEM SPACE REQUIREMENTS - SQ FT: 7410
FGD SYSTEM TURNDOWN RATIO: 3:1
FGD SYSTEM TURNDOWN METHOD: REDUCE GAS FLOW
FGD SYSTEM PRESSURE DROP - IN. H₂O: 15
FGD SYSTEM OXIDATION - %: 30-40
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 12
F FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 136
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 1
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE PERSONNEL/SHIFT): (A) 6 MAINT./SHIFT (B) 4 CLEANERS/SHIFT
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): (A) 1 SHIFT (B) 2 SHIFTS
G FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): DEDICATED
H SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: NO ROTATION
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): DEDICATED
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: 100% BYPASS ONLY ALLOWED WHEN BURNING GAS
TIME SCHEDULE FOR REDUCED BOILER LOAD: 60% LOAD 16 HOURS PER DAY
I TIME SCHEDULE FOR BOILER SHUTDOWNS: 6 WEEKS/YEAR
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): ONE MODULE IS CLEANED EVERY NIGHT
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): OVERHAUL WORK (E.G., CHANGING PUMP LINERS, ETC.)
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE): GENERAL CLEANING - DEPENDING UPON THE POWER DEMAND.
IF THE DISPATCHER NEEDS THE POWER ONLY THE EQUIPMENT ITEM IN QUESTION IS REPAIRED.

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KANSAS CITY POWER & LIGHT
HAWTHORN 3

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 0
J GENERIC TYPE: PACKED TOWER
SPECIFIC TYPE: STATIC BED PACKING
TRADE/COMMON NAME: MARBLE BED SCRUBBER
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: 18 X 26 X 56
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
K LINER MATERIAL GENERIC TYPE: STAINLESS STEEL
LINER MATERIAL SPECIFIC TYPE: AUSTENITIC
LINER MATERIAL TRADE/COMMON NAME: TYPE 316L
BOILER LOAD PER ABSORBER - %: 50
L GAS/LIQUID CONTACT DEVICE TYPE: GLASS MARBLES
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: 14
M NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 5090
L/G RATIO - GAL/1000 ACF: 26
GAS-SIDE PRESSURE DROP - IN. H2O: 11
SUPERFICIAL GAS VELOCITY - FT/SEC: 6
ABSORBER TURNDOWN RATIO: 3:1
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW

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INLET GAS FLOW RATE - ACFM: 250,000
INLET GAS TEMPERATURE - F: 300
INLET SO2 LEVEL - PPM: 1000
INLET SO2 LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF: 2.8-3.3
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F: 120
OUTLET SO2 LEVEL - PPM: 500
OUTLET SO2 LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.13
SO2 REMOVAL EFFICIENCY - %: 50
PARTICLE REMOVAL EFFICIENCY - %: 99.5

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 2
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE: IMPINGEMENT
SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CHEVRON VANE
MANUFACTURER: COMBUSTION ENGINEERING
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): A-FRAME
NUMBER OF STAGES: 2
NUMBER OF PASSES/STAGE: 2
FREEBOARD DISTANCE - FT: 10
DISTANCE BETWEEN STAGES - IN.: 6.0
DISTANCE BETWEEN VANES - IN.: 3.0
VANE ANGLES - DEGREES: 45
PRESSURE DROP - IN. H2O: 1.2
SUPERFICIAL GAS VELOCITY - FT/SEC: 6
CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC
CONSTRUCTION MATERIAL SPECIFIC TYPE: FIBER REINFORCED POLYESTER
CONSTRUCTION MATERIAL TRADE/COMMON NAME: N/A
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): FRESH
POINT OF WATER COLLECTION: FALLS THROUGH TO THE RECYCLE TANK
N WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): UNDERSPRAY
WASH FREQUENCY: EVERY 48 HOURS
WASH DURATION:
WASH RATE - GAL/MIN: 1000 PER MODULE
WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1

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GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
O SPECIFIC TYPE (STEAM, HOT WATER, ETC.): HOT WATER
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): BARE TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: TOP OF ABSORBER VESSEL
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 60
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 120
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 180
ENERGY REQUIREMENT - MM BTU/HR: 22
NUMBER OF HEAT EXCHANGER BANKS: 6
NUMBER OF BUNDLES PER BANK: 1
NUMBER OF TUBES PER BUNDLE: _____
WATER PRESSURE - PSIG: 100
WATER TEMPERATURE - F: 300
SELF CLEANING DEVICE TYPE: STEAM
P MATERIAL GENERIC TYPE: STAINLESS STEEL
MATERIAL SPECIFIC TYPE: AUSTENITIC
MATERIAL TRADE/COMMON NAME: TYPE 316L

FANS

NUMBER OF FANS: 2
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: HOUDEN, CANADA
FUNCTION (UNIT/BOOSTER): BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): DRY
Q TYPE OF WASH: MANUAL
LOCATION WRT MAJOR COMPONENTS: BETWEEN REHEATER AND STACK
FLUE GAS FLOW RATE - ACFM: _____
FLUE GAS TEMPERATURE - F: 175-185
PRESSURE DROP - IN. H₂O: _____
MATERIAL GENERIC TYPE: LOW ALLOY STEEL
MATERIAL SPECIFIC TYPE: N/A
MATERIAL TRADE/COMMON NAME: COR-TEN

DAMPERS

LOCATION: (A) INLET AND OUTLET (B) BYPASS
NUMBER OF DAMPERS: (A) 4 (TWO INLET, TWO OUTLET) (B) 2
FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) LOUVER (B) GUILLOTINE
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): (A) PARALLEL BLADE
(B) TOP-ENTRY
GUILLOTINE
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): (A) SINGLE LOUVER
MANUFACTURER: (A) COMBUSTION ENGINEERING
(B) SELF-DESIGNED AND INSTALLED BY KCP&L

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MODULATION (OPEN/CLOSED, ETC.): OPEN/CLOSED
SEAL AIR - ACFM: N/A
SERVICE CONDITIONS (MAX GAS TEMP/TIME): (A) 330-120 F (B) 330 F
MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
MATERIAL SPECIFIC TYPE: (A) HIGH STRENGTH LOW ALLOY
(B) HIGH STRENGTH LOW ALLOY
MATERIAL TRADE/COMMON NAME: (A) COR-TEN (B) COR-TEN
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET AND OUTLET (B) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) RECTANGULAR
(B) RECTANGULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.): (A) 4.5 FT X 26 FT, 3 FT X 26 FT
(B) 3 FT X 26 FT
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: (A) HIGH STRENGTH LOW ALLOY
(B) HIGH STRENGTH LOW ALLOY
SHELL MATERIAL TRADE/COMMON NAME: (A) COR-TEN (B) COR-TEN
LINER MATERIAL GENERIC TYPE: (A) INORGANIC (B) NONE
LINER MATERIAL SPECIFIC TYPE: (A) HYDRAULICALLY-BONDED MORTAR (B) N/A
LINER MATERIAL TRADE/COMMON NAME: (A) PLIBRICO GUNITE (B) N/A

EXPANSION JOINTS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): NEGATIVE
OPERATING TEMPERATURE - F: (A) 300 (B) 120 (C) 300
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: COMBUSTION ENGINEERING
R MATERIAL: VITON®-ASBESTOS

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER (BATCH)
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): AGITATED TANK
MANUFACTURER: COFFMAN INDUSTRIES
MATERIALS: CARBON STEEL
NUMBER OF DEVICES: 1
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: 57
PRODUCT QUALITY - % SOLIDS: 25
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: 7 (430 GAL/HR)
PREPARED REAGENT POINT OF ADDITION: REACTION TANK
ON-SITE STORAGE CAPABILITY - DAYS: 21

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HAWTHORN 3

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) RECYCLE (B) BLOWDOWN AND CLEAR WATER RETURN
(C) LIME SLURRY

DIMENSIONS - IN.: (A) 10 (B) 6 (C) 2

MANUFACTURER: KANSAS CITY RUBBER & BELTING

S MATERIAL: (A) RUBBER-LINED CARBON STEEL
(B) SCHEDULE 80 CARBON STEEL (FLANGED) (C) CARBON STEEL

MAJOR VALVES

LOCATION: (A) SUCTION & DISCHARGE ON RECYCLE PUMPS (B) BLOWDOWN LINE

FUNCTION (ISOLATION, CONTROL, ETC.): ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): KNIFEGATE

CONTROL MODE (AUTOMATIC/MANUAL): MANUAL

DIMENSIONS - IN.: (A) 10 (B) 4 & 6

MANUFACTURER:

T MATERIAL: TYPE 316L STAINLESS STEEL

THICKENERS

U NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 115 DIA X 10 DEPTH (7 FT STRAIGHT, 3 FT SLANTING)

CAPACITY - GAL: 75,000

SHELL MATERIAL GENERIC TYPE: CARBON STEEL (WALLS), CONCRETE (BOTTOM)

SHELL MATERIAL SPECIFIC TYPE: AISI 1110, HYDRAULICALLY-BONDED CONCRETE

SHELL MATERIAL TRADE/COMMON NAME: N/A, PORTLAND CEMENT

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME: CELCOTE

RAKE MATERIAL: CARBON STEEL

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 12% SOLIDS

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 30%
SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 13,900
GPM

OUTLET STREAM DISPOSITION: TO ASH POND

OVERFLOW STREAM DISPOSITION: TO RECYCLE CANAL, ASH SLUICE PUMP

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):

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DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: N/A
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAOH2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DIKED
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): ABOVE GRADE
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE
SITE DIMENSIONS - AREA/DEPTH: 40 ACRES/15 FT

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SITE CAPACITY - VOLUME/ACRE-FT/TONS: 600 ACRE-FEET
SITE SERVICE LIFE - YEARS: 2-3 YEARS

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: RECIRCULATING SLURRY
CHEMICAL PARAMETERS (PH, ETC.): PH
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): % SOLIDS
CONTROL LEVELS: PH 5.5-6.0, 10% SOLIDS
MONITOR TYPE (MANUFACTURER, ETC.):
MONITOR LOCATION: GRAB SAMPLES TO LABORATORY
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): MANUAL
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL):
TYPE (OPEN/CLOSED): OPEN
EVAPORATION WATER LOSS - GPM:
SLUDGE HYDRATION WATER LOSS - GPM:
SLUDGE INTERSTITIAL WATER LOSS - GPM:
POND SEEPAGE/RUNOFF WATER LOSS - GPM:
EFFLUENT WATER LOSS - GPM:
RECEIVING WATER STREAM NAME: MISSOURI RIVER
MAKEUP WATER ADDITION - GPM:
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): MISSOURI RIVER
MAKEUP WATER ADDITION POINTS & AMOUNTS:
MAKEUP WATER PRE-TREATMENT TYPE:

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIME
PRINCIPAL CONSTITUENTS: 93% CaO
SOURCE/SUPPLIER: ASHGROVE
SUPPLIER LOCATION: SPRINGFIELD, MISSOURI
CONSUMPTION (SPECIFY UNITS):
UTILIZATION - %:
POINT OF ADDITION: LIME SLAKER

V ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 12,700,000
CAPITAL COST - \$/KW: 57.5
OPERATING COST - MILLS/KWH: 2.84
MAINTENANCE COST: \$931,000/YR
LABOR COST: \$97,300/YR
UTILITIES COST: \$1,250,000/YR
CHEMICALS COST: \$341,000/YR
WASTE DISPOSAL COST:

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

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ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: N/A
SLAKER - %: 0
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 0
THICKENER - %: 0
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: N/A
SLAKER: 0
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 0
THICKENER: 0
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

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KANSAS CITY POWER & LIGHT
HAWTHORN 3

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION TANK

NUMBER OF TANKS: 2

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): N/A

LOCATION: TANK IS BOTTOM OF ABSORBER

CONFIGURATION: RECTANGULAR

DIMENSIONS - FT: 18 X 26 X 20

CAPACITY - GAL: 56,000

RETENTION TIME - MIN: 10

NUMBER OF AGITATORS: 3

W AGITATOR CONFIGURATION: SIDE ENTRY

AGITATOR MATERIALS: CARBON STEEL SHAFT AND RUBBER-CLAD BLADES

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

X LINER MATERIAL GENERIC TYPE: STAINLESS STEEL

LINER MATERIAL SPECIFIC TYPE: TYPE 316L

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLURRY

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): COVERED

LOCATION: BENEATH THE SLAKER

CONFIGURATION: CYLINDRICAL

DIMENSIONS - FT: 5 DIA X 4

CAPACITY - GAL: 550

RETENTION TIME - MIN: 30

NUMBER OF AGITATORS: 1

AGITATOR CONFIGURATION: TOP ENTRY

AGITATOR MATERIALS: CARBON STEEL

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

U FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): CLEARWELL

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): OPEN

LOCATION: NEXT TO THICKENER

CONFIGURATION: CYLINDRICAL

DIMENSIONS - FT: 28 DIA X 9.25

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CAPACITY - GAL: 41,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 0
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLAKER HOLD
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: CARBON STEEL
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): RECYCLE
NUMBER OF PUMPS: 2 (ONE PER MODULE)
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER: 6 X 13 LPO
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 5000
MOTOR BRAKE HP: 225
SPEED - RPM: 900
HEAD - FT: 135
SERVICE (PH, SOLIDS): 5.5, 12% SOLIDS
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: NI-HARD
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE: GRAY CAST IRON
IMPELLER MATERIAL TRADE/COMMON NAME: NI-HARD

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CLEAR WATER SUPPLY
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
Y COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: FAIRBANKS-MORSE
PUMP MODEL NUMBER: 5822 X 14 IN.
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 6400
MOTOR BRAKE HP: 300
SPEED - RPM: 1200
HEAD - FT: 130
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

U FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0

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GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3175
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 450
MOTOR BRAKE HP: 30
SPEED - RPM: 1200
HEAD - FT: 100
SERVICE (PH, SOLIDS): 12% SOLIDS
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

Z FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): BLOWDOWN
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3196
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 1000
MOTOR BRAKE HP: 30
SPEED - RPM: 1200
HEAD - FT: 90
SERVICE (PH, SOLIDS): PH 6.0-6.5
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): REHEATER FEED
NUMBER OF PUMPS: 4
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3735

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PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 600
MOTOR BRAKE HP: 30
SPEED - RPM: 1800
HEAD - FT: 125
SERVICE (PH, SOLIDS): 10% SOLIDS
CASING MATERIAL GENERIC TYPE: STAINLESS STEEL
CASING MATERIAL SPECIFIC TYPE: AUSTENITIC
CASING MATERIAL TRADE/COMMON NAME: TYPE 304
AA IMPELLER MATERIAL GENERIC TYPE: STAINLESS STEEL
IMPELLER MATERIAL SPECIFIC TYPE: AUSTENITIC
IMPELLER MATERIAL TRADE/COMMON NAME: TYPE 304

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY
NUMBER OF PUMPS: 1
NUMBER OF SPARES: 0
BB GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): DISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): RECIPROCATING
COMMON DESIGN (V-BELT, ETC.): DIAPHRAGM
MANUFACTURER: BIF (GENERAL SIGNAL)
PUMP MODEL NUMBER: 1741-40-9841
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): HYDRAULIC
CAPACITY - GPM: 7
MOTOR BRAKE HP: 3
SPEED - RPM: 160 STROKES/MIN
HEAD - FT: 50 PSI
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: DUCTILE IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE:
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME: HYPALON DIAPHRAGM

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): MIST ELIMINATOR
WASH
NUMBER OF PUMPS: 4
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT DRIVE
COMMON DESIGN (V-BELT, ETC.):
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3196
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):
CAPACITY - GPM: 2000
MOTOR BRAKE HP: 100
SPEED - RPM: 1800

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HEAD - FT: 140

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: CAST IRON

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: CAST IRON

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SCRUBBER MAKEUP

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT DRIVE

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: GOULDS

PUMP MODEL NUMBER: 3175

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 1700

MOTOR BRAKE HP: 40

SPEED - RPM: 1200

HEAD - FT: 65

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: CAST IRON

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: CAST IRON

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

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COMMENTS/FOOTNOTES

- A TWO GRADES OF COAL ARE BLENDED AT HAWTHORN STATION AND NATURAL GAS IS USED WHEN AVAILABLE. TYPICALLY THE COAL BLEND IS 25% ARCH MINERAL (LOW SULFUR) AND 75% PEABODY (HIGH SULFUR).
- B PARTICULATE MATTER IS COLLECTED WITH SO₂ IN THE MARBLE BED SCRUBBER/ABSORBER.
- C THE PROCESS WAS CHANGED TO LIME IN FEBRUARY, 1977 FROM A LIMESTONE INJECTION SYSTEM.
- D THERE WAS NO REQUEST FOR BIDS. THE UTILITY WAS CONSIDERING AN ESP WHEN COMBUSTION ENGINEERING PROPOSED THE SCRUBBING SYSTEM. COMBUSTION ENGINEERING PERFORMED THE PRELIMINARY DESIGN WORK SOMETIME BEFORE PRESENTING THE PLANS TO THE UTILITY.
- E THIS FIGURE INCLUDES ONLY THE SCRUBBER AND PUMPHOUSE, AND ONE-HALF OF THE AREA OCCUPIED BY THE LIME PREPARATION SYSTEM, THICKENER, AND CLEAR WELL (SINCE THEY ARE SHARED BY BOTH UNITS). OTHER ITEMS SUCH AS FANS AND THE AREA BETWEEN COMPONENTS THAT WOULD BE CONSIDERED PART OF THE SCRUBBER AREA ARE NOT INCLUDED.
- F THERE IS ONE OPERATOR AVAILABLE PER SHIFT (3 SHIFTS/DAY). THERE ARE FOUR MEN ON CLEANING DUTY PER SHIFT FOR TWO SHIFTS/DAY AND SIX MAINTENANCE MEN PER SHIFT FOR ONLY ONE SHIFT/DAY. ONE MODULE IS CLEANED EVERY NIGHT WHEN THE BOILER LOAD DROPS. DURING THIS PERIOD THE MIST ELIMINATOR IS WASHED AS WELL AS THE REHEATER TUBES (THE REHEATERS ARE CLEANED WITH A HIGH PRESSURE HOSE). THIS MEANS THAT THE ABSORBER, MIST ELIMINATOR AND REHEATER FOR A GIVEN MODULE ARE WASHED ONCE EVERY FOUR DAYS (THERE ARE FOUR MODULES FOR UNITS 3 AND 4 COMBINED). THE FANS ARE WASHED ONCE PER WEEK FOR TWO HOURS TO PREVENT VIBRATION PROBLEMS ASSOCIATED WITH SOLIDS ACCUMULATION. RECYCLE TANK HOLES ARE PATCHED ABOUT ONCE PER WEEK.
- G IN GENERAL THERE ARE NO OUTSIDE CONTRACTORS EMPLOYED AT HAWTHORN; HOWEVER, THEY ARE REQUIRED FOR EXTENSIVE OVERHAULS, DESIGN MODIFICATION, TANK AND MODULE RELINING, DAMPER REPLACEMENT, AND REHEATER REPLACEMENT.
- H THERE IS NO ROTATION OTHER THAN THAT RESULTING FROM A SENIORITY PROMOTION THAT MAY SEND AN INDIVIDUAL TO OR FROM THE SCRUBBER CREW.
- I THERE ARE TWO SCHEDULED BOILER OUTAGES PER YEAR, ONE IN SPRING AND ONE IN FALL. EACH OUTAGE DURATION IS THREE WEEKS.
- J THIS IS AN EARLY COMBUSTION ENGINEERING MARBLE BED DESIGN FOR CONTROL OF PARTICULATE MATTER AND SO₂.
- K THE ORIGINAL CEILCOTE LINING FAILED BECAUSE OF TEMPERATURE EXCURSIONS, PH EXCURSIONS, AND WELDING DAMAGE.
- L THERE ARE 0.75-INCH DIAMETER GLASS MARBLES IN A 3 TO 4 INCH BED.
- M THE ORIGINAL FRP NOZZLES FAILED AND WERE REPLACED BY GALVANIZED STEEL AND COORS Al₂O₃ CERAMIC NOZZLES, BOTH OF WHICH FAILED, AND FINALLY WITH TYPE 316L STAINLESS STEEL NOZZLES.
- N THE ON-LINE WASH LANCES ARE NO LONGER OPERATED. THE MIST ELIMINATORS ARE WASHED WITH FIREHOSES AT LEAST ONCE EVERY OTHER DAY WHEN THE MODULE IS DOWN. THE UTILITY IS CONSIDERING THE RESUMPTION OF THE ON-LINE WASH LANCE SYSTEM OPERATION.
- O HOT WATER IS PIPED FROM THE BOILER DEAERATOR.

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HAWTHORN 3

COMMENTS/FOOTNOTES (CONTINUED)

- P THESE WERE ORIGINALLY CARBON STEEL FIN TUBES; HOWEVER, THEY WERE REPLACED WITH STAINLESS STEEL BARE TUBES BECAUSE OF PLUGGING PROBLEMS.
- Q THE FAN BALANCE WILL BE LOST ABOUT ONCE PER WEEK BECAUSE OF SOLIDS ACCUMULATION. TO PREVENT/MINIMIZE THIS PROBLEM EACH FAN IS SHUT DOWN AND WASHED ONCE PER WEEK.
- R THE ELASTOMERIC EXPANSION JOINTS WERE INSTALLED AFTER THE COR-TEN, SAW-TOOTH, BELLOWS-TYPE EXPANSION JOINTS FAILED FROM CORROSION.
- S THE ORIGINAL BONDSTRAND FRP RECYCLE LINES WERE REPLACED WITH LINED CARBON STEEL.
- T THE SYSTEM CONTAINS SOME STAINLESS STEEL BALL VALVES WITH TEFLON® SEALS. MOST OF THE DEZURIK PLUG VALVES HAVE BEEN REPLACED.
- U SHARED BY UNITS 3 AND 4.
- V 15 HP DRIVE, 1150 RPM.
- W COMBINED FIGURES FOR UNITS 3 AND 4.
- X THE ORIGINAL CEILCOTE LINING FAILED BECAUSE OF TEMPERATURE EXCURSIONS, PH EXCURSIONS, AND WELDING DAMAGE.
- Y HORIZONTAL SPLIT CASE.
- Z THE BLOWDOWN PUMPS WERE ORIGINALLY INSTALLED TO DELIVER EXCESS THICKENER OVERFLOW ENTERING THE CLEARWELL TO THE DISPOSAL POND. THEY ARE SELDOM USED.
- AA THESE PUMPS HAVE MECHANICAL SEALS INSTEAD OF PACKINGS.
- BB THIS IS A HYDRAULICALLY OPERATED BALL-TYPE POSITIVE DISPLACEMENT PUMP.

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KANSAS CITY POWER & LIGHT
HAWTHORN 4

GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS CITY POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: HAWTHORN
UNIT NUMBER: 4
PLANT ADDRESS: P.O. BOX 679
CITY: KANSAS CITY
COUNTY: JACKSON
STATE: MISSOURI
ZIP CODE: 64141
EPA REGION: 7
RIVER BASIN/LAKE REGION: MISSOURI
REGULATORY CLASSIFICATION: STATE STD EQUAL/LESS STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.15, 20% OPACITY
SO2 EMISSION LIMITATION - LB/MM BTU: NONE
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 836
GROSS UNIT GENERATING CAPACITY - MW: 90
NET UNIT GENERATING CAPACITY WITH FGD - MW: 85
NET UNIT GENERATING CAPACITY W/O FGD - MW: 87
EQUIVALENT SCRUBBED CAPACITY - MW: 90

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): CYCLING
COMMERCIAL SERVICE DATE: 1955
DESIGN BOILER FLUE GAS FLOW - ACFM: 500,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: 4.5
HEAT RATE - BTU/KWH: 11,000
DESIGN FIRING RATE - TPH: 50
EXCESS AIR - %: 25
CAPACITY FACTOR - %: 25
STACK HEIGHT - FT: 200
SHELL MATERIAL: CARBON STEEL
FLUE MATERIAL GENERIC TYPE: N/A
FLUE MATERIAL SPECIFIC TYPE: N/A
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: GUNITE
FLUE LINER MATERIAL TRADE/COMMON NAME: _____
FLUE INNER DIAMETER - FT: 18.0
STACK GAS INLET TEMPERATURE - F: 175-185
STACK GAS OUTLET VELOCITY - FT/SEC: _____

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KANSAS CITY POWER & LIGHT
HAWTHORN 4

FUEL DATA (ACTUAL)

A FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): (A) BITUMINOUS (B) BITUMINOUS
NAME OF SUPPLIER: (A) ARCH MINERAL (B) PEABODY COAL CO.
MINE NAME/AREA: (A) SEMINOLE 1 & 2 (B) CHELSEY
MINE LOCATION - COUNTY: (A) _____ (B) ROGERS
MINE LOCATION - STATE: (A) WYOMING (B) OKLAHOMA
AVERAGE HEAT CONTENT - BTU/LB: (A) 9800 (B) 11,860
RANGE HEAT CONTENT - BTU/LB: (A) 9500-10,800 (B) 10,500-13,000
AVERAGE ASH CONTENT - %: (A) 11.0 (B) 12.0
RANGE ASH CONTENT - %: (A) 6-15 (B) 9-12
AVERAGE MOISTURE CONTENT - %: (A) 12 (B) 5.7
RANGE MOISTURE CONTENT - %: (A) 9-17 (B) 1.5-12
AVERAGE SULFUR CONTENT - %: (A) 0.60 (B) 3.5
RANGE SULFUR CONTENT - %: (A) 0.2-1.2 (B) 0.6-4.6
AVERAGE CHLORIDE CONTENT - %: (A) 0.04 (B) 0.19
RANGE CHLORIDE CONTENT - %: (A) 0.01-0.06 (B) 0.01-0.4
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: (A) 8/78 (B) 4/72

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED
SPACE REQUIREMENTS - SQ FT: N/A

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE
NUMBER OF SPARES:
TYPE (HOT SIDE/COLD SIDE):
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:
FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

B NUMBER OF PARTICLE SCRUBBERS:
NUMBER OF SPARES:

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GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

C PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: BLACK & VEATCH
CONSTRUCTION FIRM: COMBUSTION ENGINEERING
APPLICATION (NEW/RETROFIT): RETROFIT
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0
SO₂ DESIGN REMOVAL EFFICIENCY - %: 70
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

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KANSAS CITY POWER & LIGHT
HAWTHORN 4

COMMERCIAL START-UP: 8/72'
INITIAL START-UP: 8/72
CONSTRUCTION COMPLETION: 11/72 (TAIL END LIMESTONE INJECTION SYSTEM -
1974; THE CURRENT LIME SYSTEM - 1976)
CONSTRUCTION INITIATION: 1/71
CONTRACT AWARDED: 1971
LETTER OF INTENT SIGNED: N/A
D INITIATED BID REQUEST: N/A
INITIATED PRELIMINARY DESIGN: N/A

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 2.8
DESIGN COAL HEAT CONTENT - BTU/LB: 11,350
DESIGN COAL ASH CONTENT - %: 11.8
DESIGN COAL MOISTURE CONTENT - %: 7.3
DESIGN COAL CHLORIDE CONTENT - %: 0.15
E FGD SYSTEM SPACE REQUIREMENTS - SQ FT: 7410
FGD SYSTEM TURNDOWN RATIO: 3:1
FGD SYSTEM TURNDOWN METHOD: REDUCE GAS FLOW
FGD SYSTEM PRESSURE DROP - IN. H2O: 15
FGD SYSTEM OXIDATION - %: 30-40
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 12
F FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): SAME AS BOILER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 136
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 1
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): (A) 6 MAINT./SHIFT (B) 4 CLEANERS/SHIFT
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MAINTENANCE SHIFTS/DAY): (A) 1 SHIFT (B) 2 SHIFTS
G FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): DEDICATED
H SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: NO ROTATION
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): DEDICATED
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: 100% BYPASS ONLY ALLOWED WHEN BURNING GAS
TIME SCHEDULE FOR REDUCED BOILER LOAD: 60% LOAD 16 HOURS PER DAY
I TIME SCHEDULE FOR BOILER SHUTDOWNS: 6 WEEKS/YEAR
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): ONE MODULE IS CLEANED EVERY NIGHT
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): OVERHAUL WORK (E.G., CHANGING PUMP
LINERS, ETC.)
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): GENERAL CLEANING - DEPENDING UPON THE POWER DEMAND.
IF THE DISPATCHER NEEDS THE POWER ONLY THE EQUIPMENT
ITEM IN QUESTION IS REPAIRED.

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/12/81

KANSAS CITY POWER & LIGHT
HAWTHORN 4

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 0
J GENERIC TYPE: PACKED TOWER
SPECIFIC TYPE: STATIC BED PACKING
TRADE/COMMON NAME: MARBLE BED SCRUBBER
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: 18 X 26 X 56
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
K LINER MATERIAL GENERIC TYPE: STAINLESS STEEL
LINER MATERIAL SPECIFIC TYPE: AUSTENITIC
LINER MATERIAL TRADE/COMMON NAME: TYPE 316L
BOILER LOAD PER ABSORBER - %: 50
L GAS/LIQUID CONTACT DEVICE TYPE: GLASS MARBLES
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: 14
M NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 5090
L/G RATIO - GAL/1000 ACF: 26
GAS-SIDE PRESSURE DROP - IN. H2O: 11
SUPERFICIAL GAS VELOCITY - FT/SEC: 6
ABSORBER TURNDOWN RATIO: 3:1
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW

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INLET GAS FLOW RATE - ACFM: 250,000
INLET GAS TEMPERATURE - F: 300
INLET SO2 LEVEL - PPM: 1000
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: 2.8-3.3
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 120
OUTLET SO2 LEVEL - PPM: 500
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.13
SO2 REMOVAL EFFICIENCY - %: 50
PARTICLE REMOVAL EFFICIENCY - %: 99.5

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 2
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE: IMPINGEMENT
SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CHEVRON VANE
MANUFACTURER: COMBUSTION ENGINEERING
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): A-FRAME
NUMBER OF STAGES: 2
NUMBER OF PASSES/STAGE: 2
FREEBOARD DISTANCE - FT: 10
DISTANCE BETWEEN STAGES - IN.: 6.0
DISTANCE BETWEEN VANES - IN.: 3.0
VANE ANGLES - DEGREES: 45
PRESSURE DROP - IN. H2O: 1.2
SUPERFICIAL GAS VELOCITY - FT/SEC: 6
CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC
CONSTRUCTION MATERIAL SPECIFIC TYPE: FIBER REINFORCED POLYESTER
CONSTRUCTION MATERIAL TRADE/COMMON NAME: N/A
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): FRESH
POINT OF WATER COLLECTION: FALLS THROUGH TO THE RECYCLE TANK
WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): UNDERSPRAY
WASH FREQUENCY: EVERY 48 HOURS
WASH DURATION: _____
WASH RATE - GAL/MIN: 1000 PER MODULE
WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1

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HAWTHORN 4

GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
O SPECIFIC TYPE (STEAM, HOT WATER, ETC.): HOT WATER
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): BARE TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: TOP OF ABSORBER VESSEL
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 60
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 120
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 180
ENERGY REQUIREMENT - MM BTU/HR: 22
NUMBER OF HEAT EXCHANGER BANKS: 6
NUMBER OF BUNDLES PER BANK: 1
NUMBER OF TUBES PER BUNDLE: _____
WATER PRESSURE - PSIG: 100
WATER TEMPERATURE - F: 300
SELF CLEANING DEVICE TYPE: STEAM
P MATERIAL GENERIC TYPE: STAINLESS STEEL
MATERIAL SPECIFIC TYPE: AUSTENITIC
MATERIAL TRADE/COMMON NAME: TYPE 316L

FANS

NUMBER OF FANS: 2
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: HOUDEN, CANADA
FUNCTION (UNIT/BOOSTER): BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): DRY
Q TYPE OF WASH: MANUAL
LOCATION WRT MAJOR COMPONENTS: BETWEEN REHEATER AND STACK
FLUE GAS FLOW RATE - ACFM: _____
FLUE GAS TEMPERATURE - F: 175-185
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: LOW ALLOY STEEL
MATERIAL SPECIFIC TYPE: N/A
MATERIAL TRADE/COMMON NAME: COR-TEN

DAMPERS

LOCATION: (A) INLET AND OUTLET (B) BYPASS
NUMBER OF DAMPERS: (A) 4 (TWO INLET, TWO OUTLET) (B) 2
FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) LOUVER (B) GUILLOTINE
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): (A) PARALLEL BLADE
(B) TOP-ENTRY
GUILLOTINE
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): (A) SINGLE LOUVER
MANUFACTURER: (A) COMBUSTION ENGINEERING
(B) SELF-DESIGNED AND INSTALLED BY KCP&L

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MODULATION (OPEN/CLOSED, ETC.): OPEN/CLOSED
SEAL AIR - ACFM: N/A
SERVICE CONDITIONS (MAX GAS TEMP/TIME): (A) 330-120 F (B) 330 F
MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
MATERIAL SPECIFIC TYPE: (A) HIGH STRENGTH LOW ALLOY
(B) HIGH STRENGTH LOW ALLOY
MATERIAL TRADE/COMMON NAME: (A) COR-TEN (B) COR-TEN
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET AND OUTLET (B) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) RECTANGULAR
(B) RECTANGULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.): (A) 4.5 FT X 26 FT, 3 FT X 26 FT
(B) 3 FT X 26 FT
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: (A) HIGH STRENGTH LOW ALLOY
(B) HIGH STRENGTH LOW ALLOY
SHELL MATERIAL TRADE/COMMON NAME: (A) COR-TEN (B) COR-TEN
LINER MATERIAL GENERIC TYPE: (A) INORGANIC (B) NONE
LINER MATERIAL SPECIFIC TYPE: (A) HYDRAULICALLY-BONDED MORTAR (B) N/A
LINER MATERIAL TRADE/COMMON NAME: (A) PLIBRICO GUNITE (B) N/A

EXPANSION JOINTS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): NEGATIVE
OPERATING TEMPERATURE - F: (A) 300 (B) 120 (C) 300
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: COMBUSTION ENGINEERING
R MATERIAL: VITON®-ASBESTOS

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER (BATCH)
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): AGITATED TANK
MANUFACTURER: COFFMAN INDUSTRIES
MATERIALS: CARBON STEEL
NUMBER OF DEVICES: 1
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: 57
PRODUCT QUALITY - % SOLIDS: 25
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: 7 (430 GAL/HR)
PREPARED REAGENT POINT OF ADDITION: REACTION TANK
ON-SITE STORAGE CAPABILITY - DAYS: 21

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KANSAS CITY POWER & LIGHT
HAWTHORN 4

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) RECYCLE (B) BLOWDOWN AND CLEAR WATER RETURN
(C) LIME SLURRY

DIMENSIONS - IN.: (A) 10 (B) 6 (C) 2

MANUFACTURER: KANSAS CITY RUBBER & BELTING

S MATERIAL: (A) RUBBER-LINED CARBON STEEL
(B) SCHEDULE 80 CARBON STEEL (FLANGED) (C) CARBON STEEL

MAJOR VALVES

LOCATION: (A) SUCTION & DISCHARGE ON RECYCLE PUMPS (B) BLOWDOWN LINE

FUNCTION (ISOLATION, CONTROL, ETC.): ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): KNIFEGATE

CONTROL MODE (AUTOMATIC/MANUAL): MANUAL

DIMENSIONS - IN.: (A) 10 (B) 4 & 6

MANUFACTURER:

T MATERIAL: TYPE 316L STAINLESS STEEL

THICKENERS

U NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 115 DIA X 10 DEPTH (7 FT STRAIGHT, 3 FT SLANTING)

CAPACITY - GAL: 75,000

SHELL MATERIAL GENERIC TYPE: CARBON STEEL (WALLS), CONCRETE (BOTTOM)

SHELL MATERIAL SPECIFIC TYPE: A SI 1110, HYDRAULICALLY-BONDED CONCRETE

SHELL MATERIAL TRADE/COMMON NAME: N/A, PORTLAND CEMENT

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME: CEILCOTE

RAKE MATERIAL: CARBON STEEL

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 12% SOLIDS

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 30%

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 13,900
SOLIDS
GPM

OUTLET STREAM DISPOSITION: TO ASH POND

OVERFLOW STREAM DISPOSITION: TO RECYCLE CANAL, ASH SLUICE PUMP

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):

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DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):

NUMBER OF DEVICES:

NUMBER OF SPARES:

CONFIGURATION:

DIMENSIONS - FT:

CAPACITY:

SHELL MATERIAL GENERIC TYPE:

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE:

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME:

BELT MATERIAL GENERIC TYPE:

BELT MATERIAL SPECIFIC TYPE:

BELT MATERIAL TRADE/COMMON NAME:

FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM DISPOSITION:

OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: N/A

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAO₂ - DRY: _____

PERCENT CACO₃ - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):

DEVICE (OXIDATION TANK, PUG MILL, ETC.):

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):

INLET FLOW RATE - GPM:

INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL

GENERIC TYPE (LANDFILL, POND, ETC.): POND

SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DIKED

COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): ABOVE GRADE

LOCATION (ON-SITE/OFF-SITE): ON-SITE

TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE

SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE

SITE DIMENSIONS - AREA/DEPTH: 40 ACRES/15 FT

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SITE CAPACITY - VOLUME/ACRE-FT/TONS: 600 ACRE-FEET
SITE SERVICE LIFE - YEARS: 2-3 YEARS

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: RECIRCULATING SLURRY
CHEMICAL PARAMETERS (PH, ETC.): PH
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): % SOLIDS
CONTROL LEVELS: PH 5.5-6.0, 10% SOLIDS
MONITOR TYPE (MANUFACTURER, ETC.):
MONITOR LOCATION: GRAB SAMPLES TO LABORATORY
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): MANUAL
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL):
TYPE (OPEN/CLOSED): OPEN
EVAPORATION WATER LOSS - GPM:
SLUDGE HYDRATION WATER LOSS - GPM:
SLUDGE INTERSTITIAL WATER LOSS - GPM:
POND SEEPAGE/RUNOFF WATER LOSS - GPM:
EFFLUENT WATER LOSS - GPM:
RECEIVING WATER STREAM NAME: MISSOURI RIVER
MAKEUP WATER ADDITION - GPM:
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): MISSOURI RIVER
MAKEUP WATER ADDITION POINTS & AMOUNTS:
MAKEUP WATER PRE-TREATMENT TYPE:

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIME
PRINCIPAL CONSTITUENTS: 93% CaO
SOURCE/SUPPLIER: ASHGROVE
SUPPLIER LOCATION: SPRINGFIELD, MISSOURI
CONSUMPTION (SPECIFY UNITS):
UTILIZATION - %:
POINT OF ADDITION: LIME SLAKER

V ECONOMICS (ADJUSTED FOR CONSISTENCY; MJD-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 12,700,000
CAPITAL COST - \$/KW: 57.5
OPERATING COST - MILLS/KWH: 2.84
MAINTENANCE COST: \$931,000/YR
LABOR COST: \$97,300/YR
UTILITIES COST: \$1,250,000/YR
CHEMICALS COST: \$341,000/YR
WASTE DISPOSAL COST:

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

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ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: N/A
SLAKER - %: 0
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 0
THICKENER - %: 0
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: N/A
SLAKER: 0
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 0
THICKENER: 0
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION TANK
NUMBER OF TANKS: 2
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): N/A
LOCATION: TANK IS BOTTOM OF ABSORBER
CONFIGURATION: RECTANGULAR
DIMENSIONS - FT: 18 X 26 X 20
CAPACITY - GAL: 56,000
RETENTION TIME - MIN: 10
NUMBER OF AGITATORS: 3
W AGITATOR CONFIGURATION: SIDE ENTRY
AGITATOR MATERIALS: CARBON STEEL SHAFT AND RUBBER-CLAD BLADES
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
X LINER MATERIAL GENERIC TYPE: STAINLESS STEEL
LINER MATERIAL SPECIFIC TYPE: TYPE 316L
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLURRY
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: BENEATH THE SLAKER
CONFIGURATION: CYLINDRICAL
DIMENSIONS - FT: 5 DIA X 4
CAPACITY - GAL: 550
RETENTION TIME - MIN: 30
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

U FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): CLEARWELL
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: NEXT TO THICKENER
CONFIGURATION: CYLINDRICAL
DIMENSIONS - FT: 28 DIA X 9.25

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CAPACITY - GAL: 41,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 0
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLAKER HOLD
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: CARBON STEEL
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): RECYCLE
NUMBER OF PUMPS: 2 (ONE PER MODULE)
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER: 6 X 13 LPO
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 5000
MOTOR BRAKE HP: 225
SPEED - RPM: 900
HEAD - FT: 135
SERVICE (PH, SOLIDS): 5.5, 12% SOLIDS
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: NI-HARD
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE: GRAY CAST IRON
IMPELLER MATERIAL TRADE/COMMON NAME: NI-HARD

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CLEAR WATER SUPPLY
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
Y COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: FAIRBANKS-MORSE
PUMP MODEL NUMBER: 5822 X 14 IN.
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 6400
MOTOR BRAKE HP: 300
SPEED - RPM: 1200
HEAD - FT: 130
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

U FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0

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GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3175
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 450
MOTOR BRAKE HP: 30
SPEED - RPM: 1200
HEAD - FT: 100
SERVICE (PH, SOLIDS): 12% SOLIDS
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

Z FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): BLOWDOWN
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3196
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 1000
MOTOR BRAKE HP: 30
SPEED - RPM: 1200
HEAD - FT: 90
SERVICE (PH, SOLIDS): PH 6.0-6.5
CASING MATERIAL GENERIC TYPE: CAST IRON
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): REHEATER FEED
NUMBER OF PUMPS: 4
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3735

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HAWTHORN 4

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 600
MOTOR BRAKE HP: 30
SPEED - RPM: 1800
HEAD - FT: 125
SERVICE (PH, SOLIDS): 10% SOLIDS
CASING MATERIAL GENERIC TYPE: STAINLESS STEEL
CASING MATERIAL SPECIFIC TYPE: AUSTENITIC
CASING MATERIAL TRADE/COMMON NAME: TYPE 304
AA IMPELLER MATERIAL GENERIC TYPE: STAINLESS STEEL
IMPELLER MATERIAL SPECIFIC TYPE: AUSTENITIC
IMPELLER MATERIAL TRADE/COMMON NAME: TYPE 304

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY
NUMBER OF PUMPS: 1
NUMBER OF SPARES: 0
BB GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): DISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): RECIPROCATING
COMMON DESIGN (V-BELT, ETC.): DIAPHRAGM
MANUFACTURER: BIF (GENERAL SIGNAL)
PUMP MODEL NUMBER: 1741-40-9841
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): HYDRAULIC
CAPACITY - GPM: 7
MOTOR BRAKE HP: 3
SPEED - RPM: 160 STROKES/MIN
HEAD - FT: 50 PSI
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: DUCTILE IRON
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: HYPALON DIAPHRAGM

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): MIST ELIMINATOR
WASH
NUMBER OF PUMPS: 4
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT DRIVE
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3196
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 2000
MOTOR BRAKE HP: 100
SPEED - RPM: 1800

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HEAD - FT: 140

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: CAST IRON

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: CAST IRON

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SCRUBBER MAKEUP

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT DRIVE

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: GOULDS

PUMP MODEL NUMBER: 3175

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 1700

MOTOR BRAKE HP: 40

SPEED - RPM: 1200

HEAD - FT: 65

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: CAST IRON

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: CAST IRON

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

UTILITY EMISSION CONTROL SYSTEM DATA
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HAWTHORN 4

COMMENTS/FOOTNOTES

- A TWO GRADES OF COAL ARE BLENDED AT HAWTHORN STATION AND NATURAL GAS IS USED WHEN AVAILABLE. TYPICALLY THE COAL BLEND IS 25% ARCH MINERAL (LOW SULFUR) AND 75% PEABODY (HIGH SULFUR).
- B PARTICULATE MATTER IS COLLECTED WITH SO_2 IN THE MARBLE BED SCRUBBER/ABSORBER.
- C THE PROCESS WAS CHANGED TO LIME IN FEBRUARY, 1977 FROM A LIMESTONE INJECTION SYSTEM.
- D THERE WAS NO REQUEST FOR BIDS. THE UTILITY WAS CONSIDERING AN ESP WHEN COMBUSTION ENGINEERING PROPOSED THE SCRUBBING SYSTEM. COMBUSTION ENGINEERING PERFORMED THE PRELIMINARY DESIGN WORK SOMETIME BEFORE PRESENTING THE PLANS TO THE UTILITY.
- E THIS FIGURE INCLUDES ONLY THE SCRUBBER AND PUMPHOUSE, AND ONE-HALF OF THE AREA OCCUPIED BY THE LIME PREPARATION SYSTEM, THICKENER, AND CLEAR WELL (SINCE THEY ARE SHARED BY BOTH UNITS). OTHER ITEMS SUCH AS FANS AND THE AREA BETWEEN COMPONENTS THAT WOULD BE CONSIDERED PART OF THE SCRUBBER AREA ARE NOT INCLUDED.
- F THERE IS ONE OPERATOR AVAILABLE PER SHIFT (3 SHIFTS/DAY). THERE ARE FOUR MEN ON CLEANING DUTY PER SHIFT FOR TWO SHIFTS/DAY AND SIX MAINTENANCE MEN PER SHIFT FOR ONLY ONE SHIFT/DAY. ONE MODULE IS CLEANED EVERY NIGHT WHEN THE BOILER LOAD DROPS. DURING THIS PERIOD THE MIST ELIMINATOR IS WASHED AS WELL AS THE REHEATER TUBES (THE REHEATERS ARE CLEANED WITH A HIGH PRESSURE HOSE). THIS MEANS THAT THE ABSORBER, MIST ELIMINATOR AND REHEATER FOR A GIVEN MODULE ARE WASHED ONCE EVERY FOUR DAYS (THERE ARE FOUR MODULES FOR UNITS 3 AND 4 COMBINED). THE FANS ARE WASHED ONCE PER WEEK FOR TWO HOURS TO PREVENT VIBRATION PROBLEMS ASSOCIATED WITH SOLIDS ACCUMULATION. RECYCLE TANK HOLES ARE PATCHED ABOUT ONCE PER WEEK.
- G IN GENERAL THERE ARE NO OUTSIDE CONTRACTORS EMPLOYED AT HAWTHORN; HOWEVER, THEY ARE REQUIRED FOR EXTENSIVE OVERHAULS, DESIGN MODIFICATION, TANK AND MODULE RELINING, DAMPER REPLACEMENT, AND REHEATER REPLACEMENT.
- H THERE IS NO ROTATION OTHER THAN THAT RESULTING FROM A SENIORITY PROMOTION THAT MAY SEND AN INDIVIDUAL TO OR FROM THE SCRUBBER CREW.
- I THERE ARE TWO SCHEDULED BOILER OUTAGES PER YEAR, ONE IN SPRING AND ONE IN FALL. EACH OUTAGE DURATION IS THREE WEEKS.
- J THIS IS AN EARLY COMBUSTION ENGINEERING MARBLE BED DESIGN FOR CONTROL OF PARTICULATE MATTER AND SO_2 .
- K THE ORIGINAL CEILCOTE LINING FAILED BECAUSE OF TEMPERATURE EXCURSIONS, PH EXCURSIONS, AND WELDING DAMAGE.
- L THERE ARE 0.75-INCH DIAMETER GLASS MARBLES IN A 3 TO 4 INCH BED.
- M THE ORIGINAL FRP NOZZLES FAILED AND WERE REPLACED BY GALVANIZED STEEL AND COORS Al_2O_3 CERAMIC NOZZLES, BOTH OF WHICH FAILED, AND FINALLY WITH TYPE 316L STAINLESS STEEL NOZZLES.
- N THE ON-LINE WASH LANCES ARE NO LONGER OPERATED. THE MIST ELIMINATORS ARE WASHED WITH FIREHOSES AT LEAST ONCE EVERY OTHER DAY WHEN THE MODULE IS DOWN. THE UTILITY IS CONSIDERING THE RESUMPTION OF THE ON-LINE WASH LANCE SYSTEM OPERATION.
- O HOT WATER IS PIPED FROM THE BOILER DEAERATOR.

UTILITY EMISSION CONTROL SYSTEM DATA
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HAWTHORN 4

COMMENTS/FOOTNOTES (CONTINUED)

- P THESE WERE ORIGINALLY CARBON STEEL FIN TUBES; HOWEVER, THEY WERE REPLACED WITH STAINLESS STEEL BARE TUBES BECAUSE OF PLUGGING PROBLEMS.
- Q THE FAN BALANCE WILL BE LOST ABOUT ONCE PER WEEK BECAUSE OF SOLIDS ACCUMULATION. TO PREVENT/MINIMIZE THIS PROBLEM EACH FAN IS SHUT DOWN AND WASHED ONCE PER WEEK.
- R THE ELASTOMERIC EXPANSION JOINTS WERE INSTALLED AFTER THE COR-TEN, SAW-TOOTH, BELLOWS-TYPE EXPANSION JOINTS FAILED FROM CORROSION.
- S THE ORIGINAL BONDSTRAND FRP RECYCLE LINES WERE REPLACED WITH LINED CARBON STEEL.
- T THE SYSTEM CONTAINS SOME STAINLESS STEEL BALL VALVES WITH TEFLON® SEALS. MOST OF THE DEZURIK PLUG VALVES HAVE BEEN REPLACED.
- U SHARED BY UNITS 3 AND 4.
- V 15 HP DRIVE, 1150 RPM.
- W COMBINED FIGURES FOR UNITS 3 AND 4.
- X THE ORIGINAL CEILCOTE LINING FAILED BECAUSE OF TEMPERATURE EXCURSIONS, PH EXCURSIONS, AND WELDING DAMAGE.
- Y HORIZONTAL SPLIT CASE.
- Z THE BLOWDOWN PUMPS WERE ORIGINALLY INSTALLED TO DELIVER EXCESS THICKENER OVERFLOW ENTERING THE CLEARWELL TO THE DISPOSAL POND. THEY ARE SELDOM USED.
- AA THESE PUMPS HAVE MECHANICAL SEALS INSTEAD OF PACKINGS.
- BB THIS IS A HYDRAULICALLY OPERATED BALL-TYPE POSITIVE DISPLACEMENT PUMP.

Kansas City Power & Light
Hawthorn 3, 4

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Kansas City Power & Light Hawthorn 3	7/75	744	584	3A			Makeup water	Leak in the city water line
							ID fan	Plugged duct
							Scrubber outlet damper	Malfunctioned
				3B			Scrubber marbles	Lost from bed
	8/75	744	0	System	123		Spray header	Was damaged
				3A				
				3B				
				System	0		System	Problems encountered in July continued into August forcing the FGD system off line for the month
	9/75	720	358	3A			ID fan	ID fan for half the boiler was lost
				3B			Module	Outage due to mechanical repairs and replacement of pots, marbles, and covers in the marble bed
	10/75	744	180	System	164			
				3A			Pump	Recycle pump replaced
	11/75	720	C	3B			Boiler	Low boiler hours due to scheduled boiler outage
				System	0		Boiler	Boilers and scrubbers down due to scheduled turbine overhaul

(Continued)

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Hawthorn 3, 4

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Hawthorn 3 (Continued)	12/75	744	0	3A 3B System	0		Boiler	Continued scheduled outage for turbine overhaul
	1/76	744	0	3A 3B System	0		System	Cold weather related problems - frozen lines, lack of heat tracing, and lack of manpower due to boiler and turbine repair caused FGD outage
	2/76	696	503	3A 3B System	77		System	Scrubber outages resulted from plugging in the scrubber bed due to the conversion from under-bed to over-bed spray system
	3/76	744	0	3A 3B System	0		Spray system	Spray system converted to an under-bed configuration
							System	Cold weather problems and manpower constraints forced outage
							System bypass	Modified to a slide-gate damper arrangement
	4/76	720	0	3A 3B System	0		System	System remained down due to the continuation of manpower shortages
	5/76	744	0	3A 3B System	0		System	Manpower problems continued

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Kansas City Power & Light
Hawthorn 3, 4

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Hawthorn 3 (Continued)	6/76	720	505	3A 3B System	209		Mist eliminator wash system	Water lances changed from FRP to carbon steel to prevent the loss of nozzles inserts and the subsequent shattering of the lances
	7/76	744	0	3A 3B System	0		System	Utility began converting the system from limestone injection and tail end scrubbing to a lime-based scrubbing system
	8/76	744	0	3A 3B System	0		System	Outage due to system conversion
	9/76	720	0	3A 3B System	0		System	Outage due to continued system con- version and manpower commitments to coal mill repairs on Unit 5
	10/76	744		3A 3B System	0		System	Outage due to conversion
	11/76	720		3A 3B System	0		System	Outage due to conversion
	12/76	744		3A 3B System	0		System	Outage due to conversion

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Kansas City Power & Light
Hawthorn 3, 4

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Hawthorn 3 (Continued)	1/77	744		3A 3B System	D		System	Outage due to conversion
	2/77	672	383	3A 3B System	300		Miscellaneous equipment	Minor initial problems such as pump malfunctions, loss of slaking water, and process chemistry control were encountered at startup (lime scrubbing mode)
	3/77	744	482	3A 3B System	443			
	4/77	720	720	3A 3B System	408			
	5/77	744	736	3A 3B System	382			
	6/77	720	72	3A 3B System	72			The unit fired natural gas throughout the month with the exception of a 72-hour period during which coal was fired
	7/77	744	0	3A 3B System	0			The unit fired only natural gas, making scrubber operation unnecessary
	8/77	744	0	3A 3B System	0			The unit fired only natural gas, making scrubber operation unnecessary

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Hawthorn 3 (Continued)	9/77	720	0	3A 3B System	0			The unit continued to fire natural gas
	10/77	744	0	3A 3B System	0		Unit shutdown	Unit down due to lack of natural gas during outage, the reaction tanks and spray headers were replaced by stainless steel components
	12/77	744	541	3A 3B System	541			
	1/78	744	346	3A 3B System	346			
	2/78	672	167	3A 3B System	167			
	3/78	744	406	3A 3B System	406			
	4/78	720	548	3A 3B System	220			
	5/78	744	403	3A 3B System	403		Module	Preheater fire damage to module forced module to be down 456 hours
	6/78	720		3A 3B System				Operational data was unavailable from 6/78 to 3/79 due to plant strike

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Hawthorne 3 (Continued)	7/78	744		3A 3B System				
	8/78	744		3A 3B System				
	9/78	720		3A 3B System				
	10/78	744		3A 3B System				
	11/78	720		3A 3B System				
	12/78	744		3A 3B System				
	1/79	744		3A 3B System				
	2/79	672		3A 3B System				
	3/79	744		3A 3B System				
	4/79	720	130	3A 3B System	130		Boiler	Low boiler hours due to turbine outage
	5/79	744	409	3A 3B System	409			

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Hawthorn 3 (Continued)	6/79	720	696	3A 3B System				Boiler fired natural gas and FGD system was not needed
	7/79	744	744	3A 3B System				Unit continued to burn natural gas and FGD system was not used
	8/79	744	558	3A 3B System				Unit fired natural gas
	9/79	720	605	3A 3B System	605			Unit returned to fire coal
	10/79	744	677	3A 3B System	677			
	11/79	720	274	3A 3B System	274			
	12/79	744	684	3A 3B System	684			
	1/80	744	692	3A 3B System	692			
	2/80	696	696	3A 3B System	696	100		
	3/80	744	744	3A 3B System	744	100		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Hawthorn 3 (Continued)	4/80	720		3A 3B System	490		Boiler	Low FGD utilization of FGD occurred because of economizer outage (leaks)
	5/80	744		3A 3B System	446		Boiler	Continued economizer problems
	6/80	720		3A 3B System	475		Boiler	Continued economizer problems
	7/80	744	484	3A 3B System	484			
	8/80	744	642	3A 3B System			Reheater	Tube leak problem
	9/80	720	248	3A 3B System			Modules	67 hours outage to clean scrubbers
	10/80	744	245	3A 3B System	245	100		
	11/80	720	288	3A 3B System	288	80	Modules	143 hour outage to clean scrubbers
	12/80	744	182	3A 3B System	182	58	Modules	82 hour outage to clean scrubbers

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Kansas City Power & Light Hawthorn 4	7/75	744	518	4A 4A System	84		Marble bed	Plugging problems encountered in both modules
	8/75	744		4A 4B System	190		ID fan	Lost half of boiler ID fan causing both FGD modules to be shut down to prevent loss of the entire unit
	9/75	720	395	4A			Marble bed	Marble bed removed and replaced with stainless steel perforated bed (marbles removed because of continuing operational difficulties)
				4B System	208			
	10/75	744	721	4A 4B System	543			
	11/75	720	720	4A			Ductwork	Module shut down due to loss of draft through the ductwork from the economizer to the air preheater. Loss of draft also caused frequent plugging of reheater
				4B System	357			
	12/75	744	640	4A 4B System	52		Ductwork	Continued draft loss problem
	1/76	744	0	4A 4B System	0		System	System down all month due to cold weather related problems

(Continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Hawthorn 4 (Continued)	2/76	696	579	4A 4B System	225		Ductwork Marble bed Pump	Continued draft loss problem Experienced plugging problems Recycle pump malfunctions
	3/76	744	706	4A 4B System	12			
	4/76	720	550	4A 4B System	226		Scrubber bypass seals	Scrubber bypass seals replaced with slide-gate dampers
	5/76	744	506	4A 4B System	209		System	Utility began converting the system from limestone injection and tail end scrubbing to a lime based scrubbing system
	6/76	720	460	4A 4B System	158		Reheater	Plugging (one section of reheat tubes were removed to facilitate cleaning and maintenance work)
	7/76	744	0	4A 4B System	0		System	Outage due to conversion
	8/76	744	0	4A 4B System	0		System	Outage due to conversion
	9/76	720	0	4A 4B System	0		System	Outage due to continued system conversion and manpower commitments to coal mill repairs on Unit 5

(Continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Hawthorn 4 (Continued)	10/76	744	0	4A 4B System	0		System	Outage due to conversion
	11/76	720	486	4A 4B System	221			
	12/76	744	0	4A 4B System	0		System	Outage due to continued conversion
	1/77	744	572	4A 4B System	456			Unit became operational in lime scrubbing mode
	2/77	672	591	4A 4B System	380		Recycle tank	Plugging problems were encountered on suction side of recycle tank
	3/77	744	539	4A 4B System	482		Recycle tank	Plugging on suction side continued
	4/77	720	720	4A 4B System	311			Boiler burned natural gas for 408 hours
	5/77	744	740	4A 4B System	180			
	6/77	720	0	4A 4B System	0		System	Modules down for various equipment repairs. Underbed spray headers were replaced with 316LSS. Reaction tank was lined with a new liner. Carbon steel piping from recycle pumps to spray manifold was replaced with rubber-lined piping

(Continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Hawthorn 4 (Continued)	7/77	744	696	4A 4B System	120			
	8/77	744	550	4A 4B System	550			
	9/77	720	589	4A 4B System	520		Clarifier	Plugging problem encountered
	10/77	744	550	4A 4B System	550		Spray header System	Plugging problem encountered Liquid level in the internal reaction tank exceeded the control level, resulting in plugging of the inlet gas duct to the scrubber
	11/77	720	496	4A 4B System	496		Under nozzles	Plugging problem encountered
	12/77	744	520	4A 4B System	520			
	1/78	744	508	4A 4B System	508		Spray nozzles	Spray nozzle plugging was encountered. Some new spray nozzles were installed
							Pump	Strainer on recycle pump malfunctioned

(Continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Hawthorn 4 (Continued)	2/78	672	198	4A 4B System	198			
	3/78	744	471	4A 4B System	471		System	System down for 263 hours for maintenance (231 hours were during turbine repair outage)
	4/78	720	288	4A 4B System	288		System	System outage for general maintenance and cleaning
	5/78	744	421	4A 4B System			Clarifier	Outage due to clarifier plugging problems
	6/78	720		4A 4B System				Operational data was unavailable from 6/78 to 3/79 due to plant strike
	7/78	744		4A 4B System				
	8/78	744		4A 4B System				
	9/78	720		4A 4B System				
	10/78	744		4A 4B System				

(Continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Hawthorn 4 (continued)	11/78	720		4A 4B System				
	12/78	744		4A 4B System				
	1/79	744		4A 4B System				
	2/79	672		4A 4B System				
	3/79	744		4A 4B System				
	4/79	720	410	4A 4B System	410			
	5/79	744	699	4A 4B System	699		System	Outage was for cleaning and general maintenance
	6/79	720	101	4A 4B System	101		Boiler	Low boiler hours due to scheduled boiler overhaul
	7/79	744	692	4A 4B System				No scrubber related problems (boiler burned mostly natural gas)

(Continued)

Utility/unit	Date	period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Hawthorn 4 (Continued)	8/79	744	744	4A 4B System				Unit continued to burn mostly natural gas
	9/79	720	497	4A 4B System				Unit continued to burn mostly natural gas. No scrubber related problems occurred
	10/79	744	677	4A 4B System	677			
	11/79	720	274	4A 4B System	274			
	12/79	744	684	4A 4B System	684			
	1/80	744	0	4A 4B System	0		Boiler	Low boiler hours due to turbine overhaul
	2/80	696	0	4A 4B System	0		Boiler	Turbine repair
	3/80	744	0	4A 4B System	0		Boiler	Turbine repair
	4/80	720		4A 4B System	468		Boiler	Scheduled boiler maintenance

(Continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Hawthorn 4 (Continued)	5/80	744		4A 4B System	670			
	6/80	720		4A 4B System	706			
	7/80	744	580	4A 4B System			Underbed spray headers Boilers	A 53-hour outage was due to the replacing of the spray headers Most of system outage due to generator collector ring repairs
	8/80	744	569	4A 4B System				
	9/80	720	111	4A 4B System				
	10/80	744	509	4A 4B System	509	100		
	11/80	720	474	4A 4B System	474	72	Piping Modules	Leak problem encountered in blowdown line 203 hour outage to clean scrubbers
	12/80	744	440	4A 4B System	440	92	Modules	59 hour outage to clean scrubbers

KANSAS CITY POWER & LIGHT

LA CYGNE 1

Kansas City Power & Light
La Cygne 1

SECTION 1

BACKGROUND

During the late 1960's, Kansas Gas and Electric Company and Kansas City Power and Light (KCP&L) entered into a joint venture to construct La Cygne 1, an 874 MW (gross) coal-fired generating unit. Location of the plant site was prompted by nearby coal reserves and the availability of ample water supplies. However, the coal reserves proved to contain high levels of sulfur and ash (approximately 5 and 24%, respectively). Although construction of the unit began prior to implementation of the 1971 Federal NSPS, the owning utilities foresaw future state regulations that would specify compliance deadlines for existing sources for which La Cygne 1 would have to comply. As a result, it was determined that a full-scale FGD system would eventually be needed for control of particulate matter and sulfur dioxide emissions. The utilities contracted with Babcock and Wilcox (B&W), the boiler supplier, to install an FGD system as an integral part of the power plant (i.e., no bypass). At this time, B&W was also developing an FGD process for Commonwealth Edison to be used at their Will County facility. Follow-up research and a pilot test program conducted by B&W at its research and development center in Alliance, Ohio, led to the selection of a limestone FGD process for the La Cygne station.

Kansas City Power & Light
La Cygne 1

Initial operation of the unit with the FGD system in the gas path commenced in December 1972. Commercial operation of the FGD system began in June 1973 when seven absorber modules were placed on line. As a result of performance problems with the system, the utility was unable to operate the boiler at full load until July 1977 when an eighth absorber module was placed in service.

Kansas City Power & Light
La Cygne 1

SECTION 2

PROCESS DESCRIPTION

The La Cygne wet limestone FGD system consists of eight scrubber modules designed to treat a total boiler flue gas flow rate of 2,760,000 acfm at 285°F. Each scrubber module consists of a venturi scrubber for primary particulate control followed by a two-stage sieve tray SO₂ absorber. The modules were designed, manufactured, and installed by B&W as an integral part of the power plant generating facilities. Ductwork design is such that flue gas cannot bypass the scrubbing system, but the individual damper systems allow each module to be isolated for maintenance and repairs.

The boiler flue gas first enters the system through the venturi scrubber of each module, where it is contacted with limestone slurry. A continuous cycle of slurry is fed from a recycle tank to the venturi by a recirculation pump. On-site limestone grinding and slurry storage facilities provide the makeup slurry.

The gas flow then continues through the sump, turns 90 degrees in an upward direction, and proceeds through two layers of absorber sieve trays. Slurry is pumped to the absorber through spray nozzles, where it cascades down the trays counter to the flue gas flow. Excess slurry and reaction by-products are collected below in the sump.

Kansas City Power & Light
La Cygne 1

The venturi scrubber and tray tower absorber of each module use a common recirculation tank for completion of chemical reactions, addition of fresh alkali, and discharging of spent slurry and fly ash to the waste disposal area. The venturi recirculation line from the tank to the scrubber is equipped with a hydroclone which centrifugally separates large particles of scale from the scrubbing liquor and discharges them through a screen back to the recirculation tank. This helps to minimize plugging and erosion in the scrubber module. From each absorber, the saturated flue gas passes through a sieve tray mist pre-collector for initial entrainment separation that is followed by a chevron vane mist eliminator. Reheating is accomplished primarily by eight in-line steam reheaters. Supplementary reheat is provided on six of the eight modules when necessary by a hot air injection reheat system. In this system hot air from the boiler air preheater is ducted to the outlet of each module following the first bank of in-line reheater tubes but prior to the other in-line reheater tube banks.

Beyond each reheat section, the scrubbed flue gases enter a common plenum which discharges through six ducts. Each of the six ducts is equipped with an induced draft fan and is headered into one of two common ducts that discharge into the base of the stack.

Kansas City Power & Light
La Cygne 1

Spent scrubbing slurry is removed from the module recirculation tanks and discharged to a settling pond. Clear makeup water is returned from the pond and recycled to the ball mill and absorber modules. The settling pond is equipped with an overflow weir, which permits water to flow into a larger pond that is used primarily for plant cooling water.

A flow diagram for the La Cygne 1 FGD system is shown on the next page.

Flow Diagram: La Cygne 1

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/13/81 - 8/14/81

KANSAS CITY POWER & LIGHT
LA CYGNE 1

GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS CITY POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: KANSAS GAS & ELECTRIC
PLANT NAME: LA CYGNE
UNIT NUMBER: 1
PLANT ADDRESS: P.O. BOX 211
CITY: LA CYGNE
COUNTY: LINN
STATE: KANSAS
ZIP CODE: 66040
EPA REGION: 7

RIVER BASIN/LAKE REGION: MARAIS DES CYGNES

A REGULATORY CLASSIFICATION: STANDARD EQUAL TO OR LESS STRINGENT THAN NSPS
(12/71)

PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.128; 40% OPACITY

SO2 EMISSION LIMITATION - LB/MM BTU: 3.0

NOX EMISSION LIMITATION - LB/MM BTU: NONE

NET PLANT GENERATING CAPACITY - MW: 1450

GROSS UNIT GENERATING CAPACITY - MW: 874

NET UNIT GENERATING CAPACITY WITH FGD - MW: 820

B NET UNIT GENERATING CAPACITY W/O FGD - MW: 848

EQUIVALENT SCRUBBED CAPACITY - MW: 874

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: BABCOCK AND WILCOX

FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): CYCLONE (SUPERCRITICAL)

FURNACE FIRING METHOD: CYCLONE

WET BOTTOM/DRY BOTTOM: WET BOTTOM

FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED

SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE

COMMERCIAL SERVICE DATE: 6/73

DESIGN BOILER FLUE GAS FLOW - ACFM: 2,760,000

FLUE GAS TEMPERATURE - F: 285

FLUE GAS OXYGEN - %: 2.4 INTO SCRUBBER, 5.3 INTO STACK

HEAT RATE - BTU/KWH: 10,250

DESIGN FIRING RATE - TPH: 404

EXCESS AIR - %: 15-20 PLUS 5-10 LEAKAGE

CAPACITY FACTOR - %: 40

STACK HEIGHT - FT: 700

SHELL MATERIAL: CONCRETE

FLUE MATERIAL GENERIC TYPE: CARBON STEEL

FLUE MATERIAL SPECIFIC TYPE: AISI 1110

FLUE MATERIAL TRADE/COMMON NAME: N/A

C FLUE LINER MATERIAL GENERIC TYPE: ORGANIC

FLUE LINER MATERIAL SPECIFIC TYPE: INERT FLAKE/VINYL ESTER

FLUE LINER MATERIAL TRADE/COMMON NAME: PLASITE 4005

FLUE INNER DIAMETER - FT: 23.0

STACK GAS INLET TEMPERATURE - F: 150

STACK GAS OUTLET VELOCITY - FT/SEC: 90

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS CITY POWER & LIGHT
LA CYGNE 1

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS
NAME OF SUPPLIER: PITTSBURG & MIDWAY COAL CO.
MINE NAME/AREA: LA CYGNE
MINE LOCATION - COUNTY: LINN
MINE LOCATION - STATE: KANSAS
AVERAGE HEAT CONTENT - BTU/LB: 9400
RANGE HEAT CONTENT - BTU/LB: 9000-9700
AVERAGE ASH CONTENT - %: 25
RANGE ASH CONTENT - %: 25-35
AVERAGE MOISTURE CONTENT - %: 8.60
RANGE MOISTURE CONTENT - %: 9-10
AVERAGE SULFUR CONTENT - %: 5.4
RANGE SULFUR CONTENT - %: 5-6
AVERAGE CHLORIDE CONTENT - %: 0.027
RANGE CHLORIDE CONTENT - %: 0.02-0.03
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: WEEKLY

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED
SPACE REQUIREMENTS - SQ FT: N/A

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE
NUMBER OF SPARES:
TYPE (HOT SIDE/COLD SIDE):
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:
FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: 8
NUMBER OF SPARES: 0

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS CITY POWER & LIGHT
LA CYGNE 1

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.): VARIABLE THROAT/
SIDE-MOVABLE BLOCKS

TRADE/COMMON NAME: NONE

SUPPLIER: BABCOCK AND WILCOX

DIMENSIONS - FT: 21.5 LONG X 1.83 WIDE

SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL

SHELL MATERIAL SPECIFIC TYPE: TYPE 316L

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: INORGANIC

LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY-BONDED CONCRETE

LINER MATERIAL TRADE/COMMON NAME: KAOCRETE

BOILER LOAD PER SCRUBBER (DESIGN) - %: 12.5

GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): NONE

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A

D NUMBER OF SPRAY HEADERS: 2

NOZZLE MATERIAL: ALUMINUM OXIDE

NOZZLE PRESSURE DROP - PSI: _____

LIQUID RECIRCULATION RATE - GPM: 5000

L/G RATIO - GAL/1000 ACF: 17

PH CONTROL ADDITIVE: LIMESTONE

GAS-SIDE PRESSURE DROP - IN. H₂O: 10

SUPERFICIAL GAS VELOCITY - FT/SEC: 160

INLET GAS FLOW RATE - ACFM: 345,000

INLET GAS TEMPERATURE - F: 285

E INLET SO₂ LEVEL - PPM: 5000

INLET SO₂ LEVEL - LB/MM BTU: _____

INLET PARTICLE LEVEL - GR/SCF: 3.7

INLET PARTICLE LEVEL - LB/MM BTU: _____

OUTLET GAS FLOW RATE - ACFM: _____

OUTLET GAS TEMPERATURE - F: _____

OUTLET SO₂ LEVEL - PPM: _____

OUTLET SO₂ LEVEL - LB/MM BTU: _____

OUTLET PARTICLE LEVEL - GR/SCF: _____

OUTLET PARTICLE LEVEL - LB/MM BTU: _____

F SO₂ REMOVAL EFFICIENCY - %: 22

PARTICLE REMOVAL EFFICIENCY - %: 95

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIMESTONE

PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE

SYSTEM SUPPLIER: BABCOCK AND WILCOX

A-E FIRM: BLACK AND VEATCH

CONSTRUCTION FIRM: DANIELS CONSTRUCTION

APPLICATION (NEW/RETROFIT): NEW

PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0

SO₂ DESIGN REMOVAL EFFICIENCY - %: 80

CURRENT STATUS: OPERATIONAL

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/13/81 - 8/14/81

KANSAS CITY POWER & LIGHT
LA CYGNE 1

TERMINATION DATE: N/A
COMMERCIAL START-UP: 6/73
INITIAL START-UP: 12/72
G CONSTRUCTION COMPLETION: 6/73
CONSTRUCTION INITIATION: 4/69
CONTRACT AWARDED: 3/71
LETTER OF INTENT SIGNED: N/A
INITIATED BID REQUEST: _____
INITIATED PRELIMINARY DESIGN: _____

FGD DESIGN AND OPERATING PARAMETERS

H DESIGN COAL SULFUR CONTENT - %: _____
DESIGN COAL HEAT CONTENT - BTU/LB: _____
DESIGN COAL ASH CONTENT - %: _____
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: _____
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: 112,000 (SCRUBBERS) + 90,000
(REAGENT PREPARATION)

FGD SYSTEM TURNDOWN RATIO: 8:1
FGD SYSTEM TURNDOWN METHOD: TAKE TRAINS OFF LINE
FGD SYSTEM PRESSURE DROP - IN. H₂O: 23
FGD SYSTEM OXIDATION - %: 16
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: 18
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 18
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): LOWER
I FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 300
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 6.7
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): 20 (MONDAY THROUGH FRIDAY)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1

J FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): _____
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): DEDICATED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

K ROTATION TO FGD SYSTEM: _____
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): DEDICATED

FGD SYSTEM BYPASS CAPABILITY (YES/NO): NO
RESTRICTIONS TO USING BYPASS: N/A
TIME SCHEDULE FOR REDUCED BOILER LOAD: EVERY EVENING
L TIME SCHEDULE FOR BOILER SHUTDOWNS: SPRING AND FALL PLUS FIVE INTERIM
SHUTDOWNS

PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): CLEAN 1 MODULE (TRAYS, NOZZLES, MIST
ELIMINATOR, REHEATER, ETC.) AND 1 FAN

M PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): MAJOR OVERHAUL WORK, MODIFICATIONS, BACK
LOGGED REPAIRS

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): TIME PERMITTING, GENERAL MAINTENANCE AND REPAIRS ARE
PERFORMED

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/13/81 - 8/14/81

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LA CYGNE 1

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 8
NUMBER OF SPARES: 0
GENERIC TYPE: TRAY TOWER
SPECIFIC TYPE: SIEVE TRAY
TRADE/COMMON NAME: N/A
SUPPLIER: BABCOCK AND WILCOX
DIMENSIONS - FT: 32 X 16 X 65
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE EXCEPT ON FLOOR OF SUMP
LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED CONCRETE
LINER MATERIAL TRADE/COMMON NAME: KAOCRETE
BOILER LOAD PER ABSORBER - %: 12.5
GAS/LIQUID CONTACT DEVICE TYPE: PERFORATED TRAYS
NUMBER OF GAS CONTACTING ZONES: 2
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: 48
NUMBER OF SPRAY HEADERS: 6
NOZZLE MATERIAL: ALUMINUM OXIDE
N NOZZLE PRESSURE DROP - PSI: 12-15
LIQUID RECIRCULATION RATE - GPM: 10,000
L/G RATIO - GAL/1000 ACF: 33
GAS-SIDE PRESSURE DROP - IN. H2O: 3
SUPERFICIAL GAS VELOCITY - FT/SEC: 8.5
O ABSORBER TURNDOWN RATIO: 1:1
ABSORBER TURNDOWN METHOD: N/A

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INLET GAS FLOW RATE - ACFM: 238,500
INLET GAS TEMPERATURE - F: 122
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 122
OUTLET SO2 LEVEL - PPM: 1100
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.13
P SO2 REMOVAL EFFICIENCY - %: 80
PARTICLE REMOVAL EFFICIENCY - %: 95 (OVERALL)

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 8 (B) 8

NUMBER OF SPARES: 0

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) PERFORATED TRAYS (B) BAFFLE

COMMON DESIGN: (A) SIEVE TRAY (B) CLOSED VANE (CHEVRON)

MANUFACTURER: BABCOCK & WILCOX

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (A) N/A (B) Z-SHAPED

NUMBER OF STAGES: (A) 1 (B) 2 (ON 6 MODULES), 3 (ON 2 MODULES)

NUMBER OF PASSES/STAGE: (A) 1 (B) 3

FREEBOARD DISTANCE - FT: (A) 5.5 (B) 15

DISTANCE BETWEEN STAGES - IN.: (A) N/A (B) 3.5

DISTANCE BETWEEN VANES - IN.: (B) 3.0

VANE ANGLES - DEGREES: (B) 45

PRESSURE DROP - IN. H2O: (A) _____ (B) 1.4

SUPERFICIAL GAS VELOCITY - FT/SEC: (A) 8.5 (B) 8.4

CONSTRUCTION MATERIAL GENERIC TYPE: (A) STAINLESS STEEL (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) AUSTENITIC

(B) FIBER-REINFORCED POLYESTER

CONSTRUCTION MATERIAL TRADE/COMMON NAME: (A) TYPE 316L (B) HETRON® 72

WASH WATER SOURCE (FRESH, BLENDED,

SUPERNATANT): (A) NONE

(B) 50:50 BLEND OF FRESH LAKE WATER AND RECYCLE POND WATER

POINT OF WATER COLLECTION: RECYCLE TANK

Q WASH DIRECTION (OVERSPRAY/UNDERSPRAY,

FRONTSpray/BACKSPRAY): (A) N/A (B) FIRST STAGE OVERSPRAY

WASH FREQUENCY: (A) N/A (B) CONTINUOUS

WASH DURATION: (A) N/A (B) N/A

WASH RATE - GAL/MIN: (A) N/A (B) 160 PER MODULE

WASH COVERAGE - GAL/MIN/SQ FT: 0.16

UTILITY EMISSION CONTROL SYSTEM DATA
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REHEATER

R NUMBER OF REHEATERS: 8
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): STEAM
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): BARE TUBE
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: TOP OF ABSORBER VESSEL
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 30
INLET FLUE GAS FLOW RATE - ACFM: 238,500
INLET FLUE GAS TEMPERATURE - F: 122
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 150-175
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: 5 MODULES HAVE 4, 2 MODULES HAVE 8, 1
MODULE HAS 2
NUMBER OF BUNDLES PER BANK: 4
NUMBER OF TUBES PER BUNDLE: 32
STEAM OR WATER PRESSURE - PSIG: 170
STEAM OR WATER TEMPERATURE - F: 690
SELF CLEANING DEVICE TYPE: AUTO WASH ON 2 MODULES EVERY 4 DAYS
S MATERIAL GENERIC TYPE: STAINLESS STEEL
MATERIAL SPECIFIC TYPE: AUSTENITIC
MATERIAL TRADE/COMMON NAME: TYPE 316L

FANS

NUMBER OF FANS: (A) 3 (B) 6
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): (A) CENTRIFUGAL (B) CENTRIFUGAL
SUPPLIER: WESTINGHOUSE
FUNCTION (UNIT/BOOSTER): (A) UNIT (B) UNIT
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: (A) FORCED DRAFT
(B) INDUCED DRAFT
SERVICE (WET/DRY): (A) DRY (B) DRY
TYPE OF WASH: (A) NONE (B) 4 DAY CYCLE
LOCATION WRT MAJOR COMPONENTS: (A) AHEAD OF AIR PREHEATER
(B) AHEAD OF STACK
T FLUE GAS FLOW RATE - ACFM: (A) _____ (B) 440,000
FLUE GAS TEMPERATURE - F: (A) _____ (B) 150-175
PRESSURE DROP - IN. H2O: (A) 20 (B) 23
U MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
MATERIAL SPECIFIC TYPE: (A) AISI 1110 (B) AISI 1110
MATERIAL TRADE/COMMON NAME: (A) N/A (B) N/A

DAMPERS

LOCATION: (A) MODULE INLET (B) MODULE OUTLET (C) HOT AIR INJECTION
(D) FAN INLET (E) FAN OUTLET

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KANSAS CITY POWER & LIGHT
LA CYGNE 1

NUMBER OF DAMPERS: (A) 8 (B) 8 (C) 8 (D) 6 (E) 6
FUNCTION (CONTROL/SHUT-OFF): (A) CONTROL (B) CONTROL (C) SHUT-OFF
(D) SHUT-OFF (E) SHUT-OFF
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) LOUVER (B) LOUVER
(C) BUTTERFLY (D) LOUVER
(E) LOUVER
SPECIFIC TYPE (OPPOSED BLADE,
PARALLEL BLADE, ETC.): (A), (B), (D), & (E) PARALLEL BLADE MULTILOUVER;
(C) N/A

TRADE/COMMON DESIGN (SINGLE
LOUVER/DOUBLE LOUVER): (A), (B), (D), & (E) SINGLE LOUVER; (C) N/A
MANUFACTURER: (A) _____ (B) AIR CLEAN (C) _____ (D) _____
(E) _____

MODULATION (OPEN/CLOSED, ETC.): OPEN/CLOSED EXCEPT MODULE OUTLETS
SEAL AIR - ACFM: N/A
SERVICE CONDITIONS (MAX GAS TEMP/TIME): (A) 285 F (B) 122 F (C) _____
(D) 150-175 F (E) _____

V MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) STAINLESS STEEL
(C) CARBON STEEL (D) STAINLESS STEEL
(E) CARBON STEEL
MATERIAL SPECIFIC TYPE: (A) AISI 1110 (B) AUSTENITIC (C) AISI 1110
(D) AUSTENITIC (E) AISI 1110
MATERIAL TRADE/COMMON NAME: (A) N/A (B) TYPE 316L (C) N/A (D) TYPE 316L
(E) N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) BREECHING TO STACK
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) CIRCULAR, RECTANGULAR
(B) RECTANGULAR, CIRCULAR
(C) CIRCULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.): (A) 20 FT DIA, 10.5 FT X 10.5 FT
(B) 13 FT X 13 FT, 12 FT DIA
(C) 20 FT DIA

SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A

W LINER MATERIAL GENERIC TYPE: NONE; ORGANIC
LINER MATERIAL SPECIFIC TYPE: N/A; INERT FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: N/A; PLASITE 4005

EXPANSION JOINTS

X LOCATION: (A) UPSTREAM OF SCRUBBER INLET (B) DOWNSTREAM OF ME
(C) DOWNSTREAM OF REHEATER (D) IN PLENUM (E) FAN INLET
(F) FAN OUTLET (G) BREECHING (H) HOT AIR DUCT
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): (A), (B), (C), (D), & (E) NEGATIVE;
(F), (G), & (H) POSITIVE

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KANSAS CITY POWER & LIGHT
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OPERATING TEMPERATURE - F: 285-122
DESIGN CONFIGURATION (V-SHAPED, ETC.): V-SHAPED
MANUFACTURER: KANSAS CITY RUBBER & BELTING CO.
MATERIAL: GLASS FIBER-REINFORCED VITON®

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIMESTONE GRINDING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: KOPPERS HARDINGE

MATERIALS: CARBON STEEL LINED WITH NI-HARD

NUMBER OF DEVICES: 2

NUMBER OF SPARES: 1

Y FULL LOAD DRY FEED CAPACITY - TPH: 110

PRODUCT QUALITY - % SOLIDS: 20; 95% THRU 200 MESH

FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: 200

PREPARED REAGENT POINT OF ADDITION: RECIRCULATION TANKS

ON-SITE STORAGE CAPABILITY - DAYS: 0.5 (MILL PRODUCT STORAGE CAPACITY AT FULL LOAD)

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED

WATER, SLUDGE, ETC.): (A) SLURRY LINE (B) VENTURI/ABSORBER RECYCLE
(C) POND RETURN

DIMENSIONS - IN.: (A) 6 DIA (B) 18 DIA (C) 20 DIA

MANUFACTURER: (A) GATES AND LA FAVORITE

Z MATERIAL: (A) RUBBER-LINED CARBON STEEL (B) RUBBER-LINED CARBON STEEL
(C) RUBBER-LINED CARBON STEEL

MAJOR VALVES

LOCATION: (A) SLURRY LINE (B) VENTURI/ABSORBER RECYCLE (C) POND RETURN

FUNCTION (ISOLATION, CONTROL, ETC.): (A) CONTROL (B) ISOLATION
(C) ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): (A) KNIFEGATE (B) KNIFEGATE, BUTTERFLY
(C) BUTTERFLY

CONTROL MODE (AUTOMATIC/MANUAL): (A) AUTOMATIC (B) AUTOMATIC (C) MANUAL

DIMENSIONS - IN.: (A) 6 (B) 18 (C) 20

MANUFACTURER: FABRI (EXCEPT BUTTERFLY)

MATERIAL: TYPE 316 STAINLESS STEEL

THICKENERS

NUMBER OF THICKENERS: NONE

NUMBER OF SPARES:

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CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY:
MOISTURE CONTENT - % TOTAL FREE WATER: 76% (UP TO 24% SOLIDS)
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAOH2 - DRY: _____
PERCENT CACO3 - DRY: _____

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PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DIKED
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): ABOVE/BELOW GRADE
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE
SITE DIMENSIONS - AREA/DEPTH: 160 ACRES X 11 FT DEEP;
500 ACRES X 11 FT DEEP
SITE CAPACITY - VOLUME/ACRE-FT/TONS: 1760 ACRE-FT; 5500 ACRE-FT
SITE SERVICE LIFE - YEARS: 10 YRS ON NEW POND

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: (A) VENTURI INLET (B) MILL OUTLET
CHEMICAL PARAMETERS (PH, ETC.): (A) PH
PHYSICAL PARAMETERS (PERCENT SOLIDS,
DENSITY, FLOW, ETC.): (B) PERCENT SOLIDS
CONTROL LEVELS: PH 5.6-5.8, 20% SOLIDS
MONITOR TYPE (MANUFACTURER, ETC.): UNILOC
MONITOR LOCATION: PH AT VENTURI; SOLIDS IN MILLHOUSE
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): AUTOMATIC, MANUAL
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN
TYPE (OPEN/CLOSED): OPEN
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
MAKEUP WATER ADDITION - GPM: 1148
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: FRESH WATER - BALL MILL; SETTLING
POND RETURN WATER - RECYCLE TANK
MAKEUP WATER PRE-TREATMENT TYPE: _____

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CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIMESTONE
PRINCIPAL CONSTITUENTS: 91% CaCO_3 , 1% MgCO_3
SOURCE/SUPPLIER: BATES COUNTY ROCK (SUPPLIER)
SUPPLIER LOCATION: LA CYGNE, KANSAS
CONSUMPTION (SPECIFY UNITS): 81 TPH MAX., 70 TPH TYPICAL
UTILIZATION - %:
POINT OF ADDITION: BALL MILL

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 80,300,000
CAPITAL COST - \$/KW: 91.9
OPERATING COST - MILLS/KWH: 7.46
MAINTENANCE COST: \$15,300,000/YR
LABOR COST: \$1,490,000/YR
UTILITIES COST: \$5,470,000/YR
CHEMICALS COST: \$3,960,000/YR
WASTE DISPOSAL COST: _____

FGD SPARE CAPACITY INDICES

SCRUBBER - %: 0
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 17
BALL MILL - %: 100
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 0
THICKENER - %: N/A
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: 0
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 1
BALL MILL: 1
SLAKER: N/A
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 0
THICKENER: N/A
VACUUM FILTER: N/A
CENTRIFUGE: N/A

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PILOT PLANT

UNIT NUMBER: N/A

PARTICIPANTS:

PROCESS:

PLANT DESIGN:

SUPPLIER:

SERVICE DATE:

PERIOD OF OPERATION - MONTHS:

GAS FEED:

EQUIVALENT SCRUBBED CAPACITY - MW:

STATUS (ACTIVE/TERMINATED):

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIMESTONE SLURRY
MAKEUP

NUMBER OF TANKS: 2
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: AFTER BALL MILL
CONFIGURATION: CYLINDRICAL
DIMENSIONS - FT: 36 DIA X 26
CAPACITY - GAL: 200,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: RUBBER
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECYCLE
NUMBER OF TANKS: 8
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: DIRECTLY UNDERNEATH ABSORBER SUMPS
CONFIGURATION: CYLINDRICAL
DIMENSIONS - FT: 30 DIA X 24
CAPACITY - GAL: 116,000
RETENTION TIME - MIN: 7.3
NUMBER OF AGITATORS: 1 (ONE TANK HAS TWO)
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: RUBBER
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): DILUTION/MILL PRODUCT
NUMBER OF TANKS: 2
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: AFTER CLASSIFIER

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CONFIGURATION: RECTANGULAR
DIMENSIONS - FT: 14 X 10 X 12
CAPACITY - GAL: 12,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP ENTRY, 10 HP PADDLE, 4 FT DIA
AGITATOR MATERIALS: RUBBER-LINED CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY BOOSTER
HOLD

NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: NEAR POND
CONFIGURATION: CYLINDRICAL
DIMENSIONS - FT: 30 DIA X 24
CAPACITY - GAL: 116,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP ENTRY, 25 HP PADDLE, 8 FT DIA
AGITATOR MATERIALS: RUBBER-LINED CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: RUBBER
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): POND RETURN
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 16 X 30 D B
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 8500
MOTOR BRAKE HP: 900
SPEED - RPM: 1180
HEAD - FT: _____
SERVICE (PH, SOLIDS): 8, 0% (HIGH SULFITE IONS)
CASING MATERIAL GENERIC TYPE: BRONZE (CARBON STEEL SHAFT, STAINLESS STEEL SLEEVE)
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: BRONZE
IMPELLER MATERIAL SPECIFIC TYPE: 1130 BRONZE
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLURRY FEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: DENVER
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 200
MOTOR BRAKE HP: 40
SPEED - RPM: 1780
HEAD - FT: _____
SERVICE (PH, SOLIDS): 7.3, 20%
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: AISI 1110
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

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NUMBER OF PUMPS: 8
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: G-9-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 9000
MOTOR BRAKE HP: 400
SPEED - RPM: 500
HEAD - FT: 120
SERVICE (PH, SOLIDS): 5.5, 22-24%
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED DUCTILE IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): VENTURI
RECIRCULATION

NUMBER OF PUMPS: 8
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: G-9-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 6000
MOTOR BRAKE HP: 350
SPEED - RPM:
HEAD - FT: 98
SERVICE (PH, SOLIDS): 5.5, 22-24%
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED DUCTILE IRON
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CLASSIFIER FEED
NUMBER OF PUMPS: 4 (2/MILL)
NUMBER OF SPARES: 2 (1/MILL)
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

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COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: DENVER
PUMP MODEL NUMBER:
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 3000
MOTOR BRAKE HP: 200
SPEED - RPM: 475
HEAD - FT: 95
SERVICE (PH, SOLIDS): 7.2, 30-35%
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SPENT SLURRY
BOOSTER

NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: WARMAN
PUMP MODEL NUMBER: 300-RS-L
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM:
MOTOR BRAKE HP: 231
SPEED - RPM: 775
HEAD - FT:
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: AISI 1110
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: BRASS
IMPELLER MATERIAL SPECIFIC TYPE: N/A
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): RECIRCULATION TANK
DRAIN PUMP

NUMBER OF PUMPS: 1
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE ADMISSION INTAKE
MANUFACTURER: DENVER
PUMP MODEL NUMBER:

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PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 3000

MOTOR BRAKE HP: 125

SPEED - RPM: 475

HEAD - FT: 95

SERVICE (PH, SOLIDS): 5.5, 20-24%

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: AISI 1110

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

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COMMENTS/FOOTNOTES

- A KANSAS STATE APECR 28-19-31 (A), (B), & (C).
B 848 to 850.
C THE FLUE WAS ORIGINALLY LINED WITH A RIGIFLAK Lining WHICH FAILED IN 6 MONTHS. THE PLASITE 4005 Lining HAS BEEN INSTALLED THREE TIMES.
D THERE ARE 44 SPRAY NOZZLES.
E 5200 PPM MAX.
F 8 TO 35%.
G THE 8TH MODULE WAS ADDED IN 1977.
H THE FGD SYSTEM WAS UNDERDESIGNED. THE SYSTEM WAS DESIGNED TO ACCOMMODATE AN INLET SO₂ CONCENTRATION OF 5000 PPM. THE ACTUAL INLET SO₂ CONCENTRATION OFTEN RISES TO 5200 PPM.
I THE OPERATING AND MAINTENANCE INFORMATION SHOWN IN THIS SECTION CONSISTS OF AVERAGES AND RANGES. THE ACTUAL BREAKDOWN IS SHOWN BELOW:
 OPERATING PERSONNEL
 6 OPERATORS/SHIFT (MONDAY THROUGH THURSDAY)
 7 OPERATORS/SHIFT (FRIDAY THROUGH SUNDAY)
 MAINTENANCE PERSONNEL (MONDAY THROUGH FRIDAY 1 SHIFT/DAY)
 8 JOURNEYMEN MECHANICS
 2 APPRENTICE MECHANICS
 2 HELPERS
 1 WELDER
 2 ELECTRICIANS
 2 TECHNICIANS
 1 SHIFT FOREMAN (7 DAYS/WEEK, 3 SHIFTS/DAY)
 1 ELECTRICAL FOREMAN (MONDAY THROUGH FRIDAY 1 SHIFT/DAY)
 1 MECHANICAL FOREMAN (MONDAY THROUGH FRIDAY 1 SHIFT/DAY)
 OTHER PERSONNEL (MONDAY THROUGH FRIDAY 1 SHIFT/DAY)
 1 PROCESS ATTENDANT
 1 ENGINEER
J DURING MAJOR BOILER OUTAGES OUTSIDE CONTRACTORS ARE BROUGHT IN TO PERFORM MAJOR FGD SYSTEM OVERHAUL TASKS. THESE CONSIST OF BOILER MAKERS, WELDERS, PAINTERS, INSULATORS, CARPENTERS, ETC. OUTSIDE CONTRACTORS WORK IN CREWS OF APPROXIMATELY 150/DAY AND 75/NIGHT. THE ACTUAL MANHOURS/YEAR FIGURE IS NOT AVAILABLE.
K FGD SYSTEM OPERATORS ARE NOT ROTATED WITH THE BOILER WORKERS. THE MAINTENANCE CREWS, HOWEVER, ARE ROTATED EVERY 12 TO 18 MONTHS. THERE ARE 21 MAINTENANCE AREAS, ONE OF WHICH IS THE SCRUBBER. AREA MOVES ARE MADE BY SENIORITY REQUESTS. HOLES ARE FILLED BY JUNIOR PERSONNEL.
L THE TIME SCHEDULE OF ANNUAL BOILER SHUTDOWNS IS AS FOLLOWS:
 (a) ONE 4 TO 6-WEEK FALL OUTAGE
 (b) ONE 4-WEEK SPRING OUTAGE
 (c) THREE 1-WEEK INTERIM OUTAGES
THIS GIVES A TOTAL OF 11 TO 13 WEEKS OF SCHEDULED OUTAGES. THE FALL OUTAGE IS SCHEDULED FOR 4 WEEKS WHEN ONLY THE BOILER IS TO BE OVERHAULED. 6 WEEKS ARE SCHEDULED WHEN THE TURBINE OVERHAUL COINCIDES WITH THE BOILER OVERHAUL.

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COMMENTS/FOOTNOTES (CONTINUED)

- M DURING SCHEDULED OUTAGES ALL DUCTWORK IS CHECKED FOR EROSION AND CORROSION. THE DUCTWORK INTERIOR IS PAINTED ON EACH OUTAGE. EXPANSION JOINTS AND RUBBER-LINED PIPING ARE CHECKED AND REPLACEMENTS ARE MADE AS NECESSARY. ONE FAN ROTOR IS TYPICALLY REPLACED PER YEAR (THERE ARE SIX FANS, THE ROTORS SEEM TO LAST ABOUT SIX YEARS). THE STACK LINER IS REPAIRED/REPLACED (PLASITE 4005). NEW ABSORBER AND VENTURI NOZZLES ARE INSTALLED WHERE NECESSARY; THE REST ARE CLEANED. REHEATER TUBE BANKS ARE THOROUGHLY CLEANED AND REPLACEMENTS ARE MADE IF NECESSARY. WEAK OR FAILING PREMIST ELIMINATORS, MIST ELIMINATORS, AND ABSORBER TRAYS ARE CHANGED. THE BALL MILLS ARE THOROUGHLY CHECKED AND PERIODICALLY OVERHAULED (REDUCTION GEARBOX, REVERSE BALL GEARS, OIL/SLURRY SEALS, ETC.). THE ID FAN BEARINGS ARE CHECKED AND CLEANED.
- N 332 TO 416 IN. H₂O.
- O THE UTILITY TRIES TO KEEP THE INDIVIDUAL MODULES AT ABOUT 105 MW FLUE GAS FLOW TO MAINTAIN PARTICULATE MATTER COLLECTION IN THE VENTURIS.
- P VARIES WITH INLET SO₂ LOADING.
- Q THERE HAD BEEN A MIST ELIMINATOR UNDERSPRAY SYSTEM BUT THIS HAS SINCE BEEN CHANGED TO AN OVERSPRAY DESIGN.
- R THERE IS ALSO A HOT-AIR INJECTION REHEAT SYSTEM THAT IS CONNECTED TO 6 OF THE 8 MODULES. IN THIS SYSTEM HOT AIR FROM THE BOILER AIR PREHEATER IS DUCTED TO THE SCRUBBER OUTLET DUCT BETWEEN STEAM COIL REHEAT TUBE BANKS. THE SYSTEM IS ONLY USED WHEN THE MODULE OUTLET DUCT TEMPERATURE DROPS BELOW 150 F (AFTER STEAM REHEAT).
- S ORIGINALLY THE REHEAT TUBES WERE MADE OF TYPE 304 STAINLESS STEEL. THESE FAILED PARTICULARLY WHERE THE TUBES MET THE TUBE SHEETS AT EITHER SIDE. THESE WERE REPLACED WITH TYPE 316L STAINLESS STEEL TUBES. FAILURES SUCH AS THOSE EXPERIENCED WITH THE EARLIER MATERIAL HAVE NOT OCCURRED. EXCEPT FOR A SLIGHT POLISHED APPEARANCE OF THE TUBES AT THE TUBE SHEET JUNCTION, THERE HAVE BEEN NO SIGNS OF POTENTIAL FAILURE. THE UTILITY ATTRIBUTES THIS TO THE FACT THAT THE REHEAT TUBES ARE ONLY SHUT DOWN DURING BOILER OUTAGES. THEY ARE LEFT IN SERVICE EVEN DURING CLEANING. IT IS FELT THAT CONTINUAL TEMPERATURE FLUCTUATIONS FROM THE FULL LOAD MAXIMUM DOWN TO AMBIENT WEAKENS THE MATERIAL.
- T THE ID FANS ARE RATED AT 440,000 ACFM AT 153 F AND 41 INCHES H₂O.
- U SOME OF THE BOOSTER FANS ARE LINED WITH GLASS-REINFORCED POLYMERIC MATERIALS (PLASITE 4005), SOME HAVE INCONEL ROTORS, AND SOME HAVE INCONEL CLIPS ON THE ROTORS TO PREVENT ABRASION.
- V CARBON STEEL MODULE OUTLET DAMPERS CORRODED BADLY AND WERE REPLACED WITH TYPE 316L STAINLESS STEEL DAMPERS. THE CARBON STEEL FAN OUTLET DAMPERS HAVE 316L STAINLESS STEEL SEAL STRIPS.
- W IN 1977, PLASITE 4005 WAS INSTALLED IN THE OUTLET DUCT FROM THE FAN TO THE STACK. IN HIGH WEAR AREAS, A LAYER OF GLASS FIBER WAS USED TO REINFORCE THE LINING.
- X THE DUCTS NUMBER AS FOLLOWS: (A) 8, (B) 8, (C) 4, (D) 12, (E) 6, (F) 4, AND (G) 6.
- Y 110 TPH MAX.; 85 TO 90 TPH IS TYPICAL.

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/13/81 - 8/14/81

KANSAS CITY POWER & LIGHT
LA CYGNE 1

COMMENTS/FOOTNOTES (CONTINUED)

- Z THE ORIGINAL NATURAL GUM RUBBER LINING IN THE SLURRY LINES WAS TOO SOFT AND IS BEING CHANGED TO SYNTHETIC RUBBER (TELEX 200).
- AA THE NEW POND HAS 10 MORE YEARS OF LIFE AT PRESENT. THIS CAN BE EXTENDED BY INCREASING THE SIZE OF THE DIKES.
- BB THERE IS ONE MILL PRODUCT TANK PER BALL MILL AND ALTHOUGH ONE OF THE TWO BALL MILLS IS A SPARE THE MILL PRODUCT TANK IS NOT CONSIDERED SPARE SINCE THERE IS NO CROSS OVER CAPABILITY FROM ONE MILL TO THE OTHER.
- CC 130 PSI.
- DD 26 PSI.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Kansas City Power & Light LaCygne 1	12/72	744		A B C D E F G System			Induced draft fans	Vibrations and sensitivity to imbalance
							Mist eliminator and strainers	Plugging
							Reheater	Reheater tube bundle corrosion problems due to con- densation of flue gas
Commercial start-up	6/73	720	294	A B C D E F G System	87			
	7/73	744	303	A B C D E F G System	95			
	8/73	744	699	A B C D				

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	9/73	720	95	E F G System	476			
	10/73	744	452	A B C D E F G System	50			
	11/73	720	463	A B C D E F G System	253			
	12/73	744	339	A B C D E F G System	266			
				A B C D E F G System	179			

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	0/74							The 1974 availability figures are based upon actual system operation hours as a function of actual boiler hours
	1/74	744	364	A B C D E F G System	182			
	2/74	672	364	A B C D E F G System	251			
	3/74	744	0	A B C D E F G System	0			
	4/74	720	332	A B C D E F G System	266		Boiler	Boiler down for entire month

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	5/74	744	506	A B C D E F G System	400			
	6/74	720	480	A B C D E F G System	413			
	7/74	744	313	A B C D E F G System	250			
	8/74	744	571	A B C D E F G System	485			
	9/74	720	606	A B C D E				

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	10/74	744	662	F G System	491			
	11/74	720	386	A B C D E F G System	503			
	12/74	744	0	A B C D E F G System	293			
	0/75			A B C D E F G System	0			The 1975 availability figures are based upon system available hours as a function of hours in the period
	1/75	744	0	A B C D E F G System	0		Boiler	Boiler shut down for entire month

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	2/75	672	0	A B C D E F G System	0		Boiler	Boiler shut down for entire month
	3/75	744	694	A B C D E F G System		82 96 90 77 93 92 96 89		
	4/75	720		System		100	Boiler	Boiler shut down for 600 hours
	5/75	744	683	A B C D E F G System		95 85 94 90 90 89 83 89		
	6/75	720	667	A B C D E F G System		88 85 84 85 84 86 89 86		
	7/75	744	590	A B C D		78 90 90 84		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	8/75	744	630	E		85	Generator and ID fan	384 hour outage due to generator and ID fan problems (avail. factors do not include this outage time)
				F		87		
				G		85		
				System		86		
	9/75	720	610	A		75		
				B		88		
				C		87		
				D		78		
				E		92		
				F		85		
				G		83		
				System		84		
				A		78		
				B		84		
				C		84		
				D		85		
	10/75	744	231	E		79		
				F		78		
				G		74		
				System		80		
				A		66		
				B		77		
				C		46		
				D		74		
	11/75	720	346	E		72		
				F		73		
				G		65		
				System		68		
				A		93		
				B		91		
				C		80		
				D		93		
				E		96		
				F		89		
				G		94		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	12/75	744	597	System		91	Generator and ID fan	312 hour outage due to generator and ID fan prob- lems (avail. factors do not include this outage time)
				A		91		
				B		87		
				C		81		
				D		85		
				E		87		
				F		89		
				G		84		
				System		86		
	1/76	744	621	A		86		
				B		85		
				C		91		
				D		72		
				E		84		
				F		82		
				G		84		
				System		83		
	2/76	696	595	A		94		
				B		90		
				C		86		
				D		91		
				E		92		
				F		93		
				G		95		
				System		92		
	3/76	744	643	A		92		
				B		90		
				C		88		
				D		93		
				E		94		
				F		91		
				G		91		
				System		91		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	4/76	720	143	A		92		
				B		91		
				C		89		
				D		97		
				E		96		
				F		98		
				G		95		
				System		94	System down	Scheduled outage. During outage some maintenance was performed on scrubber ductwork due to corrosion problems
	5/76	744	436	A		97		
				B		92		
				C		94		
				D		96		
				E		89		
				F		95		
				G		96		
				System		94		
	6/76	720	656	A		93		
				B		94		
				C		94		
				D		95		
				E		92		
				F		94		
				G		91		
				System		93	System down	Four forced scrubber outages (specific problem was not reported)
	7/76	744	688	A		96		
				B		95		
				C		92		
				D		93		
				E		93		
				F		94		
				G		94		
				System		94		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	8/76	744	521	A		94	System down	Stack lined with plastite 4005 during turbine blade repair outage (avail. factors do not include the 192 hours of outage time)
				B		93		
				C		92		
				D		93		
				E		92		
				F		90		
				G		88		
				System		92		
	9/76	720	0	A	0	100	System down	Turbine blade repair (system down entire month)
				B				
				C				
				D				
				E				
				F				
				G				
				System				
	10/76	744	256	A		97	System down	Turbine blade repair (system came back on line October 20 - 480 hours of outage during month of October)
				B		97		
				C		98		
				D		89		
				E		96		
				F		96		
				G		96		
				System		96		
	11/76	720	627	A		95		
				B		93		
				C		94		
				D		95		
				E		94		
				F		91		
				G		94		
				System		94		

Utility/unit	Date	Period hours	Boiler hours	Module	IGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	12/76	744	706	A		87	Venturi recycle pump	Specific problem was not reported
				B		89		
				C		81	Reheat tubes	Number of reheat tubes was increased
				D		94		
				E		94		
				F		95		
				G		91		
				System		9C		
	1/77	744	539	A		94		
				B		9C		
				C		9E		
				D		9E		
				E		9E		
				F		9E		
				G		9C		
				System		9E		
	2/77	672	590	A		9E		
				B		9E		
				C		9E		
				D		94		
				E		9E		
				F		94		
				G		8E		
				System		9E		
	3/77	744	558	A		94		
				B		9E		
				C		8E		
				D		94		
				E		91		
				F		9E		
				G		90		
				System		9E		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	4/77	720	384	A B C D E F G System		96 94 97 94 95 96 95 95		
	5/77	744	0	A B C D E F G System	0	100	System down Mist eliminator Reheat	Turbine repair Washing configuration being changed to work countercurrent to the gas flow Additional bundles added to increase reheater area
	6/77	720	0	A B C D E F G System	0	100	System down	Turbine repair
	7/77	744	485	A B C D E F G H System		95 93 94 95 95 95 95 95 95		

Utility/unit	Date	Period hours	Boiler hours	Module	IFGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	8/77	744	501	A		89	Recirculation pump	Motor burned up - 288 hours of outage time to remove and have restarted
				B		55		
				C		93		
				D		93		
				E		90		
				F		93		
				G		93		
				H		93		
				System		87		
	9/77	720	524	A		93		
				B		94		
				C		89		
				D		90		
				E		93		
				F		95		
				G		92		
				H		93		
				System		92		
	10/77	744	457	A		91		
				B		96		
				C		89		
				D		94		
				E		93		
				F		94		
				G		89		
				H		93		
				System		92		
	11/77	720	234	A		93		
				B		96		
				C		93		
				D		94		
				E		92		
				F		93		
				G		96		
				H		95		
				System		94		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	12/77	744	300	A		98		
				B		98		
				C		96		
				D		96		
				E		96		
				F		97		
				G		98		
				H		99		
				System		97		
	1/78	744	597	A		90		
				B		95		
				C		95		
				D		95		
				E		93		
				F		94		
				G		94		
				H		94		
				System		94		
	2/78	672	578	A		92		
				B		93		
				C		95		
				D		94		
				E		91		
				F		97		
				G		96		
				H		93		
				System		94		
	3/78	744	741	A		95		
				B		95		
				C		90		
				D		95		
				E		94		
				F		95		
				G		89		
				H		93		
				System		93		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	4/78	720	620	A		91	Reheater	Reheat tube bundles changed
				B		92		
				C		93		
				D		91		
				E		90		
				F		92		
				G		91		
				H		91		
				System		91		
	5/78	744	593	A		89	Reheater	Reheat tube bundles changed
				B		92		
				C		92		
				D		93		
				E		92		
				F		91		
				G		93		
				H		86		
				System		91		
	6/78	720	15	A				
				B				
				C				
				D				
				E				
				F				
				G				
				H				
				System				
	7/78	744	341	A		88	ID fan	Two ID fan rotors replaced
				B		97		
				C		92		
				D		94		
				E		88		
				F		93		
				G		93		
				H		95		
				System		93		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	8/78	744	577	A		92		
				B		93		
				C		95		
				D		96		
				E		93		
				F		94		
				G		95		
				H		95		
				System		94	Mist eliminator	Utility experimented with a 3-stage mist eliminator and some double-stage mist eliminators to see if frequency of reheater cleaning could be reduced
	9/78	720	720	A		96		
				B		96		
				C		96		
				D		96		
				E		96		
				F		96		
				G		95		
				H		97	ID fan	ID fan rotors were replaced
				System		96		
	10/78	744	255	A		96		
				B		96		
				C		98		
				D		97		
				E		97		
				F		98		
				G		97		
				H		96		
				System		97		
	11/78	720	720	A		92		
				B		95		
				C		94		
				D		93		
				E		94		
				F		93		
				G		94		
				H		96		
				System		94		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Ava-l- abi-ity	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	12/78	744	239	A		94		
				B		93		
				C		94		
				D		95		
				E		95		
				F		91		
				G		94		
				H		95		
				System		94		
	1/79	744	205	A		96		
				B		97		
				C		97		
				D		96		
				E		91		
				F		97		
				G		97		
				H		95		
				System		96		
	2/79	672	342	A		95		
				B		95		
				C		93		
				D		94		
				E		95		
				F		94		
				G		94		
				H		94		
				System		94		
	3/79	744	314	A		96		
				B		96		
				C		93		
				D		96		
				E		97		
				F		95		
				G		96		
				H		93		
				System		95		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	4/79	720	638	A		96		
				B		96		
				C		94		
				D		91		
				E		96		
				F		96		
				G		96		
				H		96		
				System		95		
	5/79	744	476	A		97		
				B		96		
				C		97		
				D		95		
				E		95		
				F		96		
				G		96		
				H		96		
				System		96		
	6/79	720	0	A				
				B				
				C				
				D				
				E				
				F				
				G				
				H				
				System	0	100	Boiler	Boiler down entire month
	7/79	744	0	A				
				B				
				C				
				D				
				E				
				F				
				G				
				System	0	100		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	8/79	744	231	A		87		
				B		96		
				C		96		
				D		96		
				E		96		
				F		96		
				G		89		
				H		97		
	9/79	720	618	System		94		
				A		96		
				B		96		
				C		96		
				D		94		
				E		97		
				F		96		
				G		96		
	10/79	744	436	H		97		
				System		96		
				A		95		
				B		96		
				C		95		
				D		93		
				E		94		
				F		95		
	11/79	720	0	G		95		
				H		95		
				System		95		
				A				
				B				
				C				
				D				
				E				
				F				
				G				
				H				
				System	0	0	System down	Extensive maintenance work to scrubber modules during the months of November and December

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	12/79	744	0	A B C D E F G H System	0	0	Spray header	Spray headers replaced on six modules
							Modules	Side walls replaced
							Dampers	Damper replaced
							Module outlet ducts	Replaced
							Ductwork	Patching repairs
	1/80	744	0	A B C D E F G H System	0	0	System down	Modules down for continued extensive repairs
	2/80	696	157	A B C D E F G H System	0	0	System down	Continued FGD repairs and generator/turbine overhaul
					122	99		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	3/80	744	32	A	23	95		
				B		9E		
				C		9E		
				D		9E		
				E		9E		
				F		9E		
				G		9E		
				H		9E		
	4/80	720	472	System	388	9E		
				A		9E		
				B		9E		
				C		9E		
				D		9E		
				E		9E		
				F		9E		
				G		9E		
	5/80	744	700	H		9E		
				System		9E		
				A		9E		
				B		9E		
				C		9E		
				D		9E		
				E		9E		
				F		9E		
	6/80	720	370	G	334	9E		
				H		9E		
				System		9E		
				A		9E		
				B		9E		
				C		9E		
				D		9E		
				E		9E		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	7/80	744	598	A	576	90		
				B		98		
				C		97		
				D		98		
				E		98		
				F		99		
				G		98		
				H		98		
				System		97		
	8/80	744	537	A	518	95		
				B		98		
				C		98		
				D		98		
				E		97		
				F		99		
				G		98		
				H		97		
				System		97		
	9/80	720	429	A	389	99		
				B		99		
				C		98		
				D		95		
				E		99		
				F		99		
				G		99		
				H		99		
				System		98		
	10/80	744	0	A	0	100	Boiler	Boiler down for annual turbine/boiler overhaul
				B				
				C				
				D				
				E				
				F				
				G				
				H				
				System				

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
LaCygne 1 (continued)	11/80	720	63	A	55	100	Module	Fire damage repairs
				B		100		
				C		100		
				D		0		
				E		100		
				F		100		
				G		100		
				H		100		
	12/80	720	513	System		88	Module	Fire damage repair continued
				A		98		
				B		98		
				C		98		
				D		0		
				E		99		
				F		98		
				G		95		
				H		99		
				System	427	86		

KANSAS POWER & LIGHT

JEFFREY 1, 2

SECTION 1

BACKGROUND

The Jeffrey Energy Center is a coal fired generating station owned by Kansas Power and Light (KP&L). The plant is located near Belvue, Kansas, and consists of four 720-MW (gross) units, two of which (Jeffrey 1 and 2) are presently operating. Jeffrey 1 and 2 fire a low-sulfur (0.32% S) Wyoming coal, and began operations in October 1978 and June 1980, respectively. Jeffrey Energy Center would fall under the 1971 Federal NSPS, however, the state standards are more stringent. Jeffrey 1 and 2 are subject to state emission regulations that limit particulate matter emissions to 0.1 pounds per million Btu and sulfur emissions to 1.5 pounds per million Btu (0.75 pounds SO₂ per million Btu). Although Jeffrey 1 and 2 did not require FGD systems, (the units passed compliance testing without the FGD systems in service), the utility installed them so that a variety of coals could be burned and to facilitate the acquisition of future permits which would expand the generating capacity of the station.

In July 1973 KP&L awarded a contract to Combustion Engineering to design and supply a limestone scrubbing system for units 1, 2 and 3. Design of the Jeffrey FGD system was based upon spray tower studies undertaken at the Lawrence Energy Center.

SECTION 2

PROCESS DESCRIPTION

The emission control system for each of the Jeffrey units consists of two cold-side ESP's followed by a limestone FGD system. Each system includes six vertical-spray towers, one of which is a spare. The systems are designed to remove 80% of the SO_2 from 75% of the boiler flue gas (i.e., 60% overall). The remaining 25% of the flue gas is bypassed for reheat of the scrubbed gas.

Following the 98.6% efficient ESP's, the flue gas (363,000 acfm at 276°F) enters the bottom of the absorber modules and passes through two spray zones located above the gas inlet. Four reaction tanks are provided for each system. Slurry is recycled through the absorber at a rate of 14,400 gpm.

Entrained droplets of moisture and slurry are removed in the mist elimination section in the spray towers. Each system includes a bulk-entrainment separator followed by two stages of chevron vanes.

A mixing chamber is provided for each system to permit mixing of the scrubbed gas stream with the bypass gas stream. The gas then exits through separate 600 foot stacks (one for each unit).

Kansas Power & Light
Jeffrey 1, 2

Spent scrubbing slurry collected in the reaction tanks is bled to a common transfer tank as 10% solids sludge. The sludge is currently pumped wet with the boiler bottom ash and disposed of on-site in the bottom ash pond. Water returned from the pond is blended with cooling tower blowdown and used as makeup in the reaction tanks.

A flow diagram for the Jeffrey 1, 2 FGD systems is shown on the next page.

Flow Diagram: Jeffrey 1 or 2

Kansas Power & Light
Jeffrey 1, 2

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 10/7/81

KANSAS POWER & LIGHT
JEFFREY 1

GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: KANSAS GAS & ELECTRIC, MISSOURI PUBLIC SERVICE, AND
CENTRAL TELEPHONE & UTILITIES
PLANT NAME: JEFFREY ENERGY CENTER
UNIT NUMBER: 1
PLANT ADDRESS: P.O. BOX 40
CITY: ST. MARYS
COUNTY: POTTAWATOMIE
STATE: KANSAS
ZIP CODE: 66536
EPA REGION: 7
RIVER BASIN/LAKE REGION: KANSAS
REGULATORY CLASSIFICATION: STATE STANDARD MORE STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 0.70
NOX EMISSION LIMITATION - LB/MM BTU: 1.2
NET PLANT GENERATING CAPACITY - MW: 2040
GROSS UNIT GENERATING CAPACITY - MW: 720
NET UNIT GENERATING CAPACITY WITH FGD - MW: 680
NET UNIT GENERATING CAPACITY W/O FGD - MW: 680
EQUIVALENT SCRUBBED CAPACITY - MW: 540

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 9/78
DESIGN BOILER FLUE GAS FLOW - ACFM: 2,781,000
FLUE GAS TEMPERATURE - F: 276
FLUE GAS OXYGEN - %: 5-6
HEAT RATE - BTU/KWH: _____
DESIGN FIRING RATE - TPH: 2500 (STEAM)
EXCESS AIR - %: 22
CAPACITY FACTOR - %: _____
STACK HEIGHT - FT: 600
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: ACID-RESISTANT BRICK AND MORTAR
FLUE MATERIAL SPECIFIC TYPE: _____
FLUE MATERIAL TRADE/COMMON NAME: _____
FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 26.0
STACK GAS INLET TEMPERATURE - F: 170
STACK GAS OUTLET VELOCITY - FT/SEC: 80 (MAXIMUM)

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KANSAS POWER & LIGHT
JEFFREY 1

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS
NAME OF SUPPLIER: AMAX COAL COMPANY
MINE NAME/AREA: BELLE AYR MINE
MINE LOCATION - COUNTY: _____
MINE LOCATION - STATE: WYOMING
AVERAGE HEAT CONTENT - BTU/LB: 8125
RANGE HEAT CONTENT - BTU/LB: _____
AVERAGE ASH CONTENT - % 5.8
RANGE ASH CONTENT - %: _____
AVERAGE MOISTURE CONTENT - % 30.0
RANGE MOISTURE CONTENT - %: _____
AVERAGE SULFUR CONTENT - %: 0.32
RANGE SULFUR CONTENT - %: _____
AVERAGE CHLORIDE CONTENT - %: 0.01
RANGE CHLORIDE CONTENT - %: _____
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARFS: _____
TYPE: _____
SUPPLIER: _____
INLET FLUE GAS CAPACITY - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: _____
PRESSURE DROP - IN. H2O: _____
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: _____

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: C. E. WALTHER
INLET FLUE GAS CAPACITY - ACFM: 1,407,000
INLET FLUE GAS TEMPERATURE - F: 320
PRESSURE DROP - IN. H2O: 1.2
PARTICLE OUTLET LOAD - GR/SCF: <0.1
PARTICLE REMOVAL EFFICIENCY - % 98.6
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
JEFFREY 1

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %
PARTICLE REMOVAL EFFICIENCY - %

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIMESTONE
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: BLACK & VEATCH
CONSTRUCTION FIRM: COMBUSTION ENGINEERING
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0
SO₂ DESIGN REMOVAL EFFICIENCY - %: 60
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
JEFFREY 1

COMMERCIAL START-UP: _____
INITIAL START-UP: 8/78
CONSTRUCTION COMPLETION: _____
CONSTRUCTION INITIATION: _____
CONTRACT AWARDED: 7/73
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST _____
INITIATED PRELIMINARY DESIGN _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: _____
DESIGN COAL HEAT CONTENT - BTU/LB: _____
DESIGN COAL ASH CONTENT - %: _____
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: _____
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
FGD SYSTEM TURNDOWN RATIO: INFINITE
FGD SYSTEM TURNDOWN METHOD: TAKE TRAINS OFF LINE; REDUCE GAS FLOW
FGD SYSTEM PRESSURE DROP - IN. H2O: 9
FGD SYSTEM OXIDATION - %: 100
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 10
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): LOWER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 2
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): 4
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 2
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): 400
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): POOLED MAINTENANCE
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: NONE
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): POOLED ALSO
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: NONE
TIME SCHEDULE FOR REDUCED BOILER LOAD: NONE
TIME SCHEDULE FOR BOILER SHUTDOWNS: TWICE PER YEAR FOR 2 WEEKS EACH
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): NONE
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): SEE FAILURE DATA SHEET
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): SEE PM/INSPECTION DATA SHEET

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:

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KANSAS POWER & LIGHT
JEFFREY 1

LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 6
NUMBER OF SPARES: 1
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME:
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A
BOILER LOAD PER ABSORBER - %:
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 2
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: 152
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: REFRAX (SILICON CARBIDE)
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 14,400
L/G RATIO - GAL/1000 ACF: 40-50
GAS-SIDE PRESSURE DROP - IN. H2O: 4.0
SUPERFICIAL GAS VELOCITY - FT/SEC:
ABSORBER TURNDOWN RATIO: INFINITE
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM: 363,000
INLET GAS TEMPERATURE - F: 276
INLET SO2 LEVEL - PPM: 534
INLET SO2 LEVEL - LB/MM BTU:

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KANSAS POWER & LIGHT
JEFFREY 1

INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: <0.1
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 120-160
OUTLET SO2 LEVEL - PPM: 214 (OVERALL)
OUTLET SO2 LEVEL - LB/MM BTU: 0.3 (OVERALL)
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.1
SO2 REMOVAL EFFICIENCY - %: 60 (OVERALL)
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 6 (B) 6

NUMBER OF SPARES: 0

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) BAFFLE SLATS (B) BAFFLE

COMMON DESIGN: (A) BULK ENTRAINMENT SEPARATOR (B) CHEVRON VANE

MANUFACTURER: _____

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (B) A-FRAME

NUMBER OF STAGES: (A) 1 (B) 2

NUMBER OF PASSES/STAGE: (A) 1 (B) 2

FREEBOARD DISTANCE - FT: (A) _____ (B) 4

DISTANCE BETWEEN STAGES - IN.: (A) N/A (B) 12

DISTANCE BETWEEN VANES - IN.: (A) _____ (B) 3-4

VANE ANGLES - DEGREES: (A) _____ (B) VARIABLE

PRESSURE DROP - IN. H2O: (B) 1

SUPERFICIAL GAS VELOCITY - FT/SEC: _____

CONSTRUCTION MATERIAL GENERIC TYPE: (A) ORGANIC (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) FRP (B) FRP

CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (A) _____ (B) POND
RETURN
WATER

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY, _____

FRONTSpray/BACKSPRAY): (B) UNDERSPRAY/OVERSPRAY FOR FIRST STAGE,
UNDERSPRAY FOR SECOND STAGE

WASH FREQUENCY: 1/DAY

WASH DURATION: 15-30 MINUTES PER MODULE

WASH RATE - GAL/MIN: _____

WASH COVERAGE - GAL/MIN SQ FT.: _____

REHEATER

NUMBER OF REHEATERS: 1

NUMBER OF SPARES: 0

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KANSAS POWER & LIGHT
JEFFREY 1

NUMBER PER MODULE: _____
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): BYPASS
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): COLD SIDE
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): N/A
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: _____
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 25
TEMPERATURE INCREASE - F: 50
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 120
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 170
ENERGY REQUIREMENT - MM BTU/HR: N/A
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: _____
MATERIAL GENERIC TYPE: _____
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: 4
NUMBER OF SPARES: 1
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: GREEN FAN
FUNCTION (UNIT/BOOSTER): UNIT
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND SPRAY TOWERS
FLUE GAS FLOW RATE - ACFM: _____
FLUE GAS TEMPERATURE - F: 276
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
NUMBER OF DAMPERS: _____
FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF (C) _____
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): DOUBLE LOUVER
MANUFACTURER: _____
MODULATION (OPEN/CLOSED, ETC.): _____

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KANSAS POWER & LIGHT
JEFFREY 1

SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET TO REHEAT ZONE (C) REHEAT ZONE TO STACK
(D) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): RECTANGULAR (ALL)
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
(C) CARBON STEEL (D) CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) INORGANIC (D) NONE
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) COAL TAR EPOXY
(C) CHEMICALLY BONDED CONCRETE (D) N/A
LINER MATERIAL TRADE/COMMON NAME: (A) N/A (B) MARTEK 200
(C) SAUERISEN NO. 33 (D) N/A

EXPANSION JOINTS

LOCATION: 15 LOCATIONS
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): _____
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: 400 AND LESS
DESIGN CONFIGURATION (V-SHAPED, ETC.): POCKETED
MANUFACTURER: RAYBESTOS-MANHATTAN
MATERIAL: _____

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIMESTONE GRINDING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: KENNEDY VAN SAUN
MATERIALS: CARBON STEEL
NUMBER OF DEVICES: 3
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: 12 (EACH)
PRODUCT QUALITY - % SOLIDS: 60
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: REACTION TANKS
ON-SITE STORAGE CAPABILITY - DAYS: _____

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KANSAS POWER & LIGHT
JEFFREY 1

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) SLURRY FEED (B) OTHERS
DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: RUBBER-LINED CARBON STEEL (BOTH)

MAJOR VALVES

LOCATION: (A) WATER SYSTEM (B) _____
FUNCTION (ISOLATION, CONTROL, ETC.): (A) CONTROL (B) ISOLATION
TYPE (BALL, GLOBE, PLUG, ETC.): (A) BALL (B) PARTIAL PLUG
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: (B) DEZURIK
MATERIAL: _____

THICKENERS

NUMBER OF THICKENERS: NONE
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:

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DIMENSIONS - FT:

CAPACITY:

SHELL MATERIAL GENERIC TYPE:

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE:

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME:

BELT MATERIAL GENERIC TYPE:

BELT MATERIAL SPECIFIC TYPE:

BELT MATERIAL TRADE/COMMON NAME:

FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM DISPOSITION:

OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAOH2 - DRY: _____

PERCENT CACO3 - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: FORCED OXIDATION

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): RECYCLE STREAM

DEVICE (OXIDATION TANK, PUG MILL, ETC.): AIR SPARGERS IN REACTION TANKS

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): _____

INLET FLOW RATE - GPM: _____

INLET QUALITY - % SOLIDS: _____

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL

GENERIC TYPE (LANDFILL, POND, ETC.): POND

SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): _____

COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): _____

LOCATION (ON-SITE/OFF-SITE): ON-SITE

TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE

SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY LINING

SITE DIMENSIONS - AREA/DEPTH: 230 ACRES/80 FT

A SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____

SITE SERVICE LIFE - YEARS: 30 YRS

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KANSAS POWER & LIGHT
JEFFREY 1

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM:

CHEMICAL PARAMETERS (PH, ETC.): SO₂

PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____

CONTROL LEVELS:

MONITOR TYPE (MANUFACTURER, ETC.): DUPONT AND MEASUREX

MONITOR LOCATION:

PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): _____

PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): _____

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): _____

TYPE (OPEN/CLOSED): CLOSED

EVAPORATION WATER LOSS - GPM: _____

SLUDGE HYDRATION WATER LOSS - GPM: _____

SLUDGE INTERSTITIAL WATER LOSS - GPM: _____

POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____

EFFLUENT WATER LOSS - GPM: _____

RECEIVING WATER STREAM NAME: _____

MAKEUP WATER ADDITION - GPM: 577

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____

MAKEUP WATER ADDITION POINTS & AMOUNTS: _____

MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT

NAME (LIMESTONE, ADIPIC ACID, ETC.): LIMESTONE

PRINCIPAL CONSTITUENTS: _____

SOURCE/SUPPLIER: _____

SUPPLIER LOCATION: _____

CONSUMPTION (SPECIFY UNITS): 12,130 LB/HR

UTILIZATION - %: _____

POINT OF ADDITION: BALL MILL

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 36,200,000

CAPITAL COST - \$/KW: 50.2

OPERATING COST - MILLS/KWH: 0.58

MAINTENANCE COST: \$111,000/YR

LABOR COST: \$81,000/YR

UTILITIES COST: \$1,750,000/YR

CHEMICALS COST: \$205,000/YR

WASTE DISPOSAL COST: _____

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

ABSORBER - %: 20.0

MIST ELIMINATOR - %: _____

REHEATER - %: _____

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KANSAS POWER & LIGHT
JEFFREY 1

FAN - %: _____
BALL MILL - %: _____
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: N/A
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 1.0
MIST ELIMINATOR: _____
REHEATER: _____
FAN: _____
BALL MILL: _____
SLAKER: N/A
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: N/A
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: _____
PARTICIPANTS: _____
PROCESS: _____
PLANT DESIGN: _____
SUPPLIER: _____
SERVICE DATE: _____
PERIOD OF OPERATION - MONTHS: _____
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: _____
STATUS (ACTIVE/TERMINATED): _____

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KANSAS POWER & LIGHT
JEFFREY 1

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION
B NUMBER OF TANKS: 4
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED):
LOCATION: UNDERNEATH SPRAY TOWERS
CONFIGURATION:
DIMENSIONS - FT: 21.5 X 46
CAPACITY - GAL: 54,320
RETENTION TIME - MIN: 10
NUMBER OF AGITATORS: 2 PER TANK
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLUDGE STORAGE
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLUDGE TRANSFER
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____

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DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): MIST ELIMINATOR
WASH

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

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JEFFREY 1

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 6

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 14,000

MOTOR BRAKE HP:

SPEED - RPM: 500

HEAD - FT: 79

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER BLEED

NUMBER OF PUMPS: 4

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 200

MOTOR BRAKE HP:

SPEED - RPM:

HEAD - FT: 92

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE:

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE:

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE

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NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): POND RETURN

NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE FEED

NUMBER OF PUMPS: 4
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____

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JEFFREY 1

MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 615
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 90
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE TRANSFER
NUMBER OF PUMPS: 3
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ROBBINS & MEYERS
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): VARIABLE
CAPACITY - GPM: 43
MOTOR BRAKE HP: _____
SPEED - RPM: 41/324
HEAD - FT: 147
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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KANSAS POWER & LIGHT
JEFFREY 1

COMMENTS/FOOTNOTES

- A REPORTED DISPOSAL SPACE REQUIREMENT ESTIMATE IS 4 ACRE-FT/YEAR (AT 60% CAPACITY FACTOR).
- B TWO REACTION TANKS ARE EACH COMMON TO TWO SPRAY TOWERS AND TWO REACTION TANKS ARE EACH USED FOR ONE SPRAY TOWER.

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KANSAS POWER & LIGHT
JEFFREY 2

GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: KANSAS GAS & ELECTRIC, MISSOURI PUBLIC SERVICE, AND
CENTRAL TELEPHONE & UTILITIES
PLANT NAME: JEFFREY ENERGY CENTER
UNIT NUMBER: 2
PLANT ADDRESS: P.O. BOX 40
CITY: ST. MARYS
COUNTY: POTTAWATOMIE
STATE: KANSAS
ZIP CODE: 66536
EPA REGION: 7
RIVER BASIN/LAKE REGION: KANSAS
REGULATORY CLASSIFICATION: STATE STANDARD MORE STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 0.70
NOX EMISSION LIMITATION - LB/MM BTU: 1.2
NET PLANT GENERATING CAPACITY - MW: 2040
GROSS UNIT GENERATING CAPACITY - MW: 720
NET UNIT GENERATING CAPACITY WITH FGD - MW: 680
NET UNIT GENERATING CAPACITY W/O FGD - MW: 680
EQUIVALENT SCRUBBED CAPACITY - MW: 540

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 6/80
DESIGN BOILER FLUE GAS FLOW - ACFM: 2,781,000
FLUE GAS TEMPERATURE - F: 276
FLUE GAS OXYGEN - %: 5-6
HEAT RATE - BTU/KWH:
DESIGN FIRING RATE - TPH: 2500 (STEAM)
EXCESS AIR - %: 22
CAPACITY FACTOR - %:
STACK HEIGHT - FT: 600
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: ACID-RESISTANT BRICK AND MORTAR
FLUE MATERIAL SPECIFIC TYPE:
FLUE MATERIAL TRADE/COMMON NAME:
FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 26.0
STACK GAS INLET TEMPERATURE - F: 170
STACK GAS OUTLET VELOCITY - FT/SEC: 80 (MAXIMUM)

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KANSAS POWER & LIGHT
JEFFREY 2

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS
NAME OF SUPPLIER: AMAX COAL COMPANY
MINE NAME/AREA: BELLE Ayr MINE
MINE LOCATION - COUNTY: _____
MINE LOCATION - STATE: WYOMING
AVERAGE HEAT CONTENT - BTU/LB: 8125
RANGE HEAT CONTENT - BTU/LB: _____
AVERAGE ASH CONTENT - % 5.8
RANGE ASH CONTENT - %: _____
AVERAGE MOISTURE CONTENT - % 30.0
RANGE MOISTURE CONTENT - %: _____
AVERAGE SULFUR CONTENT - %: 0.32
RANGE SULFUR CONTENT - %: _____
AVERAGE CHLORIDE CONTENT - %: 0.01
RANGE CHLORIDE CONTENT - %: _____
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: C. E. WALTHER
INLET FLUE GAS CAPACITY - ACFM: 1,407,000
INLET FLUE GAS TEMPERATURE - F: 320
PRESSURE DROP - IN. H2O: 1.2
PARTICLE OUTLET LOAD - GR/SCF: <0.1
PARTICLE REMOVAL EFFICIENCY - % 98.6
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

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KANSAS POWER & LIGHT
JEFFREY 2

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %
PARTICLE REMOVAL EFFICIENCY - %

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIMESTONE
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: BLACK & VEATCH
CONSTRUCTION FIRM: COMBUSTION ENGINEERING
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0
SO₂ DESIGN REMOVAL EFFICIENCY - % 60
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

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KANSAS POWER & LIGHT
JEFFREY 2

COMMERCIAL START-UP: 6/80
INITIAL START-UP: 1/80
CONSTRUCTION COMPLETION: _____
CONSTRUCTION INITIATION: _____
CONTRACT AWARDED: 7/73
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST _____
INITIATED PRELIMINARY DESIGN _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: _____
DESIGN COAL HEAT CONTENT - BTU/LB: _____
DESIGN COAL ASH CONTENT - %: _____
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: _____
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
FGD SYSTEM TURNDOWN RATIO: INFINITE
FGD SYSTEM TURNDOWN METHOD: TAKE TRAINS OFF LINE; REDUCE GAS FLOW
FGD SYSTEM PRESSURE DROP - IN. H2O: 9
FGD SYSTEM OXIDATION - %: 100
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 10
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): LOWER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 2
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): 4
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 2
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): 400
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): POOLED MAINTENANCE
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: NONE
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): POOLED ALSO
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: NONE
TIME SCHEDULE FOR REDUCED BOILER LOAD: NONE
TIME SCHEDULE FOR BOILER SHUTDOWNS: TWICE PER YEAR FOR 2 WEEKS EACH
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): NONE
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): SEE FAILURE DATA SHEET
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): SEE PM/INSPECTION DATA SHEET

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:

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KANSAS POWER & LIGHT
JEFFREY 2

LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H₂O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 6
NUMBER OF SPARES: 1
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME: _____
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: _____
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A
BOILER LOAD PER ABSORBER - %: _____
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 2
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: 152
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: REFRAX (SILICON CARBIDE)
NOZZLE PRESSURE DROP - PSI: _____
LIQUID RECIRCULATION RATE - GPM: 14,400
L/G RATIO - GAL/1000 ACF: 40-50
GAS-SIDE PRESSURE DROP - IN. H₂O: 4.0
SUPERFICIAL GAS VELOCITY - FT/SEC: _____
ABSORBER TURNDOWN RATIO: INFINITE
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM: 363,000
INLET GAS TEMPERATURE - F: 276
INLET SO₂ LEVEL - PPM: 534
INLET SO₂ LEVEL - LB/MM BTU: _____

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INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: <0.1
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 120-160
OUTLET SO2 LEVEL - PPM: 214 (OVERALL)
OUTLET SO2 LEVEL - LB/MM BTU: 0.3 (OVERALL)
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.1
SO2 REMOVAL EFFICIENCY - %: 60 (OVERALL)
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 6 (B) 6

NUMBER OF SPARES: 0

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) BAFFLE SLATS (B) BAFFLE

COMMON DESIGN: (A) BULK ENTRAINMENT SEPARATOR (B) CHEVRON VANE

MANUFACTURER: _____

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (B) A-FRAME

NUMBER OF STAGES: (A) 1 (B) 2

NUMBER OF PASSES/STAGE: (A) 1 (B) 2

FREEBOARD DISTANCE - FT: (A) _____ (B) 4

DISTANCE BETWEEN STAGES - IN.: (A) N/A (B) 12

DISTANCE BETWEEN VANES - IN.: (A) _____ (B) 3-4

VANE ANGLES - DEGREES: (A) _____ (B) VARIABLE

PRESSURE DROP - IN. H2O: (B) 1

SUPERFICIAL GAS VELOCITY - FT/SEC: _____

CONSTRUCTION MATERIAL GENERIC TYPE: (A) ORGANIC (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) FRP (B) FRP

CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (A) _____ (B) POND
RETURN
WATER

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY,

FRONTSpray/BACKSPRAY): (B) UNDERSPRAY/OVERSPRAY FOR FIRST STAGE,
UNDERSPRAY FOR SECOND STAGE

WASH FREQUENCY: 1/DAY

WASH DURATION: 15-30 MINUTES PER MODULE

WASH RATE - GAL/MIN: _____

WASH COVERAGE - GAL/MIN SQ FT.: _____

REHEATER

NUMBER OF REHEATERS: 1

NUMBER OF SPARES: _____

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NUMBER PER MODULE:

GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): BYPASS

SPECIFIC TYPE (STEAM, HOT WATER, ETC.): COLD SIDE

COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): N/A

COMBUSTION FUEL SULFUR CONTENT - %: N/A

LOCATION:

AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 25

TEMPERATURE INCREASE - F: 50

INLET FLUE GAS FLOW RATE - ACFM: _____

INLET FLUE GAS TEMPERATURE - F: 120

OUTLET FLUE GAS FLOW RATE - ACFM: _____

OUTLET FLUE GAS TEMPERATURE - F: 170

ENERGY REQUIREMENT - MM BTU/HR: N/A

NUMBER OF HEAT EXCHANGER BANKS: N/A

NUMBER OF BUNDLES PER BANK: N/A

NUMBER OF TUBES PER BUNDLE: N/A

STEAM OR WATER PRESSURE - PSIG: N/A

STEAM OR WATER TEMPERATURE - F: N/A

SELF CLEANING DEVICE TYPE: _____

MATERIAL GENERIC TYPE: _____

MATERIAL SPECIFIC TYPE: _____

MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: 4

NUMBER OF SPARES: 1

DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL

SUPPLIER: GREEN FAN

FUNCTION (UNIT/BOOSTER): UNIT

APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT

SERVICE (WET/DRY): DRY

TYPE OF WASH: NONE

LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND SPRAY TOWERS

FLUE GAS FLOW RATE - ACFM: _____

FLUE GAS TEMPERATURE - F: 276

PRESSURE DROP - IN. H₂O: _____

MATERIAL GENERIC TYPE: CARBON STEEL

MATERIAL SPECIFIC TYPE: AISI 1110

MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS

NUMBER OF DAMPERS: _____

FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF (C) _____

GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER

SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____

TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): DOUBLE LOUVER

MANUFACTURER: _____

MODULATION (OPEN/CLOSED, ETC.): _____

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SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET TO REHEAT ZONE (C) REHEAT ZONE TO STACK
(D) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): RECTANGULAR (ALL)
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
(C) CARBON STEEL (D) CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) INORGANIC (D) NONE
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) COAL TAR EPOXY
(C) CHEMICALLY BONDED CONCRETE (D) N/A
LINER MATERIAL TRADE/COMMON NAME: (A) N/A (B) MARTEK 200
(C) SAUEREISEN NO. 33 (D) N/A

EXPANSION JOINTS

LOCATION: 15 LOCATIONS
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): _____
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: 400 AND LESS
DESIGN CONFIGURATION (V-SHAPED, ETC.): POCKETED
MANUFACTURER: RAYBESTOS-MANHATTAN
MATERIAL: _____

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIMESTONE GRINDING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: KENNEDY VAN SAUN
MATERIALS: CARBON STEEL
NUMBER OF DEVICES: 3
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: 12 (EACH)
PRODUCT QUALITY - % SOLIDS: 60
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: REACTION TANKS
ON-SITE STORAGE CAPABILITY - DAYS: _____

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TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) SLURRY FEED (B) OTHERS
DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: RUBBER-LINED CARBON STEEL (BOTH)

MAJOR VALVES

LOCATION: (A) WATER SYSTEM (B) _____
FUNCTION (ISOLATION, CONTROL, ETC.): (A) CONTROL (B) ISOLATION
TYPE (BALL, GLOBE, PLUG, ETC.): (A) BALL (B) PARTIAL PLUG
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: (B) DEZURIK
MATERIAL: _____

THICKENERS

NUMBER OF THICKENERS: NONE
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:

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DIMENSIONS - FT:

CAPACITY:

SHELL MATERIAL GENERIC TYPE:

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE:

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME:

BELT MATERIAL GENERIC TYPE:

BELT MATERIAL SPECIFIC TYPE:

BELT MATERIAL TRADE/COMMON NAME:

FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM DISPOSITION:

OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAO2 - DRY: _____

PERCENT CACO3 - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: FORCED OXIDATION

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): RECYCLE STREAM

DEVICE (OXIDATION TANK, PUG MILL, ETC.): AIR SPARGERS IN REACTION TANKS

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): _____

INLET FLOW RATE - GPM: _____

INLET QUALITY - % SOLIDS: _____

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL

GENERIC TYPE (LANDFILL, POND, ETC.): POND

SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): _____

COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): _____

LOCATION (ON-SITE/OFF-SITE): ON-SITE

TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE

SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY LINING

SITE DIMENSIONS - AREA/DEPTH: 230 ACRES/80 FT

A SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____

SITE SERVICE LIFE - YEARS: 30 YRS

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PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: _____

CHEMICAL PARAMETERS (PH, ETC.): SO₂

PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____

CONTROL LEVELS: _____

MONITOR TYPE (MANUFACTURER, ETC.): DUPONT AND MEASUREX

MONITOR LOCATION: _____

PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): _____

PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): _____

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): _____

TYPE (OPEN/CLOSED): CLOSED

EVAPORATION WATER LOSS - GPM: _____

SLUDGE HYDRATION WATER LOSS - GPM: _____

SLUDGE INTERSTITIAL WATER LOSS - GPM: _____

POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____

EFFLUENT WATER LOSS - GPM: _____

RECEIVING WATER STREAM NAME: _____

MAKEUP WATER ADDITION - GPM: 577

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____

MAKEUP WATER ADDITION POINTS & AMOUNTS: _____

MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT

NAME (LIMESTONE, ADIPIC ACID, ETC.): LIMESTONE

PRINCIPAL CONSTITUENTS: _____

SOURCE/SUPPLIER: _____

SUPPLIER LOCATION: _____

CONSUMPTION (SPECIFY UNITS): 12,130 LB/HR

UTILIZATION - %: _____

POINT OF ADDITION: BALL MILL

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 36,200,000

CAPITAL COST - \$/KW: 50.2

OPERATING COST - MILLS/KWH: 0.58

MAINTENANCE COST: \$111,000/YR

LABOR COST: \$81,000/YR

UTILITIES COST: \$1,750,000/YR

CHEMICALS COST: \$205,000/YR

WASTE DISPOSAL COST: _____

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

ABSORBER - %: 20.0

MIST ELIMINATOR - %: _____

REHEATER - %: _____

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FAN - %: _____
BALL MILL - %: _____
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: N/A
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 1.0
MIST ELIMINATOR: _____
REHEATER: _____
FAN: _____
BALL MILL: _____
SLAKER: N/A
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: N/A
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: _____
PARTICIPANTS: _____
PROCESS: _____
PLANT DESIGN: _____
SUPPLIER: _____
SERVICE DATE: _____
PERIOD OF OPERATION - MONTHS: _____
GAS FFFD: _____
EQUIVALENT SCRUBBED CAPACITY - MW: _____
STATUS (ACTIVE/TERMINATED): _____

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION

B NUMBER OF TANKS: 4

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED):

LOCATION: UNDERNEATH SPRAY TOWERS

CONFIGURATION:

DIMENSIONS - FT: 21.5 X 46

CAPACITY - GAL: 54,320

RETENTION TIME - MIN: 10

NUMBER OF AGITATORS: 2 PER TANK

AGITATOR CONFIGURATION: TOP ENTRY

AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLUDGE STORAGE

NUMBER OF TANKS:

NUMBER OF SPARES:

TYPE (OPEN/COVERED):

LOCATION:

CONFIGURATION:

DIMENSIONS - FT:

CAPACITY - GAL:

RETENTION TIME - MIN:

NUMBER OF AGITATORS:

AGITATOR CONFIGURATION:

AGITATOR MATERIALS:

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLUDGE TRANSFER

NUMBER OF TANKS:

NUMBER OF SPARES:

TYPE (OPEN/COVERED):

LOCATION:

CONFIGURATION:

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DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): MIST ELIMINATOR
WASH

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 6

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 14,000

MOTOR BRAKE HP:

SPEED - RPM: 500

HEAD - FT: 79

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER BLEED

NUMBER OF PUMPS: 4

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 200

MOTOR BRAKE HP:

SPEED - RPM:

HEAD - FT: 92

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE:

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE:

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE

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NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): POND RETURN

NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE FEED

NUMBER OF PUMPS: 4
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____

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MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 615
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 90
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE TRANSFER
NUMBER OF PUMPS: 3
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ROBBINS & MEYER
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): VARIABLE
CAPACITY - GPM: 43
MOTOR BRAKE HP: _____
SPEED - RPM: 41/324
HEAD - FT: 147
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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COMMENTS/FOOTNOTES

- A REPORTED DISPOSAL SPACE REQUIREMENT ESTIMATE IS 4 ACRE-FT/YEAR (AT 60% CAPACITY FACTOR).
- B TWO REACTION TANKS ARE EACH COMMON TO TWO SPRAY TOWERS AND TWO REACTION TANKS ARE EACH USED FOR ONE SPRAY TOWER.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Kansas Power & Light Jeffrey 1	8/78	744		System				Initial shakecown/debugging operation commenced
	9/78	720		System				
	10/78	744		System				
	11/78	720		System				
	12/78	744		System				FGD operation intermittent due to cold weather
	1/79	744		System				
	2/79	672		System				
	3/79	744		System				
	4/79	720	0	System	0			Boiler shut down for inspection
	5/79	744	0	System	0			Boiler shut down for inspection
	6/79	720		System				
	7/79	744		System				
	8/79	744		System				
	9/79	720		System				Unit shut down for two week inspection
	10/79	744		System				
	11/79	720		System				
	12/79	744		System			Limestone ball mill	Excessive ball wear
							Reaction tank	Agitator failures (motor failures, paddle arm detachments, and shaft breaking)

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Jeffrey 1 (continued)	1/80	744		System				
	2/80	696		System				
	3/80	744	504	System	504	100		
	4/80	720	720	System	720	100		
	5/80	744	744	System	744	100		
	6/80	720	720	System	720	100		
	7/80	744	514	System	514	100		Low FGD hours due to 230 hour boiler reheater outage
	8/80	744	631	System	631	100		
	9/80	720	720	System	720	100		
	10/80	744	273	System	278	100		466 hour outage for boiler inspection
	11/80	720	625	System	625	100	Damper	1 hour outage to repair automatic damper malfunction
	12/80	744	733	System	733	100		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Kansas Power & Light Jeffrey 2	1/80	744		System				Initial shakedown/debugging operations commenced
	2/80	696		System				
	3/80	744		System				
	4/80	720		System				
	5/80	744	744	System	744	100		
	6/80	720	720	System	720	100		
	7/80	744	709	System	709	100		35 hour outage due to boiler reheater tube leakage repairs
	8/80	744	744	System	744	100		
	9/80	720	720	System	720	100		
	10/80	744	744	System	744	100		
	11/80	720	404	System	404	100		316 hour boiler inspection outage
	12/80	744	468	System	468	100		Outage due to boiler superheater tube repairs

KANSAS POWER & LIGHT

LAWRENCE 4, 5

Kansas City Power & Light
Lawrence 4, 5

SECTION 1

BACKGROUND

In 1967, Kansas Power & Light (KP&L) decided to expand the Lawrence Energy Center with the addition of a 420-MW (gross) unit, Lawrence 5. At that time, the units operating at Lawrence were firing natural gas. However, it had become apparent that natural gas would not be available to fulfill the fuel requirement for Lawrence 5 for the entire lifespan of the unit. As a result, a 20-year contract was negotiated for Kansas coal (3% to 4% sulfur, 12% ash) to fulfill the unit's primary fuel requirement. (Later, the utility went strictly with a low sulfur Wyoming coal which has an average sulfur content of 0.55%).

Based on the assumption that by 1971 there would be some ambient and/or source emission regulations in effect for both particulate matter and SO₂, a decision was made by the utility to install, as original equipment, equipment to control flyash and SO₂ from Lawrence 5. Thus, KP&L awarded a contract to Combustion Engineering (the boiler supplier) to supply a limestone injection - wet scrubber system.

Since startup of Lawrence 5 was scheduled for 1971, it was further decided to retrofit a similar system on the existing 125-MW (gross) Lawrence 4 so that experience could be gained prior to startup of the larger unit.

The Lawrence 4 FGD system began initial operation in 1968. Startup of the Lawrence 5 system took place in March 1971. Both systems included facilities for pulverizing limestone and injecting it into the boiler furnace chamber for calcination. The flue gas transported the calcined limestone and flyash to the scrubber module, each consisting of a single marble bed equipped with overflow pots for drainage of recirculating slurry. The scrubbed gases then passed through a set of mist eliminators, reheaters, and ID fans prior to being discharged to the stack.

The Lawrence 4 and 5 FGD systems were converted to the presently operational two-stage rod scrubber/spray tower configurations in 1977 and 1978, respectively, as a result of problems encountered with the limestone injection processes.

Kansas Power & Light
Lawrence 4, 5

SECTION 2

PROCESS DESCRIPTION

The limestone scrubbing systems now in service on Lawrence 4 and 5 are second-generation design units. Basically, both systems encompass the same general equipment layout, consisting of a common limestone storage and preparation facility, two rod-deck venturi scrubbers and spray tower absorber modules, and a common waste disposal facility.

The process description provided in the paragraphs that follow particularly address the Lawrence 4 scrubbing system. Although the Lawrence 5 scrubbing system is similar in design and operation, a number of major features that differ are noted and described at the end of this section. .

Flue gas from the boiler passes through the air heater and is conveyed by new duct work to two scrubber modules. Each module can handle 50% of total capacity and consists of a rectangular, variable-throat, rod-deck, venturi scrubber followed by a spray tower absorber.

Flue gas enters the scrubbing system at 403,000 acfm and 280°F. Each rod-deck venturi scrubber is comprised of a converging gas section and a rod section. Limestone slurry is sprayed continuously by spray nozzles around the perimeter of the throat area. Spent slurry from the rod section falls into a collection tank located directly below the venturi section.

After passing through the rod-deck venturi scrubber, the flue gas makes a 90-degree turn and traverses the spray tower approach before making another 90-degree turn. The saturated, cooled gas enters the spray towers where additional SO₂ removal occurs as the gas flows upward through the open towers and is contacted by slurry via countercurrent sprays. The spent slurry feeds by gravity into a reaction tank directly below each tower.

Entrained droplets of moisture and slurry are removed in a mist elimination section in the spray towers. After the mist eliminators, the saturated gas stream is reheated by in-line reheaters. One reheater is provided for each spray tower. The heating medium is hot water from the feed water deaerator of the boiler. The reheaters increase the temperature of the gas stream approximately 20°F. The reheated gas stream flows through the discharge ducts leading to the induced-draft fans and stacks, which discharge the gas to the atmosphere.

The Lawrence 5 scrubbing system closely resembles the Lawrence 4 system. Two scrubbing modules, each consisting of a rod-deck scrubber with a spray tower absorber, are provided to treat 100% of the flue gas from the steam generator. In addition, the system shares the limestone handling and preparation facilities and the sludge disposal ponds used by Lawrence 4. Several major features, however, are different:

- ° Inlet gas enters the Lawrence 5 scrubbing system at 1,271,000 acfm and 300°F. Because the flue gas flow and temperature are greater than those for the Lawrence 4 system, the modules are significantly larger.

Kansas Power & Light
Lawrence 4, 5

- ° The flue gas is contacted by a single level of slurry sprays in the spray tower.
- ° A single reaction tank receives the spent slurry from both modules, as well as the fresh limestone slurry introduced into the system.
- ° Lawrence 5 is not equipped with a thickener or any other dewatering device for separation of solids from liquid prior to disposal.

Flow diagrams for the Lawrence 4, 5 FGD systems are shown on the next two pages.

Flow Diagram: Lawrence 4

Flow Diagram: Lawrence 5

Kansas Power & Light
Lawrence 4, 5

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 10/8/81

KANSAS POWER & LIGHT
LAWRENCE 4

GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS POWER & LIGHT COMPANY
ASSOCIATED UTILITIES:
PLANT NAME: LAWRENCE ENERGY CENTER
UNIT NUMBER: 4
PLANT ADDRESS: P.O. BOX 249
CITY: LAWRENCE
COUNTY: DOUGLAS
STATE: KANSAS
ZIP CODE: 66044
EPA REGION: 7
RIVER BASIN/LAKE REGION: KANSAS
REGULATORY CLASSIFICATION: STATE STD MORE STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 0.3
NOX EMISSION LIMITATION - LB/MM BTU:
NET PLANT GENERATING CAPACITY - MW: 576
GROSS UNIT GENERATING CAPACITY - MW: 125
NET UNIT GENERATING CAPACITY WITH FGD - MW: 115
NET UNIT GENERATING CAPACITY W/O FGD - MW: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 125

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
A FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM:
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): CYCLING
COMMERCIAL SERVICE DATE: 1959
DESIGN BOILER FLUE GAS FLOW - ACFM: 403,000
FLUE GAS TEMPERATURE - F: 280
FLUE GAS OXYGEN - %: 8-9
HEAT RATE - BTU/KWH: 10,300
DESIGN FIRING RATE - TPH: 50
EXCESS AIR - %: 15
CAPACITY FACTOR - %: _____
STACK HEIGHT - FT: 200
SHELL MATERIAL: COR-TEN STEEL
FLUE MATERIAL GENERIC TYPE: LOW ALLOY STEEL
FLUE MATERIAL SPECIFIC TYPE:
FLUE MATERIAL TRADE/COMMON NAME: COR-TEN
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: CHEMICALLY BONDED MORTAR
FLUE LINER MATERIAL TRADE/COMMON NAME: SAUERISEN NO. 33
FLUE INNER DIAMETER - FT: 8
STACK GAS INLET TEMPERATURE - F: 145-155
STACK GAS OUTLET VELOCITY - FT/SEC: 100

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 10/8/81

KANSAS POWER & LIGHT
LAWRENCE 4

FUEL DATA (ACTUAL)

B FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS (MEDICINE BOW COAL)

NAME OF SUPPLIER: _____

MINE NAME/AREA: HANNA MINE

MINE LOCATION - COUNTY: _____

MINE LOCATION - STATE: WYOMING

AVERAGE HEAT CONTENT - BTU/LB: 10,000

RANGE HEAT CONTENT - BTU/LB: _____

AVERAGE ASH CONTENT - % 9.8

RANGE ASH CONTENT - %: UP TO 16

AVERAGE MOISTURE CONTENT - % 11.8

RANGE MOISTURE CONTENT - %: _____

AVERAGE SULFUR CONTENT - %: 0.55

RANGE SULFUR CONTENT - %: UP TO 0.9

AVERAGE CHLORIDE CONTENT - %: 0.03

RANGE CHLORIDE CONTENT - %: _____

FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL

FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED

SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE

NUMBER OF SPARES: _____

TYPE: _____

SUPPLIER: _____

INLET FLUE GAS CAPACITY - ACFM: _____

INLET FLUE GAS TEMPERATURE - F: _____

PRESSURE DROP - IN. H2O: _____

PARTICLE OUTLET LOAD - GR/SCF: _____

PARTICLE REMOVAL EFFICIENCY - %: _____

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE

NUMBER OF SPARES: _____

TYPE (HOT SIDE/COLD SIDE): _____

SUPPLIER: _____

INLET FLUE GAS CAPACITY - ACFM: _____

INLET FLUE GAS TEMPERATURE - F: _____

PRESSURE DROP - IN. H2O: _____

PARTICLE OUTLET LOAD - GR/SCF: _____

PARTICLE REMOVAL EFFICIENCY - % _____

FLUE GAS CONDITIONING TYPE: _____

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: 2

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
LAWRENCE 4

NUMBER OF SPARES:

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI

SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.): VARIABLE-THROAT/VERTICALLY-
ADJUSTABLE ROD DECKS

TRADE/COMMON NAME: ROD SCRUBBER

SUPPLIER: COMBUSTION ENGINEERING

DIMENSIONS - FT: 3 X 23

SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL

SHELL MATERIAL SPECIFIC TYPE: TYPE 316L

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

BOILER LOAD PER SCRUBBER (DESIGN) - %: 50

GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): NORYL®-CLAD FRP RODS

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A

NUMBER OF SPRAY HEADERS:

NOZZLE MATERIAL: ALUMINUM OXIDE

NOZZLE PRESSURE DROP - PSI:

LIQUID RECIRCULATION RATE - GPM: 3600

L/G RATIO - GAL/1000 ACF: 20

PH CONTROL ADDITIVE: LIMESTONE SLURRY

GAS-SIDE PRESSURE DROP - IN. H₂O: 9.0

SUPERFICIAL GAS VELOCITY - FT/SEC: 50

INLET GAS FLOW RATE - ACFM: 201,500

INLET GAS TEMPERATURE - F: 280

INLET SO₂ LEVEL - PPM: 748

INLET SO₂ LEVEL - LB/MM BTU:

INLET PARTICLE LEVEL - GR/SCF: 2.5

INLET PARTICLE LEVEL - LB/MM BTU:

OUTLET GAS FLOW RATE - ACFM:

OUTLET GAS TEMPERATURE - F: 125

OUTLET SO₂ LEVEL - PPM:

OUTLET SO₂ LEVEL - LB/MM BTU:

OUTLET PARTICLE LEVEL - GR/SCF:

OUTLET PARTICLE LEVEL - LB/MM BTU: 0.08 (OVERALL)

SO₂ REMOVAL EFFICIENCY - %

PARTICLE REMOVAL EFFICIENCY - % >99

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIMESTONE

PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE

SYSTEM SUPPLIER: COMBUSTION ENGINEERING

A-E FIRM: BLACK & VEATCH

CONSTRUCTION FIRM:

APPLICATION (NEW/RETROFIT): RETROFIT

PARTICLE DESIGN REMOVAL EFFICIENCY - %: 98.9

SO₂ DESIGN REMOVAL EFFICIENCY - % 73

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 10/8/81

KANSAS POWER & LIGHT
LAWRENCE 4

CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A
COMMERCIAL START-UP: _____
INITIAL START-UP: 1/77 _____
CONSTRUCTION COMPLETION: _____
CONSTRUCTION INITIATION: _____
CONTRACT AWARDED: _____
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST _____
INITIATED PRELIMINARY DESIGN _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: _____
DESIGN COAL HEAT CONTENT - BTU/LB: _____
DESIGN COAL ASH CONTENT - %: _____
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: _____
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
FGD SYSTEM TURNDOWN RATIO: INFINITE
FGD SYSTEM TURNDOWN METHOD: REDUCE GAS FLOW
FGD SYSTEM PRESSURE DROP - IN. H2O: 24.0
FGD SYSTEM OXIDATION - %: _____
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: 5-10
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 5-10
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): _____
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): _____
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): _____
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: _____
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): _____
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: _____
TIME SCHEDULE FOR REDUCED BOILER LOAD: _____
TIME SCHEDULE FOR BOILER SHUTDOWNS: _____
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): _____
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): _____
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): _____

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 10/8/81

KANSAS POWER & LIGHT
LAWRENCE 4

NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI: _____

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: _____
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME: _____
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: _____
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A
BOILER LOAD PER ABSORBER - %: 50
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 2
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: 120
NUMBER OF SPRAY HEADERS: _____
NOZZLE MATERIAL: ALUMINUM OXIDE
NOZZLE PRESSURE DROP - PSI: 23 PSI
LIQUID RECIRCULATION RATE - GPM: 5300
L/G RATIO - GAL/1000 ACF: 30
GAS-SIDE PRESSURE DROP - IN. H2O: 2.5
SUPERFICIAL GAS VELOCITY - FT/SEC: 6
ABSORBER TURNDOWN RATIO: INFINITE
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM: 174,500
INLET GAS TEMPERATURE - F: 124

UTILITY EMISSION CONTROL SYSTEM DATA
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LAWRENCE 4

INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 124
OUTLET SO2 LEVEL - PPM: 200
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: 0.032
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.08
SO2 REMOVAL EFFICIENCY - %: 73
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 2 (B) 2

NUMBER OF SPARES: _____

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) BAFFLE SLATS (B) BAFFLE

COMMON DESIGN: (A) BULK ENTRAINMENT SEPARATOR (B) CHEVRON VANE

MANUFACTURER: _____

C CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): (A) _____ (B) INVERTED V-SHAPE

NUMBER OF STAGES: (A) 1 (B) 2

NUMBER OF PASSES/STAGE: (A) 1 (B) 2

FREEBOARD DISTANCE - FT: (A) 8 (B) 0.3

DISTANCE BETWEEN STAGES - IN.: (A) N/A (B) 12

DISTANCE BETWEEN VANES - IN.: (A) _____ (B) 3-4

VANE ANGLES - DEGREES: (A) _____ (B) 90

PRESSURE DROP - IN. H2O: (A) _____ (B) 1.0

SUPERFICIAL GAS VELOCITY - FT/SEC: (A) 6.0 (B) 6.0

CONSTRUCTION MATERIAL GENERIC TYPE: (A) ORGANIC (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) FRP (B) FRP

CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (A) _____ (B) POND
RECYCLE

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): (B) UNDERSPRAY
AND OVERSPRAY
FOR FIRST
STAGE; UNDER-
SPRAY FOR
SECOND STAGE

WASH FREQUENCY: (B) ONCE/DAY

WASH DURATION: (B) 45 MINUTES

WASH RATE - GAL/MIN: (B) 200 AT 60-70 PSIG

WASH COVERAGE - GAL/MIN SQ FT.: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
LAWRENCE 4

REHEATER

NUMBER OF REHEATERS: 2
NUMBER OF SPARES: _____
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): HOT WATER
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): FINNED TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: TOP OF ABSORBER VESSEL
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 20-30
INLET FLUE GAS FLOW RATE - ACFM: 363,000
INLET FLUE GAS TEMPERATURE - F: 125
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 145-155
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: 2 PER ABSORBER
NUMBER OF BUNDLES PER BANK: _____
NUMBER OF TUBES PER BUNDLE: 66
STEAM OR WATER PRESSURE - PSIG: _____
STEAM OR WATER TEMPERATURE - F: _____
SELF CLEANING DEVICE TYPE: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: N/A

FANS

NUMBER OF FANS: 2
NUMBER OF SPARES: _____
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: BUFFALO FORGE
FUNCTION (UNIT/BOOSTER): _____
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: _____
LOCATION WRT MAJOR COMPONENTS: BETWEEN REHEATER AND STACK
FLUE GAS FLOW RATE - ACFM: 170,000
FLUE GAS TEMPERATURE - F: 144-145
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: LOW ALLOY
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: COR-TEN

DAMPERS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
NUMBER OF DAMPERS: _____
FUNCTION (CONTROL/SHUT-OFF): _____
D) GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER (ALL)
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
LAWRENCE 4

TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): _____

MANUFACTURER: _____

MODULATION (OPEN/CLOSED, ETC.): _____

SEAL AIR - ACFM: _____

SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____

MATERIAL GENERIC TYPE: LOW ALLOY (ALL) _____

MATERIAL SPECIFIC TYPE: _____

MATERIAL TRADE/COMMON NAME: COR-TEN (ALL) _____

LINER MATERIAL GENERIC TYPE: NONE (ALL) _____

LINER MATERIAL SPECIFIC TYPE: N/A _____

LINER MATERIAL TRADE/COMMON NAME: N/A _____

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) BYPASS _____

CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____

DIMENSIONS (DIAMETER, LENGTH, ETC.): _____

SHELL MATERIAL GENERIC TYPE: LOW ALLOY (ALL) _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: COR-TEN (ALL) _____

LINER MATERIAL GENERIC TYPE: NONE (ALL) _____

LINER MATERIAL SPECIFIC TYPE: N/A _____

LINER MATERIAL TRADE/COMMON NAME: N/A _____

EXPANSION JOINTS

LOCATION: _____

TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC _____

FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT _____

PRESSURE (NEGATIVE/POSITIVE): _____

OPERATING TEMPERATURE - F: _____

DESIGN CONFIGURATION (V-SHAPED, ETC.): _____

MANUFACTURER: GARLOK _____

MATERIAL: ASBESTOS/BUTYL RUBBER OR ASBESTOS/VITON® _____

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIMESTONE GRINDING _____

PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL _____

DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____

MANUFACTURER: _____

MATERIALS: _____

NUMBER OF DEVICES: 2 _____

NUMBER OF SPARES: _____

FULL LOAD DRY FEED CAPACITY - TPH: 6 _____

PRODUCT QUALITY - % SOLIDS: 60 _____

FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____

PREPARED REAGENT POINT OF ADDITION: SPRAY TOWER REACTION TANKS _____

ON-SITE STORAGE CAPABILITY - DAYS: _____

TANKS

*SEE ATTACHMENT A

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
LAWRENCE 4

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) RECYCLE SLURRY AND SPRAY HEADERS (B) SLUDGE
(C) OTHER

DIMENSIONS - IN.:

MANUFACTURER: (A) AMERICAN BRIDGE CO. (B) (C)

MATERIAL: (A) FRP WITH ABRASION-RESISTANT LINING (B) POLYETHYLENE
(C) RUBBER-LINED CARBON STEEL

MAJOR VALVES

LOCATION:

FUNCTION (ISOLATION, CONTROL, ETC.): (A) PUMP ISOLATION (B) OTHER

TYPE (BALL, GLOBE, PLUG, ETC.): (A) KNIFEGATE (B) BUTTERFLY

CONTROL MODE (AUTOMATIC/MANUAL):

DIMENSIONS - IN.:

MANUFACTURER:

MATERIAL: (A) TYPE 316L STAINLESS STEEL (B)

THICKENERS

NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT:

CAPACITY - GAL:

SHELL MATERIAL GENERIC TYPE: STEEL WALLS AND CONCRETE BOTTOM

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME: COR-TEN WALLS

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

RAKE MATERIAL:

FEED STREAM SOURCE: COLLECTION TANK

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 8-10%
SOLIDS

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 30-35%
SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM DISPOSITION: TO POND

OVERFLOW STREAM DISPOSITION: RECLAIMED WATER TANK

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):

NUMBER OF DEVICES:

NUMBER OF SPARES:

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CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAOH2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

E METHOD: FORCED OXIDATION

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): RECYCLE STREAM
DEVICE (OXIDATION TANK, PUG MILL, ETC.): _____
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): _____
INLET FLOW RATE - GPM: _____
INLET QUALITY - % SOLIDS: 5-10

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): (A) INTERIM (B) FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): (A) POND (B) POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): _____
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): _____
LOCATION (ON-SITE/OFF-SITE): (A) ON-SITE (B) ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): (A) PIPELINE (B) OVERFLOW
FROM
INTERIM
POND
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): (A) NONE (B) NONE
SITE DIMENSIONS - AREA/DEPTH: _____

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SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: _____

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: _____
CHEMICAL PARAMETERS (PH, ETC.): PH, SO₂ CONCENTRATION
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): PERCENT SOLIDS,
SLURRY FLOW
CONTROL LEVELS: PH 6.5
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: PH PROBES IN REACTION TANKS
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): AUTOMATIC
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): _____
TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
MAKEUP WATER ADDITION - GPM: _____
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIMESTONE
PRINCIPAL CONSTITUENTS: 93% CaCO₃, 7% MgCO₃
SOURCE/SUPPLIER: _____
SUPPLIER LOCATION: LAWRENCE, KANSAS
CONSUMPTION (SPECIFY UNITS): 1.5 TPH
UTILIZATION - %: _____
POINT OF ADDITION: BALL MILL

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: _____
CAPITAL COST - \$/KW: _____
OPERATING COST - MILLS/KWH: _____
MAINTENANCE COST: _____
LABOR COST: _____
UTILITIES COST: _____
CHEMICALS COST: _____
WASTE DISPOSAL COST: _____

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FGD SPARE CAPACITY INDICES

SCRUBBER - %: _____
ABSORBER - %: _____
MIST ELIMINATOR - %: _____
REHEATER - %: _____
FAN - %: _____
BALL MILL - %: _____
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: _____
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: _____
ABSORBER: _____
MIST ELIMINATOR: _____
REHEATER: _____
FAN: _____
BALL MILL: _____
SLAKER: N/A
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: _____
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: _____
PARTICIPANTS: _____
PROCFSS: _____
PLANT DESIGN: _____
SUPPLIER: _____
SERVICE DATE: _____
PERIOD OF OPERATION - MONTHS: _____
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: _____
STATUS (ACTIVE/TERMINATED): _____

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SPRAY TOWER
RECYCLE

NUMBER OF TANKS: 2
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: BELOW ABSORBERS
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: 69,200
RETENTION TIME - MIN: 10
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: LOW ALLOY
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: COR-TEN
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): VENTURI RECYCLE

NUMBER OF TANKS: 2
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: BELOW VENTURIS
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: 50,100
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: LOW ALLOY
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: COR-TEN
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): CLARIFICATION
AND COLLECTION

NUMBER OF TANKS: 1
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____

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LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ADDITIVE
DILUTION

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: 1000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ADDITIVE STORAGE

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL

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SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): (A) MILL SUMP
(B) MILL PRODUCT

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECLAIMED WATER
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): VENTURI
RECIRCULATION

NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: D-6-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 5300
MOTOR BRAKE HP: 200
SPEED - RPM: 550
HEAD - FT: 83
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED DUCTILE IRON
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: DENVER
PUMP MODEL NUMBER: SRL-C
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 3600
MOTOR BRAKE HP: 200
SPEED/- RPM: 550
HEAD - FT: 83
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED DUCTILE IRON
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): MILL SLURRY/
ADDITIVE TRANS-
FER/ADDITIVE
STORAGE

NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ROBBINS & MYERS _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED STATORS
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: CHROME-MOLYBDENUM ROTORS
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE FEED

NUMBER OF PUMPS: 6
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLURRY BLEED

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NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: HARD METAL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: HARD METAL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WARMAN
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CAST ALLOY
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: NI-HARD
IMPELLER MATERIAL GENERIC TYPE: CAST ALLOY
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: NI-HARD

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CLASSIFICATION TANK
TRANSFER
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, TEC.): _____

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COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PIUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ME WASH/ RECLAIMED
WATER

NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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COMMENTS/FOOTNOTES

- A MULTIPLE FUEL DESIGN.
- B A SUBSTANTIAL AMOUNT OF OIL IS STILL USED, AS WELL AS A LITTLE NATURAL GAS.
- C SLANTED HORIZONTAL.
- D THERE IS ONE BYPASS DAMPER THAT IS A GUILLotine TYPE.
- E UNIT 4 HAS BEEN OPERATED WITH AND WITHOUT FORCED OXIDATION.

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GENERAL PLANT INFORMATION

COMPANY NAME: KANSAS POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: _____
PLANT NAME: LAWRENCE ENERGY CENTER
UNIT NUMBER: 5
PLANT ADDRESS: P.O. BOX 249
CITY: LAWRENCE
COUNTY: DOUGLAS
STATE: KANSAS
ZIP CODE: 66044
EPA REGION: 7
RIVER BASIN/LAKE REGION: KANSAS
REGULATORY CLASSIFICATION: STATE STD MORE STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 0.5
NOX EMISSION LIMITATION - LB/MM BTU: _____
NET PLANT GENERATING CAPACITY - MW: 576
GROSS UNIT GENERATING CAPACITY - MW: 420
NET UNIT GENERATING CAPACITY WITH FGD - MW: 400
NET UNIT GENERATING CAPACITY W/O FGD - MW: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 420

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
A FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM:
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): CYCLING
COMMERCIAL SERVICE DATE: 1971
DESIGN BOILER FLUE GAS FLOW - ACFM: 1,271,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: 8.9
HEAT RATE - Btu/KWH: 10,300
DESIGN FIRING RATE - TPH: 150
EXCESS AIR - %: 15
CAPACITY FACTOR - %: _____
STACK HEIGHT - FT: 350
SHELL MATERIAL: CARBON STEEL
FLUE MATERIAL GENERIC TYPE: CARBON STEEL
FLUE MATERIAL SPECIFIC TYPE: _____
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED CONCRETE
FLUE LINER MATERIAL TRADE/COMMON NAME: HAYDITE/LUMNITE
FLUE INNER DIAMETER - FT: 16
STACK GAS INLET TEMPERATURE - F: 145-155
STACK GAS OUTLET VELOCITY - FT/SEC: 80

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FUEL DATA (ACTUAL)

B FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS (MEDICINE BOW COAL)

NAME OF SUPPLIER: _____

MINE NAME/AREA: HANNA MINE

MINE LOCATION - COUNTY: _____

MINE LOCATION - STATE: WYOMING

AVERAGE HEAT CONTENT - BTU/LB: 10,000

RANGE HEAT CONTENT - BTU/LB: _____

AVERAGE ASH CONTENT - % 9.8

RANGE ASH CONTENT - %: UP TO 16

AVERAGE MOISTURE CONTENT - % 11.8

RANGE MOISTURE CONTENT - %: _____

AVERAGE SULFUR CONTENT - %: 0.55

RANGE SULFUR CONTENT - %: UP TO 0.9

AVERAGE CHLORIDE CONTENT - %: 0.03

RANGE CHLORIDE CONTENT - % _____

FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL

FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED

SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE

NUMBER OF SPARES:

TYPE:

SUPPLIER:

INLET FLUE GAS CAPACITY - ACFM:

INLET FLUE GAS TEMPERATURE - F:

PRESSURE DROP - IN. H2O:

PARTICLE OUTLET LOAD - GR/SCF:

PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE

NUMBER OF SPARES:

TYPE (HOT SIDE/COLD SIDE):

SUPPLIER:

INLET FLUE GAS CAPACITY - ACFM:

INLET FLUE GAS TEMPERATURE - F:

PRESSURE DROP - IN. H2O:

PARTICLE OUTLET LOAD - GR/SCF:

PARTICLE REMOVAL EFFICIENCY - %

FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: 2

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NUMBER OF SPARES:

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI

SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.): VARIABLE-THROAT/VERTICALLY-
ADJUSTABLE ROD DECKS

TRADE/COMMON NAME: ROD SCRUBBER

SUPPLIER: COMBUSTION ENGINEERING

DIMENSIONS - FT: 5 X 37

SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL

SHELL MATERIAL SPECIFIC TYPE: TYPE 316L

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

BOILER LOAD PER SCRUBBER (DESIGN) - %: 50

GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): TYPE 316L STAINLESS
STEEL RODS

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A

NUMBER OF SPRAY HEADERS:

NOZZLE MATERIAL: SILICON CARBIDE

NOZZLE PRESSURE DROP - PSI:

LIQUID RECIRCULATION RATE - GPM: 10,400

L/G RATIO - GAL/1000 ACF: 20

PH CONTROL ADDITIVE: LIMESTONE SLURRY

GAS-SIDE PRESSURE DROP - IN. H₂O: 9.0

SUPERFICIAL GAS VELOCITY - FT/SEC: 50

INLET GAS FLOW RATE - ACFM: 635,000

INLET GAS TEMPERATURE - F: 300

INLET SO₂ LEVEL - PPM: 748

INLET SO₂ LEVEL - LB/MM BTU:

INLET PARTICLE LEVEL - GR/SCF: 2.5

INLET PARTICLE LEVEL - LB/MM BTU:

OUTLET GAS FLOW RATE - ACFM:

OUTLET GAS TEMPERATURE - F: 125

OUTLET SO₂ LEVEL - PPM:

OUTLET SO₂ LEVEL - LB/MM BTU:

OUTLET PARTICLE LEVEL - GR/SCF:

OUTLET PARTICLE LEVEL - LB/MM BTU: 0.08 (OVERALL)

SO₂ REMOVAL EFFICIENCY - %

PARTICLE REMOVAL EFFICIENCY - % >99

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIMESTONE

PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE

SYSTEM SUPPLIER: COMBUSTION ENGINEERING

A-E FIRM: BLACK & VEATCH

CONSTRUCTION FIRM: COMBUSTION ENGINEERING

APPLICATION (NEW/RETROFIT): RETROFIT

PARTICLE DESIGN REMOVAL EFFICIENCY - %: 98.9

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SO2 DESIGN REMOVAL EFFICIENCY - % 52
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A
COMMERCIAL START-UP: _____
INITIAL START-UP: 4/78
CONSTRUCTION COMPLETION: _____
CONSTRUCTION INITIATION: _____
CONTRACT AWARDED: _____
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST _____
INITIATED PRELIMINARY DESIGN _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: _____
DESIGN COAL HEAT CONTENT - BTU/LB: _____
DESIGN COAL ASH CONTENT - %: _____
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: _____
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
FGD SYSTEM TURNDOWN RATIO: INFINITE
FGD SYSTEM TURNDOWN METHOD: REDUCE GAS FLOW
FGD SYSTEM PRESSURE DROP - IN. H2O: 28.8
FGD SYSTEM OXIDATION - %: _____
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: 5-10
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 5-10
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): _____
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): _____
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): _____
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): _____
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: _____
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): _____
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: _____
TIME SCHEDULE FOR REDUCED BOILER LOAD: _____
TIME SCHEDULE FOR BOILER SHUTDOWNS: _____
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): _____
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): _____
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): _____

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QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER: ~
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI: _____

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES:
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME:
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A
BOILER LOAD PER ABSORBER - %: 50
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: SILICON CARBIDE
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 10,400
L/G RATIO - GAL/1000 ACF: 20
GAS-SIDE PRESSURE DROP - IN. H2O: 0.8
SUPERFICIAL GAS VELOCITY - FT/SEC: 6
ABSORBER TURNDOWN RATIO: INFINITE
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW

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INLET GAS FLOW RATE - ACFM: 544,000
INLET GAS TEMPERATURE - F: 126
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 126
OUTLET SO2 LEVEL - PPM: 359
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.08
SO2 REMOVAL EFFICIENCY - %: 70
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 2 (B) 2

NUMBER OF SPARES: _____

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) BAFFLE SLATS (B) BAFFLE

COMMON DESIGN: (A) BULK ENTRAINMENT SEPARATOR (B) CHEVRON VANE

MANUFACTURER: _____

C CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): (A) _____ (B) INVERTED V-SHAPE

NUMBER OF STAGES: (A) 1 (B) 2

NUMBER OF PASSES/STAGE: (A) 1 (B) 2

FREEBOARD DISTANCE - FT: (A) 8 (B) 0.3

DISTANCE BETWEEN STAGES - IN.: (A) N/A (B) 12

DISTANCE BETWEEN VANES - IN.: (A) _____ (B) 3-4

VANE ANGLES - DEGREES: (A) _____ (B) 90

PRESSURE DROP - IN. H2O: (A) _____ (B) 1.0

SUPERFICIAL GAS VELOCITY - FT/SEC: (A) 6.0 (B) 6.0

CONSTRUCTION MATERIAL GENERIC TYPE: (A) ORGANIC (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) FRP (B) FRP

CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (A) _____ (B) POND
RECYCLE

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): (B) UNDERSPRAY
AND OVER-
SPRAY FOR
FIRST
STAGE;
UNDERSPRAY
FOR SECOND
STAGE

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WASH FREQUENCY: (B) ONCE/DAY
WASH DURATION: (B) 45 MINUTES
WASH RATE - GAL/MIN: (B) 200 AT 60-70 PSIG
WASH COVERAGE - GAL/MIN SQ FT.: _____

REHEATER

NUMBER OF REHEATERS: 2
NUMBER OF SPARES: _____
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): HOT WATER
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): FINNED TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: TOP OF ABSORBER VESSEL
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 20-30
INLET FLUE GAS FLOW RATE - ACFM: 1,168,000
INLET FLUE GAS TEMPERATURE - F: 125
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 145-155
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: 2 PER ABSORBER
NUMBER OF BUNDLES PER BANK: _____
NUMBER OF TUBES PER BUNDLE: 66
STEAM OR WATER PRESSURE - PSIG: _____
STEAM OR WATER TEMPERATURE - F: _____
SELF CLEANING DEVICE TYPE: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: 2
NUMBER OF SPARES: _____
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: AMERICAN STANDARD
FUNCTION (UNIT/BOOSTER): BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: _____
LOCATION WRT MAJOR COMPONENTS: BETWEEN REHEATER AND STACK
FLUE GAS FLOW RATE - ACFM: 600,000
FLUE GAS TEMPERATURE - F: 145-155
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

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DAMPERS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
NUMBER OF DAMPERS: _____
FUNCTION (CONTROL/SHUT-OFF): _____
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER (ALL)
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): _____
MANUFACTURER: _____
MODULATION (OPEN/CLOSED, ETC.): _____
SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: LOW ALLOY (ALL)
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: COR-TEN (ALL)
LINER MATERIAL GENERIC TYPE: NONE (ALL)
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
SHELL MATERIAL GENERIC TYPE: LOW ALLOY (ALL)
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: COR-TEN (ALL)
LINER MATERIAL GENERIC TYPE: NONE (ALL)
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

EXPANSION JOINTS

LOCATION: _____
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: _____
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: GARLOK
MATERIAL: ASBESTOS/BUTYL RUBBER OR ASBESTOS/VITON®

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIMESTONE GRINDING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: _____
MATERIALS: _____
NUMBER OF DEVICES: 2
NUMBER OF SPARES: _____
FULL LOAD DRY FEED CAPACITY - TPH: 24
PRODUCT QUALITY - % SOLIDS: 60

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FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: SPRAY TOWER REACTION TANK
ON-SITE STORAGE CAPABILITY - DAYS: _____

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) RECYCLE SLURRY AND SPRAY HEADERS (B) SLUDGE
DIMENSIONS - IN.: _____
MANUFACTURER: (A) AMERICAN BRIDGE CO. (B) _____
MATERIAL: (A) FRP WITH ABRASION-RESISTANT LINING (B) RUBBER-LINED CARBON
STEEL

MAJOR VALVES

LOCATION: _____
FUNCTION (ISOLATION, CONTROL, ETC.): (A) PUMP ISOLATION (B) OTHER
TYPE (BALL, GLOBE, PLUG, ETC.): (A) KNIFEGATE (B) BUTTERFLY
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: (A) TYPE 316L STAINLESS STEEL (B) _____

THICKENERS

NUMBER OF THICKENERS: NONE
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE

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DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAO2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): (A) INTERIM (B) FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): (A) POND (B) POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): _____
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): _____
LOCATION (ON-SITE/OFF-SITE): (A) ON-SITE (B) ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): (A) PIPELINE (B) OVERFLOW
FROM INTERIM POND

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SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): (A) NONE (B) NONE
SITE DIMENSIONS - AREA/DEPTH: _____
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: _____

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: _____
CHEMICAL PARAMETERS (PH, ETC.): PH, SO₂ CONCENTRATION
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): PERCENT SOLIDS,
SLURRY FLOW
CONTROL LEVELS: PH 6.5
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: PH PROBE IN REACTION TANK
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): AUTOMATIC
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): _____
TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
MAKEUP WATER ADDITION - GPM: _____
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIMESTONE
PRINCIPAL CONSTITUENTS: 93% CaCO₃, 7% MgCO₃
SOURCE/SUPPLIER: _____
SUPPLIER LOCATION: LAWRENCE, KANSAS
CONSUMPTION (SPECIFY UNITS): 4 TPH
UTILIZATION - %: _____
POINT OF ADDITION: BALL MILL

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: _____
CAPITAL COST - \$/KW: _____
OPERATING COST - MILLS/KWH: _____
MAINTENANCE COST: _____
LABOR COST: _____
UTILITIES COST: _____

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CHEMICALS COST: _____

WASTE DISPOSAL COST: _____

FGD SPARE CAPACITY INDICES

SCRUBBER - %: _____

ABSORBER - %: _____

MIST ELIMINATOR - %: _____

REHEATER - %: _____

FAN - %: _____

BALL MILL - %: _____

SLAKER - %: N/A

EFFLUENT HOLD TANK - %: _____

RECIRCULATION PUMP - %: _____

THICKENER - %: N/A

VACUUM FILTER - %: N/A

CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: _____

ABSORBER: _____

MIST ELIMINATOR: _____

REHEATER: _____

FAN: _____

BALL MILL: _____

SLAKER: N/A

EFFLUENT HOLD TANK: _____

RECIRCULATION PUMP: _____

THICKENER: N/A

VACUUM FILTER: N/A

CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: _____

PARTICIPANTS: _____

PROCESS: _____

PLANT DESIGN: _____

SUPPLIER: _____

SERVICE DATE: _____

PERIOD OF OPERATION - MONTHS: _____

GAS FEED: _____

EQUIVALENT SCRUBBED CAPACITY - MW: _____

STATUS (ACTIVE/TERMINATED): _____

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): VENTURI AND
ABSORBER RECYCLE

NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: 600,000
RETENTION TIME - MIN: 10
NUMBER OF AGITATORS: 4
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL BLADES AND CARBON STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): DILUTION AND
STORAGE

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: 1000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): CLARIFICATION
AND COLLECTION

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____

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TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): MILL SUMP
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): MILL PRODUCT
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____

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SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECLAIMED WATER

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
LAWRENCE 5

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): VENTURI
RECIRCULATION

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: _____

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: _____

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED DUCTILE IRON

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: _____

NUMBER OF SPARES: _____

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

D MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER: MIR 500

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: _____

MOTOR BRAKE HP: 500

SPEED - RPM: 480

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: CAST ALLOY

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: NI-HARD

IMPELLER MATERIAL GENERIC TYPE: CAST ALLOY

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: NI-HARD

UTILITY EMISSION CONTROL SYSTEM DATA
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KANSAS POWER & LIGHT
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PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): MILL SLURRY/
ADDITIVE TRANSFER/
ADDITIVE STORAGE

NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ROBBINS & MYERS _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED STATORS
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: CHROME-MOLYBDENUM ROTORS
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE FEED
NUMBER OF PUMPS: 6
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLURRY BLEED
NUMBER OF PUMPS: _____

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NUMBER OF SPARES:

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER:

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM:

MOTOR BRAKE HP:

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE

NUMBER OF PUMPS:

NUMBER OF SPARES:

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER:

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM:

MOTOR BRAKE HP:

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE:

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE:

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CLASSIFICATION TANK
TRANSFER

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

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KANSAS POWER & LIGHT
LAWRENCE 5

MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ME WASH/RECLAIMED
WATER

NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 10/8/81

KANSAS POWER & LIGHT
LAWRENCE 5

COMMENTS/FOOTNOTES

- A MULTIPLE FUEL DESIGN.
- B A SUBSTANTIAL AMOUNT OF OIL IS STILL USED, AS WELL AS A LITTLE NATURAL GAS.
- C SLANTED HORIZONTAL.
- D THERE ARE TWO INGERSOLL-RAND PUMPS IN USE WHICH WERE THE ORIGINAL PUMPS ON THE OLD FGD SYSTEM ON UNIT 5. THERE IS ALSO A RUBBER-LINED ABSORBER RECYCLE PUMP ON UNIT 5.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Kansas Power & Light Lawrence 4	0/69			System			Miscellaneous equipment	Buildup/plugging of the inlet duct where hot gases enter the venturi scrubbers, ID fan rotors, absorber, marble beds, mist eliminators, and drain lines
							Absorber modules	Erosion/corrosion problems of internals and vessel walls
							Reheater	Plugging (eliminated by replacing copper reheat coils with carbon steel unit with widely spaced fins and addition of soot blowers)
							Absorber modules	Modified by raising mist eliminators and addition of soot blowers and spray nozzles
	0/70			System			Absorber modules	Interior sandblasted and coated
							Internal feed lines	All internal steel pipes replaced with fiberglass
							Mist eliminators	Stainless steel mist eliminators replaced with fiberglass
	0/72			System				System modifications included enlargement of the crystallization tank, installation of new plastic spray nozzles, new slurry pump and strainers, and new multiple mixers
							Pump	Rapid erosion problem with slurry pump
							Valve	Failure problem
							Dampers	Inefficient
							Expansion joints	Failure problem

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Lawrence 4 (continued)	0/73			System				Operation of FGD system since the Fall of 1973 was the most successful to date
	0/74			System				In 1974 the unit was available for operation 343 days
	0/75			System				In 1975 the unit was available for operation 333 days. Utility completed negotiations for low sulfur coal
	6/75	720		System				Station load is reduced to 50 percent every night. Therefore, one of the modules can be taken off line nightly for cleaning or repair
	7/75	744		System				Each module is shut down once per week for inspection and cleaning
	8/75	744		System				
	9/75	720		System				
	10/75	744		System				
	11/75	720		System				
	12/75	744		System				
	1/76	744		System				Utility is replacing the limestone injection FGD system with rod-deck venturi/spray tower FGD system. New system to come on line in January 1977
	2/76	696		System				
	3/76	744		System				
	4/76	720		System				

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Lawrence 4 (continued)	5/76	744		System				
	6/76	720		System				
	7/76	744		System				
	8/76	744		System				
	9/76	720		System				
	10/76	744		System				
	11/76	720		System				
	12/76	744		System				
	1/77	744		System				New limestone FGD system became commercially available
	2/77	672		System				
	3/77	744		System			Makeup tank	Problem maintaining desired solid levels (utility plans to pump the 35 percent solids slurry directly from the slurry tank into the recirculation loop)
	4/77	720		System				Scrubber was not required because natural gas was fired in the boiler
	5/77	744		System				
	6/77	720		System			Mist eliminator	Cracking
							Recycle tank air agitation system	Compressor failure
							Recycle tank screen	Twists itself off under the pressurized waste system

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Lawrence 4 (continued)							Soot blowers	Malfunctioned
							Pumps	Denver slurry pumps have experienced problems, while the Allen-Sherman-Hoff pumps have operated satisfactorily
	7/77	774		System				
	8/77	744		System			Mist eliminator	Cracks repaired
							Recycle tank air agitation system	Air agitation system compressor continues to malfunction due to faulty unloading air control mechanism (this has resulted in solid deposition in the recycle tank)
							Pumps	Denver slurry pumps functioned adequately. The pump gland packings are being redesigned.
	9/77	720		System				Unit 4 burned 100 percent natural gas for all but 8 to 10 days since April 1977. Unit returned to burn coal on September 15.
	10/77	720		System				System load cut back 50 percent because of construction of new cooling tower
	11/77	720		System				FGD system repair was conducted during turbine inspection and cooling tower construction outage
	12/77	744		System				System came back on-line at full capacity on December 20
	1/78	744		System			Pipelines	Weather related (freezing)

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Lawrence 4 (continued)							Clarifier	Thickener discharge line froze causing clarifier to plug
	2/78	672		System			Thickener	Discharge line remained frozen (two 3-inch diameter fire hoses were used to pump the underflow solids to pond)
	3/78	744		System				
	4/78	720	720	A B System	720	100 100 100		
	5/78	744	744	A B System	744	100 100 100		
	6/78	720	720	A B System	720	100 100 100		
	7/78	744	744	A B System	744	100 100 100		
	8/78	744	744	A B System	744	100 100 100		
	9/78	720	456	A B System	456	100 100 100		
	10/78	744	576	System				
	11/78	720	720	System				
	12/78	744	744	System				
								EPA sponsored continuous monitoring test commenced. Test involves 24-hour monitoring of SO ₂ , opacity, and NO _x

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Lawrence 4 (continued)	1/79	744		System			ID fan	Forced out of service on January 5 forcing unit to operate at 50 percent capacity
	2/79	672	672	A B System	564	96 71 84	Tank agitator	Failure forced a module out of service for 48 hours
							ID fan	Motor failure forced a module out of service of 192 hours
	3/79	744		System			ID fan	Motor failure problems continued
	4/79	720		System				
	5/79	744		System				
	6/79	720		System			Agitator	Utility reported that FGD system had performed well except for mixer failure
	7/79	744		System				
	8/79	744		System				
	9/79	720		System			Mixer motor	Outage occurred during third quarter due to mixer motor and other related problems
	10/79	744		System				Unit operated at half load during last week of September and shut down completely in early October for annual inspection
	11/79	720		System				
	12/79	744		System				Unit shut down for 240 hour scheduled outage for fall maintenance
							Reactor tank agitator	Shaft failure
	1/80	744	744	System	744	100		

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Lawrence 4 (continued)	2/80	696	696	System	696	100	Storage tank	Storage tank eroded completely through causing 48 hour outage Low FGD hours due to 408 hour boiler inspection outage
	3/80	744	744	System	744	100		
	4/80	720	576	System	576	100		
	5/80	744	744	System	744	100		
	6/80	720	720	System	720	100		
	7/80	744	744	System	720	97		
	8/80	744	744	System	744	100		
	9/80	720	290	System	290	100		
	10/80	744	744	System	744	100		
	11/80	720	646	System	646	100		
	12/80	744	730	System	730	100		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Kansas Power & Light Lawrence 5	0/74			System				Lawrence 5 was originally equipped with a limestone injection FGD system. Respective dates of construction and commercial operation were March 1968 and March 1977. This FGD system was modified a number of times up until March 1978, when it was abandoned for a new rod deck-venturi/spray tower system
	8/74	744		System			Mist eliminators	Ineffective mist eliminator wash system (mist eliminators have to be cleaned manually)
	9/74	720		System				
	10/74	744		System			Absorber modules	Pocr gas distribution through marble beds
	11/74	720		System			Absorber modules	Pocr gas distribution problems continued
	12/74	744		System			Slurry recycle pumps	Rubber lining failures
	1/75	744		System				
	2/75	672		System				
	3/75	744		System				
	4/75	720		System				
	5/75	744		System				
	6/75	720		System			Absorber modules	FGD system shutdown to rebuild spray systems in all eight modules (boiler fired oil and FGD system bypassed)

Utility/unit	Date	Period hours	Boiler- hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Lawrence 5 (continued)	7/75	744	744	System	0			
	8/75	744	744	System	0			Natural gas fired and FGD system operation was not required
	9/75	720		System				
	10/75	744		System			Slurry recycle tanks	Screens replaced
	11/75	720		System				
	12/75	744		System				
	1/76	744		System				
	2/76	696		System				Utility decided to convert to new rod deck-venturi/spray tower
	3/76	744		System				FGD system
	4/76	720		System				
	5/76	744		System				
	6/76	720		System				
	7/76	744		System				
	8/76	744		System				
	9/76	720		System				
	10/76	744		System				Limestone FGD system will be available (when unit burns coal) until new FGD system construction is completed)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Lawrence 5 (continued)	11/76	720		System				
	12/76	744		System				
	1/77	744		System				
	2/77	672		System				
	3/77	744		System				
	4/77	720		System				
	5/77	744		System				
	6/77	720		System				Operation of the existing FGD system has been quite satisfactory and nearly problem free
	7/77	744		System				
	8/77	744		System				
	9/77	720		System				
	10/77	744		System				
	11/77	720		System				Existing FGD system operated acceptably throughout October and November
	12/77	744		System				
	1/78	744		System				Only six modules left on existing system (two were removed to make room for the new system)
	2/78	672		System				
	3/78	744		System				Original FGD system pull off line on March 20 so that the new scrubber-absorber system could be tied into gas stream

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Lawrence 5 (continued)	4/78	720		System				
	5/78	744		System				New system went into service on April 14 without any outages
	6/78	720		System		100		
	7/78	744		System		100		FGD system operated the entire time the boiler was on line (boiler down only 48 hours during the June-July period)
	8/78	744		System				
	9/78	720		System				System operated without any forced outages during August-September period. Unit was taken off line at the end of September during turbine/boiler inspection
	10/78	744		System				
	11/78	720		System				FGD system operated throughout October and November with only one outage due to annual boiler/turbine inspection
	12/78	744		System	642			
	1/79	744		System				
	2/79	672		System			Pipeline	30 hour outage due to ruptured pipeline
	3/79	744		System				
	4/79	720		System				
	5/79	744		System			Air preheater fan motor	Unit brought down to 50 percent capacity for a scheduled 504 hour outage to rebuild an air preheater fan motor

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Lawrence 5 (continued)	6/79	720		System			Recycle tank agitator	Utility reported that system operated well through June. Only related FGD outages due to agitator failure and general maintenance
	7/79	744		System				
	8/79	744		System				
	9/79	720		System				Unit operated without any major problems throughout the third quarter
	10/79	744		System				Unit shut down for 240 hours for scheduled fall outage. Scrubbers were cleaned and repair work performed on recycle tank agitators
	11/79	720		System				
	12/79	744		System				
	1/80	744	744	System	744	100		
	2/80	696	360	System	360			Low FGD hours due to boiler/turbine outage
	3/80	744	408	System	408			
	4/80	720	720	System	720	100		
	5/80	744	600	System	600	100		144 boiler/turbine outage (general maintenance performed on FGD system during outage)
	6/80	720	720	System	720	100		
	7/80	744	715	System	715	100		29-hour outage due to boiler reheater tube repairs

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Lawrence 5 (continued)	8/80	744	606	System	606	100		
	9/80	720	689	System	689	100		
	10/80	744	485	System	485	100		259 hour outage for boiler inspection
	11/80	720	720	System	720	100		
	12/80	744	744	System	744	100		No FGD related problems were encountered during the months of November and December

KENTUCKY UTILITIES

GREEN RIVER 1-3

SECTION 1

BACKGROUND

The Green River Generating Station of Kentucky Utilities is located near Central City, Kentucky. Boilers 1, 2, and 3 supply steam to two steam turbine generators having a combined generating capacity of 64 MW (gross). At the time of construction, there were no particulate matter or SO₂ emission limitations in effect. However, in the 1970's the State of Kentucky promulgated a regulation requiring that particulate matter emissions be limited to 0.145 pounds per million Btu and that SO₂ emissions not exceed 2.0 pounds per million Btu. To comply with these requirements, Kentucky Utilities decided to retrofit a single FGD system to control SO₂ emissions from these three boilers, along with mechanical collectors and a venturi scrubber for particulate matter control.

The utility's decision to utilize a wet scrubber versus ESP's for compliance with particulate matter regulations was based on an economic study that indicated that the overall cost to the utility would be less. In addition, the absorber module was incorporated into the system to provide operating experience in anticipation of more stringent future regulations limiting SO₂ emissions from new Kentucky utility units.

Kentucky Utilities
Green River 1-3

A turnkey contract was awarded to American Air Filter in June, 1973, to supply (and operate for a limited period) the FGD system. Western Precipitation Division, Joy supplied the mechanical collectors. Startup of the Green River FGD system commenced in September 1975. The SO₂ standard to which these boilers are subject was changed to 1.2 pounds per million Btu in 1975 and finally to 0.9 pounds per million Btu in early 1981 under a new station "bubble" regulation which allows 4.57 pounds of SO₂ emission per million Btu on boilers 4 and 5.

SECTION 2

PROCESS DESCRIPTION

The Green River emission control system consists of mechanical collectors and a variable throat venturi scrubber for particulate matter control followed by a single mobile-bed contactor absorber module for SO₂ control.

The flue gas from each boiler passes first through a series of mechanical collectors. The flue gas is then drawn from the breeching, through a guillotine-type isolation damper and associated ductwork, to the scrubber FD fan. By use of the isolation dampers, operators can selectively allow flue gases to bypass the FGD system and pass directly to an existing stack.

From the outlet of the fan, the gas flows through a variable-throat venturi scrubber with a flooded elbow. These components provide additional capability for removal of particulate matter escaping the upstream mechanical collectors and also effect initial quenching of the hot gas.

From the venturi, the gas passes through the flooded elbow and flows upward through the mobile-bed contactor at a rate of 288,200 acfm at 116°F. The gases continue upward and pass through a radial vane mist eliminator. In the initial FGD system design, no reheat was provided and the flue gas exited to the atmosphere via a wet stack. However, the operation of the

Kentucky Utilities
Green River 1-3

system was accompanied by various problems. The most severe problem concerned the high loadings of acid mist in the FGD system exit gas stream. These high loadings caused acid condensation and rainout in the stack and the immediate plant area. To rectify this situation the carboline stack lining, which had failed around nearly half the circumference, was replaced with a refractory coating, the stack shell was repaired by welding a backup metal plate to the portions of the stack that were pitted and an indirect hot air injection reheater was incorporated to raise the gas temperature by 40°F.

The Green River FGD system operates in a closed water loop mode and sludge is disposed of in an on-site lined pond. A flow diagram for the Green River 1-3 FGD system is shown on the next page.

Flow Diagram: Green River 1-3

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

GENERAL PLANT INFORMATION

COMPANY NAME: KENTUCKY UTILITIES
ASSOCIATED UTILITIES: NONE
PLANT NAME: GREEN RIVER
UNIT NUMBER: 1-3
PLANT ADDRESS: P.O. BOX 191
CITY: CENTRAL CITY
COUNTY: MUHLENBURG
STATE: KENTUCKY
ZIP CODE: 42330
EPA REGION: 4
RIVER BASIN/LAKE REGION: GREEN
REGULATORY CLASSIFICATION: STATE STANDARD MORE STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.145
SO2 EMISSION LIMITATION - LB/MM BTU: 0.90
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 242
GROSS UNIT GENERATING CAPACITY - MW: 64
NET UNIT GENERATING CAPACITY WITH FGD - MW: 60
NET UNIT GENERATING CAPACITY W/O FGD - MW: 62
EQUIVALENT SCRUBBED CAPACITY - MW: 64

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: BABCOCK & WILCOX
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: FRONT WALL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): PEAK
COMMERCIAL SERVICE DATE: 1950
DESIGN BOILER FLUE GAS FLOW - ACFM: 360,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: 4.5
HEAT RATE - BTU/KWH: 13,250
DESIGN FIRING RATE - TPH: 26
EXCESS AIR - %: 25
CAPACITY FACTOR - %: 40
STACK HEIGHT - FT: 165 ABOVE GRADE (78 FT. ABOVE ABSORBER)
SHELL MATERIAL: CARBON STEEL
FLUE MATERIAL GENERIC TYPE: CARBON STEEL
FLUE MATERIAL SPECIFIC TYPE:
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY-BONDED MORTAR
FLUE LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8
FLUE INNER DIAMETER - FT: 16
STACK GAS INLET TEMPERATURE - F: 170
STACK GAS OUTLET VELOCITY - FT/SEC:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: P&M COAL CO. AND RIVER PROCESSING
MINE NAME/AREA: HOYT & DRAKE MINE
MINE LOCATION - COUNTY: HARLAN & MUHLENBURG
MINE LOCATION - STATE: KENTUCKY
AVERAGE HEAT CONTENT - BTU/LB: 11,580
RANGE HEAT CONTENT - BTU/LB: _____
AVERAGE ASH CONTENT - %: 9.6
RANGE ASH CONTENT - %: _____
AVERAGE MOISTURE CONTENT - %: 11.0
RANGE MOISTURE CONTENT - %: _____
AVERAGE SULFUR CONTENT - %: 2.5
RANGE SULFUR CONTENT - %: 2.4-2.6
AVERAGE CHLORIDE CONTENT - %: _____
RANGE CHLORIDE CONTENT - %: _____
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED AND SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: 3
NUMBER OF SPARES: 0
TYPE: CYCLONES
SUPPLIER: WESTERN PREC. DIVISION, JOY
INLET FLUE GAS CAPACITY - ACFM: 105,000
INLET FLUE GAS TEMPERATURE - F: 300-350
PRESSURE DROP - IN. H2O: 0.02
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: 65

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE
NUMBER OF SPARES:
TYPE (HOT SIDE/COLD SIDE):
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:
FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: 1
NUMBER OF SPARES: 0

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.): VARIABLE THROAT/TOP-ENTRY
PLUMB BOB

TRADE/COMMON NAME: N/A

SUPPLIER: AMERICAN AIR FILTER

DIMENSIONS - FT:

SHELL MATERIAL GENERIC TYPE: CARBON STEEL TO INLET, STAINLESS STEEL TO
THROAT, THEN MILD STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110 AND TYPE 316

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: INORGANIC

LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY-BONDED MORTAR

LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8

BOILER LOAD PER SCRUBBER (DESIGN) - %: 100

GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): NONE

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A

A NUMBER OF SPRAY HEADERS: 1

NOZZLE MATERIAL: STELLITE

NOZZLE PRESSURE DROP - PSI:

LIQUID RECIRCULATION RATE - GPM: 1360

L/G RATIO - GAL/1000 ACF: 4.0

PH CONTROL ADDITIVE: ABSORBER RECYCLE

GAS-SIDE PRESSURE DROP - IN. H₂O: 6.4-9.0

SUPERFICIAL GAS VELOCITY - FT/SEC:

INLET GAS FLOW RATE - ACFM: 360,000

INLET GAS TEMPERATURE - F: 300

INLET SO₂ LEVEL - PPM: 1600-2200

INLET SO₂ LEVEL - LB/MM BTU:

INLET PARTICLE LEVEL - GR/SCF: 2.68

INLET PARTICLE LEVEL - LB/MM BTU:

OUTLET GAS FLOW RATE - ACFM: 288,200

OUTLET GAS TEMPERATURE - F: 116

OUTLET SO₂ LEVEL - PPM:

OUTLET SO₂ LEVEL - LB/MM BTU:

OUTLET PARTICLE LEVEL - GR/SCF:

OUTLET PARTICLE LEVEL - LB/MM BTU:

SO₂ REMOVAL EFFICIENCY - %:

B PARTICLE REMOVAL EFFICIENCY - %: 98

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME

PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE

SYSTEM SUPPLIER: AMERICAN AIR FILTER

A-E FIRM: AMERICAN AIR FILTER

CONSTRUCTION FIRM: AMERICAN AIR FILTER

APPLICATION (NEW/RETROFIT): RETROFIT

PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.5

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

SO2 DESIGN REMOVAL EFFICIENCY - %: 80.0

CURRENT STATUS: OPERATIONAL

TERMINATION DATE: N/A

COMMERCIAL START-UP: 6/76

INITIAL START-UP: 9/75

CONSTRUCTION COMPLETION:

CONSTRUCTION INITIATION: 4/74

CONTRACT AWARDED: 6/73

LETTER OF INTENT SIGNED:

INITIATED BID REQUEST:

INITIATED PRELIMINARY DESIGN:

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 3.8

DESIGN COAL HEAT CONTENT - BTU/LB: 11,100

DESIGN COAL ASH CONTENT - %: 14.0

DESIGN COAL MOISTURE CONTENT - %:

DESIGN COAL CHLORIDE CONTENT - %:

FGD SYSTEM SPACE REQUIREMENTS - SQ FT:

FGD SYSTEM TURNDOWN RATIO: 1.2:1

FGD SYSTEM TURNDOWN METHOD: CLOSE DAMPERS AT BOTTOM OF ABSORBER COMPARTMENTS

FGD SYSTEM PRESSURE DROP - IN. H2O: 14

FGD SYSTEM OXIDATION - %:

FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: 10

FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 10

FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 48

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 1

C FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE PERSONNEL/SHIFT): 3

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1

D FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR):

TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): SHARED WITH BOILER

E SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

ROTATION TO FGD SYSTEM: ON AN AS NEEDED BASIS

F TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): SHARED WITH BOILER

FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES (BYPASS TO OLD STACK)

RESTRICTIONS TO USING BYPASS: START-UP ONLY

G TIME SCHEDULE FOR REDUCED BOILER LOAD: N/A

TIME SCHEDULE FOR BOILER SHUTDOWNS: ANNUAL OUTAGES ONLY

PLANNED MAINTENANCE DURING REDUCED

BOILER LOAD (TYPE AND FREQUENCY): N/A

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY): REPAIRS AS NEEDED

H TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE):

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE (VENTURI SERVES AS QUENCHER)
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 1
NUMBER OF SPARES: 0
I GENERIC TYPE: PACKED TOWER
SPECIFIC TYPE: ENTRAINED PACKING
TRADE/COMMON NAME: MOBILE BED CONTACTOR
SUPPLIER: AMERICAN AIR FILTER
DIMENSIONS - FT: 20 X 20 X 27.5
J SHELL MATERIAL GENERIC TYPE: CARBON STEEL AND STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110 AND TYPE 316
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: INORGANIC
LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY-BONDED MORTAR
LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8
BOILER LOAD PER ABSORBER - %: 100
K GAS/LIQUID CONTACT DEVICE TYPE: PLASTIC/RUBBER MOBILE BALLS
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: 6
NOZZLE MATERIAL: NONE ABOVE THE BED AND STELLITE BELOW THE BED
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 9750
L/G RATIO - GAL/1000 ACF: 35
GAS-SIDE PRESSURE DROP - IN. H2O: 2.8-3.2
SUPERFICIAL GAS VELOCITY - FT/SEC: 11-12

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

ABSORBER TURNDOWN RATIO: 1.2:1
L ABSORBER TURNDOWN METHOD: CLOSE DAMPERS AT BOTTOM OF ABSORBER COMPARTMENTS
INLET GAS FLOW RATE - ACFM: 288,200
INLET GAS TEMPERATURE - F: 116
INLET SO2 LEVEL - PPM: 2200
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: 288,200
OUTLET GAS TEMPERATURE - F: 116
OUTLET SO2 LEVEL - PPM: 300-450
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: 0.044
OUTLET PARTICLE LEVEL - LB/MM BTU: _____
B SO2 REMOVAL EFFICIENCY - %: 80-90
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 1
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
M GENERIC TYPE: CENTRIFUGAL
SPECIFIC TYPE: RADIAL VANE
COMMON DESIGN: RADIAL BAFFLE
MANUFACTURER: AMERICAN AIR FILTER
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): N/A
NUMBER OF STAGES: 1
NUMBER OF PASSES/STAGE: 1
N FREEBOARD DISTANCE - FT: 13.5
DISTANCE BETWEEN STAGES - IN.: N/A
O DISTANCE BETWEEN VANES - IN.: 3.0
VANE ANGLES - DEGREES: N/A
PRESSURE DROP - IN. H2O: 2.3
P SUPERFICIAL GAS VELOCITY - FT/SEC: 27.5
CONSTRUCTION MATERIAL GENERIC TYPE: STAINLESS STEEL
CONSTRUCTION MATERIAL SPECIFIC TYPE: TYPE 316
CONSTRUCTION MATERIAL TRADE/COMMON NAME: N/A
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): FRESH MAKEUP
POINT OF WATER COLLECTION: BOTTOM OF ABSORBER
WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): OUTWARD
WASH FREQUENCY: CONTINUOUS
WASH DURATION: CONTINUOUS
WASH RATE - GAL/MIN: 45
WASH COVERAGE - GAL/MIN/SQ FT: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

REHEATER

NUMBER OF REHEATERS: 1
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1

Q GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): INDIRECT
HOT AIR

SPECIFIC TYPE (STEAM, HOT WATER, ETC.): EXTERNAL HEAT EXCHANGER
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): STEAM TUBE BUNDLE
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: EXTERNAL

AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 0

TEMPERATURE INCREASE - F: 40

INLET FLUE GAS FLOW RATE - ACFM: 296,300

INLET FLUE GAS TEMPERATURE - F: 116

OUTLET FLUE GAS FLOW RATE - ACFM: _____

OUTLET FLUE GAS TEMPERATURE - F: 156

ENERGY REQUIREMENT - MM BTU/HR: _____

NUMBER OF HEAT EXCHANGER BANKS: _____

NUMBER OF BUNDLES PER BANK: _____

NUMBER OF TUBES PER BUNDLE: _____

STEAM OR WATER PRESSURE - PSIG: _____

STEAM OR WATER TEMPERATURE - F: _____

SELF CLEANING DEVICE TYPE: _____

MATERIAL GENERIC TYPE: CARBON STEEL

MATERIAL SPECIFIC TYPE: _____

MATERIAL TRADE/COMMON NAME: N/A

FANS

NUMBER OF FANS: 1

NUMBER OF SPARES: 0

DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL

SUPPLIER: BUFFALO FORGE

FUNCTION (UNIT/BOOSTER): BOOSTER

APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT

SERVICE (WET/DRY): DRY

TYPE OF WASH: NONE

LOCATION WRT MAJOR COMPONENTS: BETWEEN MECHANICAL COLLECTOR AND VENTURI

FLUE GAS FLOW RATE - ACFM: 360,000

FLUE GAS TEMPERATURE - F: 300

PRESSURE DROP - IN. H2O: _____

MATERIAL GENERIC TYPE: CARBON STEEL

MATERIAL SPECIFIC TYPE: AISI 1110

MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) UNDER MOBILE BEDS (B) BYPASS STACK

NUMBER OF DAMPERS: (A) 10 (B) 3

FUNCTION (CONTROL/SHUT-OFF): (A) CONTROL (B) SHUT-OFF

GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) LOUVER (B) GUILLotine

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

SPECIFIC TYPE (OPPOSED BLADE,
PARALLEL BLADE, ETC.): (B) TOP-ENTRY GUILLOTINE/SEAL AIR
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): (B) N/A
MANUFACTURER: _____
MODULATION (OPEN/CLOSED, ETC.): (B) OPEN/CLOSED
SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: (B) CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: (B) NONE
LINER MATERIAL SPECIFIC TYPE: (B) N/A
LINER MATERIAL TRADE/COMMON NAME: (B) N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) RETROFIT DUCT TO FGD BOOSTER FAN
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) RECTANGULAR (B) CIRCULAR
(C) CIRCULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
(C) CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: (A) NONE (B) INORGANIC (C) NONE
LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY-BONDED MORTAR
LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8

EXPANSION JOINTS

LOCATION: INLET & OUTLET OF FGD FORCED DRAFT FAN
R TYPE (METALLIC/ELASTOMERIC): METALLIC (OUTLET-1); ELASTOMERIC (INLET-2)
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: 300
DESIGN CONFIGURATION (V-SHAPED, ETC.): V-SHAPED (INLET/OUTLET)
MANUFACTURER: _____
MATERIAL: STAINLESS STEEL (OUTLET); VITON® (INLET)

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: _____
MATERIALS: _____
NUMBER OF DEVICES: 1
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: _____
PRODUCT QUALITY - % SOLIDS: 20
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

PREPARED REAGENT POINT OF ADDITION: SPENT SLURRY RETURN SECTION OF REACTION
TANK

ON-SITE STORAGE CAPABILITY - DAYS: 8

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED

WATER, SLUDGE, ETC.): (A) RECYCLE SLURRY (B) RECLAIMED WATER (C) SLUDGE
(D) ABSORBER BLEED (E) SPRAY HEADERS

DIMENSIONS - IN.: _____

MANUFACTURER: _____

MATERIAL: (A) FRP AND RUBBER LINED CARBON STEEL

(B) RUBBER LINED CARBON STEEL (C) RUBBER LINED CARBON STEEL

(D) TYPE 316 STAINLESS STEEL (E) FRP

MAJOR VALVES

LOCATION: _____

FUNCTION (ISOLATION, CONTROL, ETC.): (A) ISOLATION (B) CONTROL

TYPE (BALL, GLOBE, PLUG, ETC.): (A) KNIFEGATE (B) PLUG

CONTROL MODE (AUTOMATIC/MANUAL): _____

DIMENSIONS - IN.: _____

MANUFACTURER: (A) DEZURIK (B) _____

MATERIAL: (A) _____ (B) STAINLESS STEEL BODY AND RUBBER-
LINED PLUG

THICKENERS

NUMBER OF THICKENERS: NONE

NUMBER OF SPARES:

CONFIGURATION:

DIMENSIONS - FT:

CAPACITY - GAL:

SHELL MATERIAL GENERIC TYPE:

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE:

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME:

RAKE MATERIAL:

FEED STREAM SOURCE:

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):

OUTLET STREAM DISPOSITION:

OVERFLOW STREAM DISPOSITION:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAOH2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): _____
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): _____
LOCATION (ON-SITE/OFF-SITE): ON-SITE

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NATURAL CLAY
SITE DIMENSIONS - AREA/DEPTH: 9 ACRES X 25 FT
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 12 (AT FULL LOAD)

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: REACTION TANK (PH)
CHEMICAL PARAMETERS (PH, ETC.): SO₂, PH
PHYSICAL PARAMETERS (PERCENT
SOLIDS, DENSITY, FLOW, ETC.): GAS FLOW, PRESSURE DROP, PERCENT SOLIDS
CONTROL LEVELS: PH 5.5-6.0; SOLIDS 10%
MONITOR TYPE (MANUFACTURER, ETC.): UNIFLO
MONITOR LOCATION: PH - REACTION TANK; DENSITY METERS - RECYCLE LINE
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): _____
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN
TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
MAKEUP WATER ADDITION - GPM: 75
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): RIVER WATER
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIME
PRINCIPAL CONSTITUENTS: _____
SOURCE/SUPPLIER: _____
SUPPLIER LOCATION: VIRGINIA OR MISSOURI
CONSUMPTION (SPECIFY UNITS): 2 TPH
UTILIZATION - %: _____
POINT OF ADDITION: SLAKER

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 7,700,000
CAPITAL COST - \$/KW: 120
OPERATING COST - MILLS/KWH: 2.03
MAINTENANCE COST: 0.20 MILLS/KWH
LABOR COST: 0.37 MILLS/KWH
UTILITIES COST: 0.25 MILLS/KWH
CHEMICALS COST: 1.21 MILLS/KWH
WASTE DISPOSAL COST: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

FGD SPARE CAPACITY INDICES

SCRUBBER - %: 0
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: N/A
SLAKER - %: 0
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 33
THICKENER - %: N/A
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: 0
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: N/A
SLAKER: 0
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 1
THICKENER: N/A
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: N/A
PARTICIPANTS: KENTUCKY UTILITIES, LOUISVILLE GAS & ELECTRIC
PROCESS: LIMESTONE
PLANT DESIGN: _____
SUPPLIER: _____
SERVICE DATE: 1972
PERIOD OF OPERATION - MONTHS: _____
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 3.3
STATUS (ACTIVE/TERMINATED): TERMINATED

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): SLAKED SLURRY DILUTION/HOLDING
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED):
LOCATION: SLAKER BUILDING
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL: 1980
RETENTION TIME - MIN:
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: TOP MOUNTED
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): REACTION/RECYCLE
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: TO SIDE OF ABSORBER
CONFIGURATION: RECTANGULAR, THREE SECTIONS
DIMENSIONS - FT:
CAPACITY - GAL: 311,000
RETENTION TIME - MIN: 27-30
NUMBER OF AGITATORS: 3
AGITATOR CONFIGURATION: TOP MOUNTED
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: ACID PROOF CONCRETE
SHELL MATERIAL SPECIFIC TYPE: N/A
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLAKING
NUMBER OF TANKS: 2
NUMBER OF SPARES: 1
TYPE (OPEN/COVERED):
LOCATION: SLAKER BUILDING

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1 EACH
AGITATOR CONFIGURATION: TOP MOUNTED
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED,
ABSORBER RECIRCULATION, ETC.): SCRUBBER/ABSORBER RECIRCULATION

NUMBER OF PUMPS: 3

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT DRIVE

COMMON DESIGN (V-BELT, ETC.): V-BELT

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER: 400 C

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 5900

MOTOR BRAKE HP: 300

SPEED - RPM: _____

HEAD - FT: 115

SERVICE (PH, SOLIDS): PH 8.5-9.0; SOLIDS 10%

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

S IMPELLER MATERIAL GENERIC TYPE: CAST ALLOY

IMPELLER MATERIAL SPECIFIC TYPE: HIGH CHROMIUM AND NICKEL

IMPELLER MATERIAL TRADE/COMMON NAME: NI-HARD

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLURRY TRANSFER

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 90

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-CLAD CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): POND RETURN

NUMBER OF PUMPS: 2

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: _____

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): BLEED STREAM

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT DRIVE

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: _____

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 350

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-CLAD CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 6/30/81

KENTUCKY UTILITIES
GREEN RIVER 1-3

COMMENTS/FOOTNOTES

- A RING HEADER WITH 12 NOZZLES.
- B OVERALL REMOVAL EFFICIENCY.
- C DAY SHIFT ONLY (7:30 A.M. - 4:00 P.M.).
- D OCCASIONAL WORK IS PERFORMED BY OUTSIDE CONTRACTORS AS NEEDED (I.E., PULLING IMPELLERS, CONCRETE WORK, FAN MAINTENANCE). FAN MAINTENANCE IS PERFORMED APPROXIMATELY EVERY 6 MONTHS (2 MEN - 48 MANHOURS EACH TIME).
- E MAINTENANCE CREW CONSISTS OF 37 PEOPLE THAT PERFORM BOTH BOILER AND FGD MAINTENANCE. ON THE AVERAGE, 3 MEN/DAY (1-SHIFT) ARE INVOLVED IN FGD MAINTENANCE (1 INSTRUMENTATION/2 MECHANICAL).
- F FOUR FOREMEN OVERSEE MAINTENANCE WORK ON BOILER AND FGD (1-MECHANICAL, 1-ELECTRICAL, 1-INSTRUMENTATION, 1-BUILDING & GROUNDS).
- G DURING PERIODS OF BOILER OPERATION, UNIT IS RUN ON A CONTINUOUS BASIS AT FULL LOAD UNTIL A MECHANICAL MALFUNCTION NECESSITATES AN OUTAGE (EXCEPT FOR ANNUAL OUTAGES).
- H DEPENDING ON AMOUNT OF TIME AVAILABLE (I.E., SYSTEM LOAD REQUIREMENTS) ADDITIONAL MAINTENANCE OTHER THAN CORRECTION OF FAILURE MAY BE PERFORMED (E.G., EXPANSION JOINT LEAKS, LEAKY VALVES).
- I AMERICAN AIR FILTER MOBILE BED DESIGN.
- J UNLINED TYPE 316 STAINLESS STEEL FROM THE BED AREA TO THE TOP OF THE MIST ELIMINATOR.
- K PVC AND POLYETHYLENE SOLID SPHERES.
- L TOTAL OF 10 LOUVER DAMPERS; (NINE OPEN AT FULL LOAD).
- M AMERICAN AIR FILTER RADIAL VANE DESIGN.
- N RANGES FROM 10 TO 15 FT.
- O 2.5 TO 3.0 IN. AT INLET AND 4.0 IN. AT OUTLET.
- P VARIES FROM 25 TO 30 FT/SEC.
- Q PLACED IN SERVICE IN 1979.
- R FORCED DRAFT FAN VITON® OUTLET EXPANSION JOINT WAS REPLACED WITH STAINLESS STEEL.
- S REPLACED RUBBER-CLAD IMPELLERS AFTER LININGS HAD TO BE REPLACED TWICE.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Kentucky Utilities Green River 1-3	9/75	720		System				System operation commenced on September 13 on a half load basis because of turbine overhaul
	10/75	744		System				
	11/75	720						
	12/75	744	398	System	257	74		
	1/76	744	572	System	64	42	Recycle pump	Failure of recycle pumps
							Lines	Thawing and repair of numerous frozen lines
							Sump pumps	Had to be shut down
							Feed tank agitator	Repaired
	2/76	696	499	System	211	70	Slake tanks	Repaired
							Mix hold tanks	Repaired
							Reactant pumps	Cleaned out and repaired
	3/76	744	458	System	386	97	Pumps	Rubber-lined impellers replaced
	4/76	720	552	System	552	90		
	5/76	744	456	System	456	81		
	6/76	720	597	System	589	100		
Commercial start-up	7/76	744	584	System	574	90		
	8/76	744	744	System	722	97	ID fan	22 hour outage to repair ID fan
(continued)								

Kentucky Utilities
Green River 1-3

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Green River 1-3 (continued)	9/76	720	571	System	571	86	10 fan	Minor problems (no forced outage occurred)
	10/76	744	699	System	699	100		Half load operations conducted due to turbine bearing problems
	11/76	720	704	System	704	100		
	12/76	744	536	System	517	73	Absorbers	During November and December, the utility conducted a checkout of the scrubber internals and replaced some of the packing spheres in the mobile beds
	1/77	744	744	System	698	94		
	2/77	672	266	System	243	36		
	3/77	744	0	System	0	0	Stack liner	During the month of February it was found that the carboline stack liner had badly deteriorated. Scrubber and boiler operation were terminated until the stack liner was repaired. The stack was repaired first by welding metal plates to the portions where pitting had occurred. The entire stack was then lined with a refractory lining called precrete by AAF.
	4/77	720	167	System	164	40		
	5/77	744	527	System	513	99		
	6/77	720	34	System	34	100	Venturi	Leaks repaired
							Underbed damper	Repaired
							Lime slaking operations	Repaired

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Green River 1-3 (continued)	7/77	744	0	System	0	100		Boiler and FGD system shut down due to plant strike
	8/77	744	0	System	0	100		
	9/77	720	0	System	0	100		
	10/77	744	0	System	0	100		
	11/77	720	332	System	301	86	Recycle pumps	Failures encountered
							Recycle pump impeller	Leaks encountered in recycle pump impeller coating
							Sump pump	Failures encountered
							Absorber	Leaks in packing
	12/77	744	596	System	375	50	Miscellaneous equipment	Weather related problems (numerous freeze-ups)
	1/78	744	537	System	170	31	Slurry line to pond	Unit went down after 170 hours of operation due to frozen slurry line to pond
	2/78	672	672	System	0	97		System considered available throughout winter period because emergency conditions forced utility to concentrate all maintenance crews to power production
	4/78	720	296	System	295	41		
	5/78	744	474	System	474	64	Screens	The screens on the suction side of the pump's that pump the slurry from the prep room to the nozzles plugged

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Green River 1-3 (continued)	6/78	720	525	System	524	73		
	7/78	744	103	System	99	13	System	FGD system outages were for general maintenance
	8/78	744	207	System	205	61	Bleed pump	288 hour outage to repair bleed pump
	9/78	720	303	System	298	76		Because of plugging problems to FGD, system operated at approximately one-third of the total capacity the last two weeks of September
	10/78	744	236	System	222	30	Recycle tank screen	Plugging encountered
							Booster fan	Vibration problems
	11/78	720	175	System	175	24		
	12/78	744	0	System	0	0		
	1/79	744	1	System	0	0		
	2/79	672	0	System	0	0	System	FGD system was unavailable in December, January and February due to winter weather related problems
	3/79	744	83	System	83	11	Recycle pump	Specific problem was not reported
	4/79	720	131	System	131	18	Recycle pump	Specific problem was not reported
	5/79	744	0	System	0	100	Boiler/turbine	Boiler taken down for repairs. During outage an indirect steam reheat system was added to increase exiting flue gas temperatures. (Work continued on boiler until 7/80.)

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Green River 1-3 (continued)	6/79	720	0	System	0	100	Reheater	Reheat system will be available when boiler restarts
	7/79	744	0	System	0	100		
	8/79	744	0	System	0	100		
	9/79	720	0	System	0	100		
	10/79	744	0	System	0	100		
	11/79	720	0	System	0	100		
	12/79	744	0	System	0	100		
	1/80	744	0	System	0	100		
	2/80	696	0	System	0	100		
	3/80	744	0	System	0	100		
	4/80	720	0	System	0	100		
	5/80	744	0	System	0	100		
	6/80	720	0	System	0	100		Boiler repairs were delayed due to unavailability of some needed parts
	7/80	744	0	System	0	100		Boiler repairs completed (boiler did not operate due to repairs to turbine)
	8/80	744	0	System	0	100		
	9/80	720	0	System	0	100		
(continued)								

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Green River 1-3 (continued)								
	10/80	744	0	System	0	100		
	11/80	720	0	System	0	100		
	12/80	744	0	System	0	100		Repairs to turbine continued

LOUISVILLE GAS & ELECTRIC

CANE RUN 4, 5

SECTION 1

BACKGROUND

The Cane Run Power Station in Louisville, Kentucky is owned and operated by Louisville Gas & Electric (LG&E). The station consists of six units, which provide a total steam turbine generating capacity of 992 MW (net). Louisville Gas & Electric (LG&E) built the 188-MW (gross) Cane Run 4 unit in 1962. In 1966, the Cane Run Station was expanded with the addition of Cane Run 5, a 200-MW (gross) unit. These units fire a bituminous high-sulfur (3.8%) coal.

At the time of construction, SO₂ and particulate matter emission control systems were not required. However, in 1970, LG&E was faced with imminent ambient air standards for SO₂ emissions from their coal-fired plants. As such, LG&E requested Combustion Engineering to evaluate their marble-bed scrubber design for application in a carbide lime slurry FGD system on a coal-fired boiler at their Paddy's Run Power Station. The request to develop a process that could use carbide lime stemmed from LG&E's easy access to supplies of this by-product from a local acetylene manufacturing plant operated by Airco. Carbide lime is a by-product of the manufacture of acetylene and is mainly composed of calcium hydroxide and calcium carbonate.

Louisville Gas & Electric
Cane Run 4, 5

During the course of the Paddy's Run FGD demonstration program, LG&E had discussions with the U.S. EPA, the Air Control District of Jefferson County, and the Kentucky State Division of Air Pollution in an attempt to establish a compliance plan for the Cane Run units. The success of the Paddy's Run FGD demonstration program, coupled with the utility's long-term contractual commitment to high sulfur coal, resulted in the signing of a consent decree on December 10, 1975. The enforcement order in effect mandated the installation of FGD systems on Cane Run 4, 5, and 6 and Mill Creek 3 and 4.

Based on the requirements of the consent decree, a contract was awarded to American Air Filter for a carbide lime FGD system to be installed on Cane Run 4. Initial startup of this system commenced in August 1976. A contract was also awarded to Combustion Engineering for the installation of a carbide lime FGD system at Cane Run 5. The initial operation of this system commenced in December 1977.

SECTION 2

PROCESS DESCRIPTION

The emission control system at Cane Run 4 consists of cold-side ESP's followed by a carbide lime scrubbing system.

The flue gas exits the boiler and passes through each ESP at 365,000 acfm at 320°F. Flue gas from existing unit ID fans discharges through FD FGD booster fans into the FGD system. The ductwork and damper network provided with the FGD system allows gas to partially or totally bypass the two absorber modules.

Following passage through the booster fans, the gas enters the absorber modules. Each module consists of a vertical packed tower preceded by a quencher and flooded elbow. A series of nozzles in the quencher inject lime slurry into the gas stream to insure thorough wetting of the gases prior to passage through the absorber. Immediately below each quencher is a flooded elbow. Some removal of SO_2 occurs in the quencher and the flooded elbow since part of the lime slurry recycle stream is diverted to these sections for wetting and saturation.

The quenched flue gas enters the base of each absorber tower at 291,500 acfm and 140°F. Each absorber tower is a single stage mobile bed contactor. The mobile bed contactor contains a fluid bed packing of solid spheres which serve to

Louisville Gas & Electric
Cane Run 4, 5

break up the gas stream and provide pockets for mixing of the flue gases and scrubbing slurry. The flue gas passes upward through the packing where it contacts the scrubbing slurry sprayed into the gas stream countercurrently through large, low pressure, slurry sprays.

Entrained droplets of moisture and slurry picked up by the gas stream due to the turbulent mixing of slurry and gas in absorption zone are removed by mist eliminators. Each absorber is equipped with a two-stage, three-pass, chevron-type mist eliminator located in the top portion of each tower. Each mist eliminator is equipped with its own set of water sprays to prevent the accumulation of solids.

Following passage through the mist eliminators, the cool, saturated gas stream is reheated by oil-fired burners located in the discharge ducts entering the stack. The direct oil-fired reheaters boost the temperature of the gas stream approximately 25 to 30°F prior to discharge to the existing stack.

Spent slurry (10% solids) is discharged to a thickener and is further dewatered (25% solids). An IUCS process stabilizes the sludge before being disposed of in an onsite landfill.

The lime FGD system operating at Cane Run 5 is similar to Cane Run 4 in process design and gas treating capacity.

The flue gas exits the boiler and passes through two ESP's to the FGD system. The FGD system consists of two 50% capacity absorber modules with a combined capacity of 740,000 acfm of flue gas at 300°F. Each scrubber module contains a horizontal

approach duct which enters the base of a vertical spray tower absorber. The ductwork and dampers provided with the FGD system allow gas to partially or totally bypass the scrubber modules. As the gas enters the base of the spray tower it is decelerated and turned 90 degrees with the aid of ladder-type turning vanes. In this zone of the tower the gas is rapidly quenched to a temperature of 126°F. The gas then flows upward through each vertical spray tower at a rate of 261,000 acfm. Slurry is sprayed countercurrent to the flue gas flow from three levels of spray nozzles. The saturated, scrubbed gas stream then passes through a mist eliminator section situated at the top of each spray tower. Each mist eliminator consists of two stages of chevrons preceded by a bulk entrainment separator. Entrained droplets of moisture and slurry picked up by the gas stream as it passes through the spray towers are removed in the mist eliminator section.

Following passage through the mist eliminators, the saturated gas stream exits the tower and turns 90 degrees and passes through in-line steam reheaters. Each module is equipped with four vertical rows of tubes which use glycol to raise the temperature of the scrubbed gas stream approximately 25°F as it leaves the spray tower. The treated gas stream then exits each spray tower and passes through an ID booster fan. Each fan is provided to overcome the gas-side pressure drop encountered through the scrubber module and associated ductwork. The reheated, scrubbed gas stream is then discharged to the atmosphere through the existing stack.

A thickener dewateres the spent slurry from 7% to 25% solids. The sludge is IUCS stabilized before being disposed of in an on-site landfill.

Flow diagrams for the Cane Run 4, 5 FGD systems are shown on the next two pages.

Louisville Gas & Electric
Cane Run 4,5

Flow Diagram: Cane Run 4

Flow Diagram: Cane Run 5

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

GENERAL PLANT INFORMATION

COMPANY NAME: LOUISVILLE GAS & ELECTRIC COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: CANE RUN
UNIT NUMBER: 4
PLANT ADDRESS: CANE RUN ROAD, P.O. BOX 32010
CITY: LOUISVILLE
COUNTY: JEFFERSON
STATE: KENTUCKY
ZIP CODE: 40232
EPA REGION: 4
RIVER BASIN/LAKE REGION: OHIO
REGULATORY CLASSIFICATION: STANDARD EQUAL TO OR LESS STRINGENT THAN NSPS
(12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.116
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 992
GROSS UNIT GENERATING CAPACITY - MW: 188
NET UNIT GENERATING CAPACITY WITH FGD - MW: 175
NET UNIT GENERATING CAPACITY W/O FGD - MW: 178
EQUIVALENT SCRUBBED CAPACITY - MW: 188

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: FRONT FIRED
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED DRAFT
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): CYCLIC
COMMERCIAL SERVICE DATE: 1962
DESIGN BOILER FLUE GAS FLOW - ACFM: 734,000
FLUE GAS TEMPERATURE - F: 310-325
FLUE GAS OXYGEN - %: 5-6
HEAT RATE - BTU/KWH: 10,600
DESIGN FIRING RATE - TPH: 84
EXCESS AIR - %: >25
CAPACITY FACTOR - %: 55-60
STACK HEIGHT - FT: 250
SHELL MATERIAL: CONCRETE
A FLUE MATERIAL GENERIC TYPE: N/A
FLUE MATERIAL SPECIFIC TYPE: N/A
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED MORTAR
FLUE LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8
FLUE INNER DIAMETER - FT: 19.0
STACK GAS INLET TEMPERATURE - F: 155-160
STACK GAS OUTLET VELOCITY - FT/SEC: 80.0

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: PEABODY COAL CO.
MINE NAME/AREA: STAR MINE
MINE LOCATION - COUNTY: MUHLENBURG
MINE LOCATION - STATE: KENTUCKY
AVERAGE HEAT CONTENT - BTU/LB: 11,300
RANGE HEAT CONTENT - BTU/LB: 10,400-11,900
AVERAGE ASH CONTENT - %: 15
RANGE ASH CONTENT - %: 10.0-20.0
AVERAGE MOISTURE CONTENT - %: 9
RANGE MOISTURE CONTENT - %: 8.0-10.8
AVERAGE SULFUR CONTENT - %: 3.87
RANGE SULFUR CONTENT - %: 3.5-4.0
AVERAGE CHLORIDE CONTENT - %: 0.04
RANGE CHLORIDE CONTENT - %: 0.03-0.06
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: RESEARCH-COTTRELL
INLET FLUE GAS CAPACITY - ACFM: 365,000
INLET FLUE GAS TEMPERATURE - F: 310-325
PRESSURE DROP - IN. H2O: 0.10-0.20 (DESIGN >0.10)
PARTICLE OUTLET LOAD - GR/SCF: 0.06-0.08
PARTICLE REMOVAL EFFICIENCY - %: 98.6-99.1
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/Common NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/Common NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/Common NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME (CARBIDE)
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: AMERICAN AIR FILTER
A-E FIRM: FLUOR-PIONEER
CONSTRUCTION FIRM: IN-HOUSE
APPLICATION (NEW/RETROFIT): RETROFIT
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0
SO₂ DESIGN REMOVAL EFFICIENCY - %: 85
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

COMMERCIAL START-UP: 8/77
INITIAL START-UP: 8/76
CONSTRUCTION COMPLETION: 8/76
CONSTRUCTION INITIATION: 10/74
CONTRACT AWARDED: 4/74
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST: _____
INITIATED PRELIMINARY DESIGN: _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.0
DESIGN COAL HEAT CONTENT - BTU/LB: 11,000
DESIGN COAL ASH CONTENT - %: 15.0
DESIGN COAL MOISTURE CONTENT - %: 12.0
DESIGN COAL CHLORIDE CONTENT - %: 0.075
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____

FGD SYSTEM TURNDOWN RATIO: 4:1

B FGD SYSTEM TURNDOWN METHOD: CONTINUOUSLY ALTERNATED CLOSING OF COMPARTMENTS

FGD SYSTEM PRESSURE DROP - IN. H₂O: 12

FGD SYSTEM OXIDATION - %: 3-5

FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A

FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 10

FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER

C FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT

(MANHOURS/DAY): 304 (UNITS 4 & 5)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT

(OPERATORS/SHIFT): 3 (DEDICATED)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE

PERSONNEL/SHIFT): 20 (ADDITIONAL PERSONNEL BROUGHT IN AS NEEDED FROM IN-HOUSE CONSTRUCTION CREW)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1

FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE

TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): SHARE WITH BOILER

SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

ROTATION TO FGD SYSTEM: AS NEEDED

TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): FGD SUPERVISORS
OVERSEE MAINTENANCE

FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES

RESTRICTIONS TO USING BYPASS: 10 DAY LIMIT

TIME SCHEDULE FOR REDUCED BOILER LOAD: REDUCED LOAD AT NIGHT TO DESLAG

TIME SCHEDULE FOR BOILER SHUTDOWNS: ANNUAL UNIT OUTAGE (2-4 WEEKS)

TURBINE OVERHAUL EVERY 4 YEARS
(8 WEEKS)

PLANNED MAINTENANCE DURING REDUCED

BOILER LOAD (TYPE AND FREQUENCY): OCCASIONAL PUMP MAINTENANCE

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY): ROUTINE MAINTENANCE AS REQUIRED

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE): ROUTINE MAINTENANCE AND GENERAL INSPECTION

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: 2
NUMBER OF SPARES: 0
TYPE: WETTED WALL CONICAL FRUSTUM
LOCATION: INLET TO ABSORBER
SUPPLIER: AMERICAN AIR FILTER
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE: STAINLESS STEEL
LINER MATERIAL SPECIFIC TYPE: AUSTENITIC
D LINER MATERIAL TRADE/COMMON NAME: TYPE 316L
INLET GAS FLOW - ACFM: 365,000
INLET GAS TEMPERATURE - F: 310-325
PRESSURE DROP - IN. H2O: 2.0
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER,
ABSORBER SLURRY, ETC.): ABSORBER RECYCLE
LIQUID RECIRCULATION RATE - GPM: 1760
L/G RATIO - GAL/1000 ACF: 5
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 0
E GENERIC TYPE: PACKED TOWER
SPECIFIC TYPE: ENTRAINED PACKING
TRADE/COMMON NAME: MOBILE BED CONTACTOR
SUPPLIER: AMERICAN AIR FILTER
DIMENSIONS - FT: 20 X 20 X 27.5
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: INORGANIC
LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED MORTAR
LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8
BOILER LOAD PER ABSORBER - %: 50
GAS/LIQUID CONTACT DEVICE TYPE: ORGANIC MOBILE BALLS
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 17,625
L/G RATIO - GAL/1000 ACF: 50-60
GAS-SIDE PRESSURE DROP - IN. H2O: 6.0
SUPERFICIAL GAS VELOCITY - FT/SEC: 10-14
ABSORBER TURNDOWN RATIO: 2:1

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

ABSORBER TURNDOWN METHOD: CONTINUOUSLY ALTERNATED CLOSING OF COMPARTMENTS
INLET GAS FLOW RATE - ACFM: 291,500
INLET GAS TEMPERATURE - F: 130-150
INLET SO2 LEVEL - PPM: 2200-3700
INLET SO2 LEVEL - LB/MM BTU: 6.5
INLET PARTICLE LEVEL - GR/SCF: 0.06-0.08
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 130
OUTLET SO2 LEVEL - PPM: 200-300
OUTLET SO2 LEVEL - LB/MM BTU: 0.08
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: _____
SO2 REMOVAL EFFICIENCY - %: 86-88
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 2
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1

F GENERIC TYPE: IMPINGEMENT

SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CHEVRON VANE
MANUFACTURER: _____

CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): A-FRAME

NUMBER OF STAGES: 2

NUMBER OF PASSES/STAGE: 3

FREEBOARD DISTANCE - FT: 6.0

DISTANCE BETWEEN STAGES - IN.: _____

DISTANCE BETWEEN VANES - IN.: 1-1.5

VANE ANGLES - DEGREES: _____

PRESSURE DROP - IN. H2O: 1.0-1.5

SUPERFICIAL GAS VELOCITY - FT/SEC: 10-15

CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: FRP

CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): FRESH

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY,

FRONTSpray/BACKSPRAY): FIRST STAGE OVER AND UNDER, SECOND STAGE UNDER

WASH FREQUENCY: EVERY 16 MIN.

WASH DURATION: _____

WASH RATE - GAL/MIN: 20-100

WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: 2

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR,
IN-LINE BURNER, ETC.): DIRECT COMBUSTION
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): EXTERNAL COMBUSTION CHAMBER
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): NO. 2 FUEL OIL
COMBUSTION FUEL SULFUR CONTENT - %: _____
LOCATION: DISCHARGE DUCT
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: N/A
TEMPERATURE INCREASE - F: 25-30 (SUPPOSED TO BE 50)
INLET FLUE GAS FLOW RATE - ACFM: 291,500
INLET FLUE GAS TEMPERATURE - F: 130
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 155-160
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: _____
MATERIAL GENERIC TYPE: REFRACTORY LINING WITH CAST IRON BURNERS
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: 4
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: BUFFALO FORGE/AMERICAN STANDARD FLUID
FUNCTION (UNIT/BOOSTER): 2 BOOSTER AND 2 ID
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND QUENCHERS
FLUE GAS FLOW RATE - ACFM: 367,000
FLUE GAS TEMPERATURE - F: 325
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) UNDER MOBILE BEDS
(B) 2 OUTLET FROM ABSORBERS, 2 INLET TO ABSORBER MODULES,
2 BYPASS
NUMBER OF DAMPERS: (A) 20 (10 PER MODULE) (B) 6
FUNCTION (CONTROL/SHUT-OFF): (A) CONTROL (B) SHUT-OFF
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) LOUVER (B) GUILLOTINE
SPECIFIC TYPE (OPPOSED BLADE,
PARALLEL BLADE, ETC.): (B) TOP ENTRY GUILLOTINE/SEAL AIR

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

TRADE/Common Design (SINGLE LOUVER/DOUBLE LOUVER): N/A
MANUFACTURER: (A) AMERICAN AIR FILTER (B) AMERICAN AIR FILTER
MODULATION (OPEN/CLOSED, ETC.): (B) OPEN/CLOSED
SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: (B) MILD STEEL SET IN STAINLESS STEEL RUNNERS
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/Common Name: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/Common Name: _____

DUCTWORK

LOCATION: (A) INLET (B) OUTLET TO REHEATER
(C) OUTLET FROM REHEATER TO STACK (D) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL (ALL)
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/Common Name: N/A
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) INORGANIC (D) NONE
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) VINYL ESTER
(C) HYDRAULICALLY BONDED MORTAR (D) N/A
G LINER MATERIAL TRADE/Common Name: (A) N/A (B) PLASITE 4005
(C) PRE-KRETE G-8 (D) N/A

EXPANSION JOINTS

LOCATION: _____
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS
PRESSURE (NEGATIVE/POSITIVE): POSITIVE
OPERATING TEMPERATURE - F: _____
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: _____
MATERIAL: RUBBER (REPLACED ONCE)

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): REAGENT DELIVERED AS A
SLURRY (BY BARGE)
H PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): TUBE MILL
MANUFACTURER: _____
MATERIALS: _____
NUMBER OF DEVICES: 1 (SHARED BETWEEN UNITS 4 & 5)
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: _____
PRODUCT QUALITY - % SOLIDS: 20-30
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
I PREPARED REAGENT POINT OF ADDITION: HOLD TANK
ON-SITE STORAGE CAPABILITY - DAYS: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): TO AND FROM SCRUBBER

DIMENSIONS - IN.: _____

MANUFACTURER: _____

J MATERIAL: FRP

MAJOR VALVES

LOCATION: _____

FUNCTION (ISOLATION, CONTROL, ETC.): (A) FLOW CONTROL (B) ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): (A) BUTTERFLY (B) KNIFEGATE

CONTROL MODE (AUTOMATIC/MANUAL): _____

DIMENSIONS - IN.: _____

MANUFACTURER: (A) _____ (B) DEZURIK

MATERIAL: (A) STAINLESS STEEL (B) STAINLESS STEEL

THICKENERS

NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 85 WIDE X 14 DEEP

CAPACITY - GAL: _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

RAKE MATERIAL: _____

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 10% SOLIDS

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE,

PERCENT SOLIDS): 245 GPM, 22-25% SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 185 GPM

OUTLET STREAM DISPOSITION: VACUUM FILTER

OVERFLOW STREAM DISPOSITION: LIME HOLD TANK AND REACTION TANKS

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): DRUM

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): ROTARY

NUMBER OF DEVICES: 2 (SHARED BETWEEN UNITS 4 & 5)

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

NUMBER OF SPARES: 1 (SHARED BETWEEN UNITS 4 & 5)

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: _____

CAPACITY: 500 GPM

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

BELT MATERIAL GENERIC TYPE: _____

BELT MATERIAL SPECIFIC TYPE: _____

BELT MATERIAL TRADE/COMMON NAME: _____

FEED STREAM SOURCE (ABSORBER BLEED,
THICKENER UNDERFLOW, ETC.): THICKENER UNDERFLOW

FEED STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 25% SOLIDS

OUTLET STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 60% SOLIDS

OVERFLOW STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: _____

OVERFLOW STREAM DISPOSITION: _____

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: 6.3

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAOH2 - DRY: _____

PERCENT CACO3 - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: FIXATION

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): FLY ASH/LIME

DEVICE (OXIDATION TANK, PUG MILL, ETC.): PUG MILL (1 - SHARED BETWEEN
UNITS 4 & 5)

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): IUCS

INLET FLOW RATE - GPM: _____

INLET QUALITY - % SOLIDS: 60

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL

GENERIC TYPE (LANDFILL, POND, ETC.): LANDFILL (SHARED BETWEEN UNITS 4 & 5)

SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): SIDE-HILL FILL

COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): N/A

LOCATION (ON-SITE/OFF-SITE): ON-SITE

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): TRUCK
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY LINED
SITE DIMENSIONS - AREA/DEPTH: _____
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 10

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: RECYCLE LIQUOR
CHEMICAL PARAMETERS (PH, ETC.): PH
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____
CONTROL LEVELS: PH 6.1-6.2 AT OUTLET AND 8.5 AT INLET TO ABSORBER
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: REACTION TANK
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): AUTOMATIC
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN
K TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: OHIO RIVER
MAKEUP WATER ADDITION - GPM: 100
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT,
SOLIDS SETTLING, ETC.): (A) ABSORBENT (B) SOLIDS SETTLING IN THICKENER
NAME (LIMESTONE, ADIPIC ACID, ETC.): (A) CARBIDE LIME (B) POLYFLOC 1100
PRINCIPAL CONSTITUENTS: (A) $\text{Ca}(\text{OH})_2$ (B) _____
SOURCE/SUPPLIER: (A) AIRCO (B) BETZ
SUPPLIER LOCATION: (A) LOUISVILLE (B) _____
CONSUMPTION (SPECIFY UNITS): (A) 15,000 LB/HR DRY $\text{Ca}(\text{OH})_2$ AT FULL LOAD
(B) _____
UTILIZATION - %: (A) 100 (B) N/A
POINT OF ADDITION: (A) RECYCLE TANK (B) THICKENER

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 20,100,000
CAPITAL COST - \$/KW: 106
OPERATING COST - MILLS/KWH: 2.43
MAINTENANCE COST: \$429,000/YR
LABOR COST: \$182,000/YR
UTILITIES COST: \$765,000/YR

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

CHEMICALS COST: \$791,000/YR
WASTE DISPOSAL COST: \$8,700/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: N/A
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 0
THICKENER - %: 0
VACUUM FILTER - %: 0
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: 0
SLAKER: N/A
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 0
THICKENER: 0
VACUUM FILTER: 0
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/7/81

LOUISVILLE GAS & ELECTRIC
CANE RUN 4

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): REACTION/RECIRCULATION/BLEED

NUMBER OF TANKS: 2

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): OPEN

LOCATION: _____

CONFIGURATION: RECTANGULAR

DIMENSIONS - FT: _____

CAPACITY - GAL: 225,000

RETENTION TIME - MIN: 12

NUMBER OF AGITATORS: 6

AGITATOR CONFIGURATION: _____

L AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL

SHELL MATERIAL GENERIC TYPE: INORGANIC

SHELL MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED CONCRETE

SHELL MATERIAL TRADE/COMMON NAME: PORTLAND CEMENT

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLURRY HOLD
TANK

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): COVERED

LOCATION: _____

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: _____

CAPACITY - GAL: _____

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECYCLE

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): _____

LOCATION: ASIDE THICKENER

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LOUISVILLE GAS & ELECTRIC
CANE RUN 4

CONFIGURATION: CIRCULAR
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 4

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 6

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: GARDNER-DENVER

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 5875

MOTOR BRAKE HP: 300

SPEED - RPM: 1000

HEAD - FT: 120

SERVICE (PH, SOLIDS): 10% SOLIDS, PH 8.5

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: ROBBINS & MYERS

PUMP MODEL NUMBER: 2XNG 12H-CDR

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 200

MOTOR BRAKE HP: 20

SPEED - RPM: 1800

HEAD - FT: 115

SERVICE (PH, SOLIDS): 25% SOLIDS

CASING MATERIAL GENERIC TYPE: STAINLESS STEEL

CASING MATERIAL SPECIFIC TYPE: TYPE 316

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER OVERFLOW

NUMBER OF PUMPS: 2

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LOUISVILLE GAS & ELECTRIC
CANE RUN 4

NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: GOULDS
PUMP MODEL NUMBER: 3196
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 600
MOTOR BRAKE HP: 25
SPEED - RPM: 1800
HEAD - FT: 100
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): BLEED
NUMBER OF PUMPS: 4
NUMBER OF SPARES: 2
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): PH 8.5, 10% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY FEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____

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LOUISVILLE GAS & ELECTRIC
CANE RUN 4

PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 4

COMMENTS/FOOTNOTES

- A STACK WAS LINED WITH ACID RESISTANT BRICK, BUT THE MORTAR WASHED OUT AFTER 9 MONTHS OF SCRUBBER OPERATION WITHOUT REHEAT. THE BRICKS WERE REMOVED AND A PRE-KRETE LINING WAS INSTALLED.
- B BOTH TRAINS ARE ALWAYS ON LINE WHEN THE FGD SYSTEM IS IN OPERATION.
- C 3 OPERATORS PER UNIT FOR UNITS 4 & 5, TWO PERSONS OPERATING THE CONTROL PANEL AND ONE PERSON AT THE BARGE FACILITY. 20 PEOPLE ON DAY SHIFT (ELECTRICIANS, INSTRUMENTATION ENGINEERS) THAT ARE AVAILABLE TO PERFORM MAINTENANCE ON UNITS 4 & 5. FOR MAJOR MAINTENANCE PROJECTS PERSONNEL ARE BROUGHT IN AS NEEDED FROM THE CONSTRUCTION STAFF OF 1100. THERE IS ONE SALARIED SUPERVISOR ON EACH SHIFT THAT OVERSEES OPERATION OF UNITS 4 & 5.
- D ORIGINALLY THE QUENCHER WAS LINED WITH PRE-KRETE G-8; HOWEVER, DUE TO CORROSION THE LINER WAS REPLACED WITH TYPE 316L STAINLESS STEEL.
- E AMERICAN AIR FILTER MOBILE BED DESIGN. SLURRY ALSO CIRCULATES IN QUENCHER SECTION AND FLOODED ELBOW, WHICH SUPPLY SECONDARY SO₂ AND PARTICULATE REMOVAL.
- F REPLACED CENTRIFUGAL DESIGN BECAUSE OF HIGH PRESSURE DROP. THE ORIGINAL MIST ELIMINATOR WAS CONSTRUCTED OF TYPE 316 STAINLESS STEEL.
- G PLASITE 4005 REPLACED CARBOLINE LINING IN OUTLET DUCT TO REHEATER.
- H BALL MILL IS USED TO REDUCE MESH SIZE OF CARBIDE LIME WHEN NECESSARY.
- I PRIOR TO HOLD TANK, CARBIDE LIME FIRST PASSES THROUGH A "DIRTY" HOLD TANK (RECEIVES CARBIDE LIME FROM BARGES), A "CLEAN" HOLD TANK, AND ANY SOLID MATERIAL IS DISINTEGRATED VIA HYDROCLONES AND BALL MILL.
- J PIPES HAVE RUBBER-LINED SPOOL PIECES NEAR VALVES.
- K WATER LOOP WAS CLOSED WHEN IUCS SYSTEM BECAME OPERATIONAL.
- L REPLACED RUBBER CLAD CAST STAINLESS STEEL.

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

GENERAL PLANT INFORMATION

COMPANY NAME: LOUISVILLE GAS & ELECTRIC COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: CANE RUN
UNIT NUMBER: 5
PLANT ADDRESS: CANE RUN ROAD, P.O. BOX 32010
CITY: LOUISVILLE
COUNTY: JEFFERSON
STATE: KENTUCKY
ZIP CODE: 40232
EPA REGION: 4
RIVER BASIN/LAKE REGION: OHIO
REGULATORY CLASSIFICATION: STANDARD EQUAL TO OR LESS STRINGENT THAN NSPS
(12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.116
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 992
GROSS UNIT GENERATING CAPACITY - MW: 200
NET UNIT GENERATING CAPACITY WITH FGD - MW: 192
NET UNIT GENERATING CAPACITY W/O FGD - MW: 195
EQUIVALENT SCRUBBED CAPACITY - MW: 200

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: RILEY STOKER
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: FRONT
WET BOTTOM/DRY BOTTOM: DRY
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED DRAFT
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): CYCLIC
COMMERCIAL SERVICE DATE: 1966
DESIGN BOILER FLUE GAS FLOW - ACFM: 740,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: 6
HEAT RATE - BTU/KWH: 10,600
DESIGN FIRING RATE - TPH: 87
EXCESS AIR - %: 30
CAPACITY FACTOR - %: 62.7
STACK HEIGHT - FT: 250
SHELL MATERIAL: CONCRETE

A FLUE MATERIAL GENERIC TYPE: INORGANIC
FLUE MATERIAL SPECIFIC TYPE: PREFIRED BRICK/SHAPES
FLUE MATERIAL TRADE/COMMON NAME: ACID-RESISTANT BRICK
FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 19.0
STACK GAS INLET TEMPERATURE - F: 155
STACK GAS OUTLET VELOCITY - FT/SEC: _____

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: PEABODY COAL CO.
MINE NAME/AREA: STAR MINE
MINE LOCATION - COUNTY: MUHLENBURG
MINE LOCATION - STATE: KENTUCKY
AVERAGE HEAT CONTENT - BTU/LB: 11,000
RANGE HEAT CONTENT - BTU/LB: 10,400-11,900
AVERAGE ASH CONTENT - %: 13.9
RANGE ASH CONTENT - %: 10.0-20.0
AVERAGE MOISTURE CONTENT - %: 9.0
RANGE MOISTURE CONTENT - %: 8.0-10.8
AVERAGE SULFUR CONTENT - %: 3.8
RANGE SULFUR CONTENT - %: 3.5-4.0
AVERAGE CHLORIDE CONTENT - %: 0.04
RANGE CHLORIDE CONTENT - %: 0.03-0.06
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: RESEARCH-COTTRELL
INLET FLUE GAS CAPACITY - ACFM: 370,000
INLET FLUE GAS TEMPERATURE - F: 300
PRESSURE DROP - IN. H2O: 0.10-0.20 (DESIGN >0.10)
PARTICLE OUTLET LOAD - GR/SCF: 0.05-0.10
PARTICLE REMOVAL EFFICIENCY - %: 98.0-99.5
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H2O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO2 LEVEL - PPM:
INLET SO2 LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO2 LEVEL - PPM:
OUTLET SO2 LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO2 REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): CARBIDE LIME
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: FLUOR-PIONEER
CONSTRUCTION FIRM: IN-HOUSE
APPLICATION (NEW/RETROFIT): RETROFIT
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99
SO2 DESIGN REMOVAL EFFICIENCY - %: 85
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

COMMERCIAL START-UP: 7/78
INITIAL START-UP: 12/77
CONSTRUCTION COMPLETION: 12/77
CONSTRUCTION INITIATION: 10/75
CONTRACT AWARDED: 4/75
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST: _____
INITIATED PRELIMINARY DESIGN: _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.0
DESIGN COAL HEAT CONTENT - BTU/LB: 11,000
DESIGN COAL ASH CONTENT - %: 15.0
DESIGN COAL MOISTURE CONTENT - %: 12.0
DESIGN COAL CHLORIDE CONTENT - %: 0.075

FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____

FGD SYSTEM TURNDOWN RATIO: 6:1

B FGD SYSTEM TURNDOWN METHOD: REDUCE GAS FLOW

FGD SYSTEM PRESSURE DROP - IN. H₂O: 6-7

FGD SYSTEM OXIDATION - %: 10

FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A

FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 10

FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER

C FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MANHOURS/DAY): 304 (UNITS 4 & 5)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(OPERATORS/SHIFT): 3 (DEDICATED)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): 20 (ADDITIONAL PERSONNEL BROUGHT IN AS NEEDED FROM
IN-HOUSE CONSTRUCTION CREW)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1

FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE

TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): SHARE WITH BOILER

SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

ROTATION TO FGD SYSTEM: AS NEEDED

TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): FGD SUPERVISOR
OVERSEES MAINTENANCE

FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES

RESTRICTIONS TO USING BYPASS: 10 DAY LIMIT

TIME SCHEDULE FOR REDUCED BOILER LOAD: HALF LOAD AT NIGHT TO DESLAG

TIME SCHEDULE FOR BOILER SHUTDOWNS: ANNUAL UNIT OUTAGE (2-4 WEEKS)
TURBINE OVERHAUL EVERY 4 YEARS
(8 WEEKS)

PLANNED MAINTENANCE DURING REDUCED

BOILER LOAD (TYPE AND FREQUENCY): OCCASIONAL PUMP MAINTENANCE

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY): ROUTINE MAINTENANCE AS REQUIRED

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): ROUTINE MAINTENANCE AND GENERAL INSPECTION

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 0
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME: N/A
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: 32 X 22.5
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE: STAINLESS STEEL
LINER MATERIAL SPECIFIC TYPE: AUSTENITIC
D LINER MATERIAL TRADE/COMMON NAME: TYPE 316L
BOILER LOAD PER ABSORBER - %: 50
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 3
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: 3
NOZZLE MATERIAL: SILICON CARBIDE
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 17,500
L/G RATIO - GAL/1000 ACF: 65-70
GAS-SIDE PRESSURE DROP - IN. H2O: 2.0
SUPERFICIAL GAS VELOCITY - FT/SEC: 12
ABSORBER TURNDOWN RATIO: 6:1
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

INLET GAS FLOW RATE - ACFM: 261,000
INLET GAS TEMPERATURE - F: 126
INLET SO2 LEVEL - PPM: 2700-2900
INLET SO2 LEVEL - LB/MM BTU: 5.77-6.46 (RESULTS OF ACCEPTANCE TEST)
INLET PARTICLE LEVEL - GR/SCF: 0.05-0.10
INLET PARTICLE LEVEL - LB/MM BTU: 0.089-0.333 (RESULTS OF ACCEPTANCE TEST)
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 130
OUTLET SO2 LEVEL - PPM: 200
OUTLET SO2 LEVEL - LB/MM BTU: 0.49-0.58 (RESULTS OF ACCEPTANCE TEST)
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.035-0.061 (RESULTS OF ACCEPTANCE TEST)
SO2 REMOVAL EFFICIENCY - %: >85
PARTICLE REMOVAL EFFICIENCY - %: 50-88 (RESULTS OF ACCEPTANCE TEST)

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 2 (B) 2

NUMBER OF SPARES: (A) 0 (B) 0

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) BAFFLE SLATS (B) BAFFLE

COMMON DESIGN: (A) BULK ENTRAINMENT SEPARATOR (B) CHEVRON VANE

MANUFACTURER: _____

CONFIGURATION (HORIZONTAL/VERTICAL): (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (B) A-FRAME

NUMBER OF STAGES: (A) 1 (B) 2

NUMBER OF PASSES/STAGE: (A) 1 (B) 3

FREEBOARD DISTANCE - FT: _____

DISTANCE BETWEEN STAGES - IN.: _____

DISTANCE BETWEEN VANES - IN.: _____

VANE ANGLES - DEGREES: _____

PRESSURE DROP - IN. H2O: (B) 0.5

SUPERFICIAL GAS VELOCITY - FT/SEC: (B) 7.0

CONSTRUCTION MATERIAL GENERIC TYPE: (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (B) FIBERGLASS REINFORCED PLASTIC

CONSTRUCTION MATERIAL TRADE/COMMON NAME: N/A

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (B) RIVER

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY, _____

FRONTSpray/BACKSPRAY): (B) BELOW FIRST STAGE AND BETWEEN FIRST AND SECOND STAGES

WASH FREQUENCY: (B) ONCE PER SHIFT

WASH DURATION: _____

WASH RATE - GAL/MIN: (B) 80 (200 PSI)

WASH COVERAGE - GAL/MIN/SQ FT: _____

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

REHEATER

NUMBER OF REHEATERS: 2
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
E SPECIFIC TYPE (STEAM, HOT WATER, ETC.): STEAM/GLYCOL
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): FINNED TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: 10 FT BEYOND THE ABSORBER OUTLET
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 25
INLET FLUE GAS FLOW RATE - ACFM: 562,000
INLET FLUE GAS TEMPERATURE - F: 130
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 155
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: _____
NUMBER OF BUNDLES PER BANK: _____
NUMBER OF TUBES PER BUNDLE: 34
STEAM OR WATER PRESSURE - PSIG: 200
STEAM OR WATER TEMPERATURE - F: 450
SELF CLEANING DEVICE TYPE: SOOT BLOWERS
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: N/A

FANS

NUMBER OF FANS: (A) 2 (B) 2
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL (ALL)
SUPPLIER: _____
FUNCTION (UNIT/BOOSTER): (A) UNIT (B) BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: (A) FORCED DRAFT
(B) INDUCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: (A) BETWEEN ESP AND ABSORBER
(B) ABSORBER OUTLET
FLUE GAS FLOW RATE - ACFM: (A) 350,000 (B) _____
FLUE GAS TEMPERATURE - F: (A) 300 (B) 155
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET TO ABSORBERS (B) OUTLET FROM ABSORBERS (C) BYPASS
NUMBER OF DAMPERS: (A) 2 (B) 2 (C) 2
FUNCTION (CONTROL/SHUT-OFF): SHUT-OFF (ALL)

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER (ALL)
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____
TRADE/Common DESIGN (SINGLE LOUVER/DOUBLE LOUVER): _____
MANUFACTURER: COMBUSTION ENGINEERING (ALL)
MODULATION (OPEN/CLOSED, ETC.): _____
SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: MILD STEEL WITH TYPE 316 STAINLESS STEEL BLADES
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/Common NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/Common NAME: _____

DUCTWORK

LOCATION: (A) INLET TO ABSORBER AND OUTLET FROM REHEATER
(B) OUTLET FROM ABSORBER TO REHEATER
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/Common NAME: N/A
F LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) MICA FLAKE/POLYESTER
LINER MATERIAL TRADE/Common NAME: (A) N/A (B) FLAKELINE 252

EXPANSION JOINTS

LOCATION: _____
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: _____
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: _____
MATERIAL: RUBBER TYPE

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME IS DELIVERED AS A SLURRY
G PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): TUBE MILL
MANUFACTURER: _____
MATERIALS: _____
NUMBER OF DEVICES: 1 (SHARED BETWEEN UNITS 4 & 5)
NUMBER OF SPARES: 0
FULL LOAD DRY FEED CAPACITY - TPH: _____
PRODUCT QUALITY - % SOLIDS: 25
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
H PREPARED REAGENT POINT OF ADDITION: LIME FEED TANK
ON-SITE STORAGE CAPABILITY - DAYS: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): GENERAL

DIMENSIONS - IN.: _____

MANUFACTURER: _____

MATERIAL: FRP

MAJOR VALVES

LOCATION: SUCTION SIDE OF RECYCLE PUMPS

FUNCTION (ISOLATION, CONTROL, ETC.): _____

TYPE (BALL, GLOBE, PLUG, ETC.): KNIFEGATE

CONTROL MODE (AUTOMATIC/MANUAL): _____

DIMENSIONS - IN.: _____

MANUFACTURER: DEZURIK

MATERIAL: TYPE 316 STAINLESS STEEL

THICKENERS

NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 110 DIA

CAPACITY - GAL: _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL WALLS AND CONCRETE BOTTOM

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

RAKE MATERIAL: _____

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 7% SOLIDS

OUTLET STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 25% SOLIDS (250 GPM)

OVERFLOW STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 250 GPM

OUTLET STREAM DISPOSITION: VACUUM FILTER

OVERFLOW STREAM DISPOSITION: RECYCLE TANK AND THEN REACTION TANK

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): DRUM

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): ROTARY

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

NUMBER OF DEVICES: 2 (SHARED BETWEEN UNITS 4 & 5)
NUMBER OF SPARES: 1 (SHARED BETWEEN UNITS 4 & 5)
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: _____
CAPACITY: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____
BELT MATERIAL GENERIC TYPE: _____
BELT MATERIAL SPECIFIC TYPE: _____
BELT MATERIAL TRADE/COMMON NAME: _____
FEED STREAM SOURCE (ABSORBER BLEED,
THICKENER UNDERFLOW, ETC.): THICKENER UNDERFLOW
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 25% SOLIDS
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OUTLET STREAM DISPOSITION: _____
OVERFLOW STREAM DISPOSITION: _____

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: 15.7
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAO₂ - DRY: _____
PERCENT CACO₃ - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: FIXATION
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): FLY ASH/LIME
DEVICE (OXIDATION TANK, PUG MILL, ETC.): PUG MILL (1 - SHARED BETWEEN
UNITS 4 & 5)
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): IUCS
INLET FLOW RATE - GPM: _____
INLET QUALITY - % SOLIDS: _____

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): LANDFILL (SHARED BETWEEN UNITS 4 & 5)
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): SIDE-HILL FILL
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): N/A
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): TRUCK
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY LINING

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

SITE DIMENSIONS - AREA/DEPTH: _____
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 10

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: ABSORBER RECYCLE LINE
CHEMICAL PARAMETERS (PH, ETC.): PH
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____
CONTROL LEVELS: PH 9 AT OUTLET AND PH 5.4-5.6 AT INLET TO RECYCLE TANK
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: REACTION TANK
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): AUTOMATIC
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN
I TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: OHIO RIVER
MAKEUP WATER ADDITION - GPM: _____
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): (A) ABSORBENT
/ (B) SOLIDS SETTLING
NAME (LIMESTONE, ADIPIC ACID, ETC.): (A) CARBIDE LIME (B) POLYFLOC 1100
PRINCIPAL CONSTITUENTS: (A) $\text{Ca}(\text{OH})_2$ (B) _____
SOURCE/SUPPLIER: (A) AIRCO (B) BETZ
SUPPLIER LOCATION: (A) LOUISVILLE (B) _____
CONSUMPTION (SPECIFY UNITS): (A) 137,000 TPY (B) _____
UTILIZATION - %: (A) 95
POINT OF ADDITION: (A) SLURRY FEED TANK (B) THICKENER

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 18,800,000
CAPITAL COST - \$/KW: 93.9
OPERATING COST - MILLS/KWH: 1.97
MAINTENANCE COST: \$312,000/YR
LABOR COST: \$145,000/YR
UTILITIES COST: \$816,000/YR
CHEMICALS COST: \$605,000/YR
WASTE DISPOSAL COST: \$9,700/YR

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: 0
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 0
THICKENER - %: 0
VACUUM FILTER - %: 0
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: 0
SLAKER: N/A
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 0
THICKENER: 0
VACUUM FILTER: 0
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECYCLE
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: _____
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: _____
CAPACITY - GAL: 470,000
RETENTION TIME - MIN: 7-8
NUMBER OF AGITATORS: 2
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: MILD STEEL SHAFTS AND RUBBER-CLAD MILD STEEL BLADES
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: UNDERNEATH MODULES
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 59 DIA X 25 HIGH
CAPACITY - GAL: 475,000
RETENTION TIME - MIN: 10
NUMBER OF AGITATORS: 2
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: MILD STEEL SHAFTS AND RUBBER-CLAD MILD STEEL BLADES
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME FEED
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: 20 DIA X 23 HIGH

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1 _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: MILD STEEL WITH RUBBER-CLAD MILD STEEL BLADES
SHELL MATERIAL GENERIC TYPE: MILD STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED,
ABSORBER RECIRCULATION, ETC.): ABSORBER RECIRCULATION
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT DRIVE
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: DENVER
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): DIRECT
CAPACITY - GPM: 18,000
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): PH 9, 7% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME FEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 0
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 124
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 25
SERVICE (PH, SOLIDS): PH 11-12, 25% SOLIDS
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS: 2

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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): POSITIVE DISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ROBBINS & MYERS _____
PUMP MODEL NUMBER: MOYNO
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): VARIABLE
CAPACITY - GPM: 25-250
MOTOR BRAKE HP: 20
SPEED - RPM: _____
HEAD - FT: 115 @ 200 GPM
SERVICE (PH, SOLIDS): PH 9-10, 25% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: STAINLESS STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): WATER RECYCLE
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 616
MOTOR BRAKE HP: 25
SPEED - RPM: _____
HEAD - FT: 100
SERVICE (PH, SOLIDS): PH 8-10, 0% SOLIDS
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
CANE RUN 5

COMMENTS/FOOTNOTES

- A ACID-RESISTANT BRICK LINING REMOVED FROM TOP 50 FT. OF STACK BEFORE SCRUBBER STARTUP.
- B BOTH TRAINS ARE USUALLY OPERATED, BUT A TRAIN HAS TO BE TAKEN OFF LINE TO WASH THE REHEATER.
- C 3 OPERATORS PER UNIT FOR UNITS 4 & 5, TWO PERSONS OPERATING THE CONTROL PANEL AND ONE PERSON AT THE BARGE FACILITY. 20 PEOPLE ON DAY SHIFT (ELECTRICIANS, INSTRUMENTATION ENGINEERS) THAT ARE AVAILABLE TO PERFORM MAINTENANCE ON UNITS 4 & 5. FOR MAJOR MAINTENANCE PROJECTS PERSONNEL ARE BROUGHT IN AS NEEDED FROM THE CONSTRUCTION STAFF OF 1100. THERE IS ONE SALARIED SUPERVISOR ON EACH SHIFT THAT OVERSEES OPERATIONS OF UNITS 4 & 5.
- D THE ORIGINAL FLAKELINE 252 LINER WAS REPLACED WITH TYPE 316L STAINLESS STEEL.
- E BOILER SUPERHEATED STEAM IS USED TO HEAT GLYCOL WHICH IS THE ACTUAL HEAT TRANSFER FLUID USED IN THE IN-LINE REHEATER.
- F TYPE 316L STAINLESS STEEL WEAR PLATES HAVE BEEN INSTALLED IN THE OUTLET DUCT FOR 3 FEET AHEAD OF THE REHEATER.
- G BALL MILL IS USED TO REDUCE MESH SIZE OF CARBIDE LIME WHEN NECESSARY.
- H PRIOR TO LIME FEED TANK, CARBIDE LIME FIRST PASSES THROUGH A "DIRTY" HOLD TANK (RECEIVES CARBIDE LIME FROM BARGES), A "CLEAN" HOLD TANK, AND ANY SOLID MATERIAL IS DISINTEGRATED VIA HYDROCLONES AND BALL MILL.
- I WATER LOOP WAS CLOSED WHEN IUCS SYSTEM BECAME OPERATIONAL.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Louisville Gas & Electric Cane Run 4	8/76	744	740	System	666			Initial shakedown/startup operations commenced
							Spray nozzles	Operating temperatures caused plastic housings to expand resulting in the vanes extruding out of front end, subsequently causing a blockage of the slurry feed (nozzles were replaced with ceramic components)
							Auxiliary equipment motors	Minor mechanical problems encountered
	9/76	720	720	System	648			
	10/76	744	600	System	540		Pumps	Pump capacity was increased
							Absorbers	Modifications to decrease pressure drop
	11/76	720	600	System	570			
	12/76	744	598	System	538			
	1/77	744	666	System	251			Due to Ohio River freeze up barge deliveries of lime ceased causing the FGD system to be taken off line
	2/77	672	0	System	8			Scrubber operated for two 4-hour periods to prevent freezing
	3/77	744	432	System	358		Bypass damper	DC power supply failed (scrubber system was bypassed while repairs were made)
	4/77	720	406	System	432			
	5/77	744		System	0			
	6/77	720		System	0			Scrubber system was down for modifications from April 19 to July 17

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Cane Run 4 (continued) Commercial start-up							Mist eliminator	Chevron mist eliminator installed
							Absorber	Spray header added to increase the L/G ratio
							Reheater	Direct oil-fired reheat added
							Lining	Lining from mist eliminator to stack relined with plasite 4005 (original lining had bubbled and was near failure)
	7/77	744	360	System	324			System back on line July 17
	8/77	744	657	System	588	79		
	9/77	720	529	System	524	99		Unit was approved by EPA to be meeting compliance
	10/77	744	677	System	662	98		
	11/77	720	483	System	453	70		
	12/77	744	715	System	608	85	Lime feed line	Lime supplier feed line froze subsequently lime was unavailable for a short time
	1/78	744	742	System	494	66		
	2/78	672	0	System	0	100	Lime/coal supply	Unit down entire month due to lime and coal shortage due to severe winter weather
	3/78	744	744	System	249	100		Unit back on line March 21
	4/78	720	303	System	303	100		Boiler was down for repairs

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Cane Run 4 (continued)	5/78	744	352	System	115	31	Dampers	During boiler outage a number of modifications were made to the FGD system dampers
	6/78	720	720	System	715	99		
	7/78	744	687	System	678	99		
	8/78	744	744	System	701			
	9/78	720	138	System	138			Boiler was down for repairs
	10/78	744	0	System	0	100		Boiler repairs continued
	11/78	720	432	System	420			Boiler came back on line
	12/78	744	0	System	0	100		System down for turbine repairs from 1/79 to 5/79
	1/79	744	0	System	0	100		
	2/79	672	0	System	0	100		
	3/79	744	0	System	0	100		
	4/79	720	0	System	0	100		
	5/79	744	0	System	0	100		
	6/79	720	266	System	123			Boiler back on line
	7/79	744	701	System	692			
	8/79	744	744	System	664			
	9/79	720	168	System	0		Dampers	Lower boiler hours due to tube failure with FGD being down because of mechanical failure with damper gates

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Cane Run 4 (continued)	10/79	744	296	System	89			
	11/79	720	445	System	418			
	12/79	744	390	System	150			No major problems excepted for general maintenance repairs
	1/80	744	711	System	711			
	2/80	696	465	System	464			
	3/80	744	687	System	553			
	4/80	720	582	System	575	99	Spray pump	7 hours outage due to spray pump problems
	5/80	744	52	System	52	97	Spray pump	24 hour outage to repair seal (low FGD hours due to low utilization of boiler during May)
	6/80	720	350	System	0	0		Boiler was mostly on reserve during June, in which time was used to make various repairs/maintenance
							Expansion joint	Expansion joint located at the discharge of the booster pump was replaced
							Ductwork	Repaired/replaced with 316L stainless steel
							Absorber	Relined
	7/80	744	687	System	638	86	Reheater	Problems encountered with oil reheat system
							Spray pump and valves	Failures encountered
	8/80	744	576	System	572	100		
	9/80	720	257	System	257	100		

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Cane Run 4 (continued)	10/80	744	611	System	611	100		
	11/80	720	572	System	254	72	Ductwork	Failed
	12/80	744	572	System	572	100	Mist eliminator	Failed

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Louisville Gas & Electric Cane Run 5	12/77	744		System				Operation of the FGD system, on a trial basis, began on December 29. However, system was forced down for necessary modifications
	1/78	744		System			System controls	System remained off line due to modifications to the FGD system controls
	2/78	672		System				
	3/78	744	182	System	91			Initial startup/shakedown problems continue
	4/78	720	669	System	648			
	5/78	744	432	System	364			Inconclusive performance tests were conducted
	6/78	720	685	System	590	87		
	7/78	744	632	System	506	83	Steam reheat coils	Weld failures
	8/78	744	540	System	464			
	9/78	720	609	System	485			
	10/78	744	530	System	510			
	11/78	720	253	System	237			336 hour outage to repair reheat coils
	12/78	744	654	System	302	53		
	1/79	744	693	System	467	70		
	2/79	672	477	System	337		Lime supply	Cold weather related problems (freezing caused problems with lime delivery)
	3/79	744	596	System	428			
	4/79	720	360	System	357		Dampers and pumps	Failures

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Cane Run 5 (continued)	5/79	744	433	System	365			Compliance testing conducted and unit declared commercial
	6/79	720	544	System	419		Reheat coils Spray pumps	Weld failures Packing failures
	7/79	744	583	System	420			
	8/79	744	613	System	540			
	9/79	720	469	System	392		Reheat coils	Weld problems continued
	10/79	744	583	System	488			
	11/79	720	351	System	334			
	12/79	744	574	System	472			
	1/80	744	583	System	537			
	2/80	696	481	System	346		Lime supply	Utility ran out of lime due to freezeup problems encountered by their lime supplier company
	3/80	744	454	System	202		Reheat coils	Reheater tube problems continued (utility to replace tube bundles)
	4/80	720	0	System	0	0	System	FGD system was off line entire month to install 316L stainless steel in ductwork and in the modules
	5/80	744	632	System	597	95	System	24 hour outage to complete 316L stainless steel work
							Recirculation pump	10 hour outage due to failed pump seal
	6/80	720	598	System	445	79	Reheat coils	153 hour outage due to poor welds on tube bundles continued

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Cane Run 5 (continued)	7/80	744	669	System	585	79	Thickener	72 hour outage occurred because a limestone rock disabled thickener
			95				Reheat coils	Reheat tube bundles failed (new exchangers on site and to be installed at end of year)
	8/80	744	632	System	363	50		
	9/80	720	644	System	623	87	Reheater coils	Down time in August and September caused by reheater repairs
	10/80	744	72	System	72	100		
	11/80	720	177	System	177	100		
	12/80	744	743	System	742	100		

LOUISVILLE GAS & ELECTRIC

MILL CREEK 1, 3

SECTION 1

BACKGROUND

The Mill Creek Station, located in Louisville, Kentucky, is owned and operated by Louisville Gas & Electric (LG&E). The plant has three operational units which provide a total capacity of 1084 MW (net). A fourth unit, Mill Creek 4, is currently under construction and will bring the overall plant capacity to 1585 MW (net). Mill Creek units 1 and 3 fire coal with an average sulfur content of 3.75% and are rated at 358 MW (gross) and 427 MW (gross), respectively.

At the time of construction, Mill Creek 1 was not subject to regulations limiting emissions of SO₂ and particulate matter. However, in 1974 and 1975, LG&E had discussions with EPA and the Air Pollution Control District of Jefferson County in an attempt to establish a compliance plan for SO₂ control at their stations in Jefferson County. The discussions culminated in the signing of a consent decree on December 10, 1975, in which SO₂ control systems were mandated for various boilers at the Cane Run and Mill Creek generating stations. The enforcement order called for the installation of seven SO₂ removal systems, which included Cane Run 4, 5, and 6 and Mill Creek 1, 2, 3, and 4. This was revised somewhat in September 1977 when various construction delays and difficulties were recognized. The revision called

for the installation of five FGD systems (Cane Run 4, 5, and 6 and Mill Creek 1 and 3) by July 1, 1979.

In accordance with the consent decree, a contract was awarded by LG&E to Combustion Engineering to retrofit a carbide lime FGD system on Mill Creek 1. This system began initial operations in December 1980.

Mill Creek 3 is a new unit that was placed in service in August 1978. A contract was awarded to American Air Filter to supply a carbide lime FGD system to control SO₂ emissions from this unit. The boiler and FGD system began operating at the same time.

Combustion Engineering supplied the lime FGD system retrofitted on Mill Creek 2. The system commenced initial operations in December 1981.

Mill Creek 4 is a new unit scheduled for startup in June 1982. American Air Filter was contracted to supply a wet lime scrubbing system for SO₂ emission control.

SECTION 2

PROCESS DESCRIPTION

The Mill Creek 1 carbide lime FGD system is similar in design to the Cane Run 5 FGD system. Both systems were supplied by Combustion Engineering and use carbide lime as the scrubbing reagent. The FGD system consists of two 50% capacity absorber modules, each designed to treat 670,000 acfm of flue gas at 300°F. The ductwork and dampers provide partial or total bypass capacity.

Each absorber module contains a horizontal approach duct which enters the base of a vertical spray tower absorber. As the gas enters the base of the absorber, it is decelerated and turned 90 degrees with the aid of ladder-type turning vanes. In this zone of the tower, the gas is rapidly quenched. The gas then flows upward through the tower and the lime slurry is sprayed countercurrent to the flue gas flow. The saturated gas stream then passes through a mist eliminator section situated at the top of each absorber consisting of a bulk entrainment separator followed by a single stage, three pass chevron. Following passage through the mist eliminators, the cool, saturated gas stream exits the tower and is reheated via an in-line steam/glycol reheater that provides a temperature boost of 50°F before being discharged to the atmosphere through the stack.

The spent slurry from this closed water loop process is IUCS stabilized before being disposed of in an on-site landfill.

The Mill Creek 3 carbide lime FGD system is similar in design to the Cane Run 4 FGD system. Both systems were supplied by American Air Filter and use carbide lime as the scrubbing reagent. The FGD system consists of four parallel scrubber modules, each designed to handle a maximum flue gas flow of 408,000 acfm at 300°F. Cold-side ESP's provide primary particulate matter removal.

Following the ESP's, the gas passes through booster fans and enters the absorber modules. Each absorber module consists of a vertical absorber tower preceded by a quencher and flooded elbow. A series of nozzles in the quencher inject lime slurry into the gas stream to ensure thorough wetting of the gases prior to passage through the absorber. Immediately below each quencher is a flooded elbow. Some removal of SO₂ occurs in the quencher and the flooded elbow since part of the lime slurry stream is diverted to these sections for wetting and saturation.

The quenched flue gas enters the base of each absorber tower, which consists of a single stage mobile bed contactor. The mobile bed contactor contains a fluid bed packing of solid spheres which serve to break up the gas stream and provide pockets for intimate mixing of the flue gases and scrubbing slurry. The flue gas passes upward through the packing where it contacts the lime slurry sprayed into the gas stream counter-currently through large, low pressure, slurry sprays.

Entrained droplets of moisture and slurry picked up by the gas stream in the absorption zone are removed by mist eliminators. Each absorber is equipped with two sets of three-pass, chevron-type mist eliminators located in the top portion of each tower. Following passage through the mist eliminators, the cool saturated gas stream is reheated by an in-line, bare tube, steam reheater. The reheater boosts the gas temperature approximately 50°F prior to discharge to the 600-foot stack.

The spent slurry from this closed water loop system is discharged to a thickener. The thickener underflow is dewatered by a vacuum filter before being IUCS stabilized and disposed of in an on-site landfill.

Flow diagrams for the Mill Creek 1, 3 FGD systems are shown on the next two pages.

Flow Diagram: Mill Creek 1

Flow Diagram: Mill Creek 3

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Louisville Gas & Electric
Mill Creek 1, 3

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

GENERAL PLANT INFORMATION

COMPANY NAME: LOUISVILLE GAS & ELECTRIC COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: MILL CREEK
UNIT NUMBER: 1
PLANT ADDRESS: P.O. BOX 32010
CITY: LOUISVILLE
COUNTY: JEFFERSON
STATE: KENTUCKY
ZIP CODE: 40232
EPA REGION: 4
RIVER BASIN/LAKE REGION: OHIO
REGULATORY CLASSIFICATION: STATE STANDARD EQUAL TO OR LESS STRINGENT THAN
NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 1084
GROSS UNIT GENERATING CAPACITY - MW: 358
NET UNIT GENERATING CAPACITY WITH FGD - MW: 334
NET UNIT GENERATING CAPACITY W/O FGD - MW: 339
EQUIVALENT SCRUBBED CAPACITY - MW: 358

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: WET BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED DRAFT
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 4/72
DESIGN BOILER FLUE GAS FLOW - ACFM: 1,400,000
FLUE GAS TEMPERATURE - F: 305
FLUE GAS OXYGEN - %: _____
HEAT RATE - BTU/KWH: 9200
DESIGN FIRING RATE - TPH: 150
EXCESS AIR - %: 25
CAPACITY FACTOR - %: 55
A STACK HEIGHT - FT: 600
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: STAINLESS STEEL
FLUE MATERIAL SPECIFIC TYPE: AUSTENITIC
FLUE MATERIAL TRADE/COMMON NAME: TYPE 316
FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 19.0
STACK GAS INLET TEMPERATURE - F: _____
STACK GAS OUTLET VELOCITY - FT/SEC: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
B NAME OF SUPPLIER: PEABODY COAL COMPANY
MINE NAME/AREA: _____
MINE LOCATION - COUNTY: _____
MINE LOCATION - STATE: KENTUCKY
AVERAGE HEAT CONTENT - BTU/LB: 11,500
RANGE HEAT CONTENT - BTU/LB: 10,800-12,100
AVERAGE ASH CONTENT - %: 14.5
RANGE ASH CONTENT - %: 10.0-18.0
AVERAGE MOISTURE CONTENT - %: 9.0
RANGE MOISTURE CONTENT - %: 8.0-10.0
AVERAGE SULFUR CONTENT - %: 3.75
RANGE SULFUR CONTENT - %: 3.5-4.5
AVERAGE CHLORIDE CONTENT - %: 0.04
RANGE CHLORIDE CONTENT - %: 0.03-0.06
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): AVERAGE
FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): HOT SIDE
SUPPLIER: WESTERN PRECIPITATOR
INLET FLUE GAS CAPACITY - ACFM: 700,000
INLET FLUE GAS TEMPERATURE - F: 305
PRESSURE DROP - IN. H2O: 0.5
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: 99.4
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): CARBIDE LIME
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: FLUOR-PIONEER
CONSTRUCTION FIRM: IN-HOUSE
APPLICATION (NEW/RETROFIT): RETROFIT
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.5

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

SO2 DESIGN REMOVAL EFFICIENCY - %: 85

CURRENT STATUS: OPERATIONAL

TERMINATION DATE: N/A

COMMERCIAL START-UP: 4/81

INITIAL START-UP: 12/80

CONSTRUCTION COMPLETION: _____

CONSTRUCTION INITIATION: _____

CONTRACT AWARDED: 11/77

LETTER OF INTENT SIGNED: _____

INITIATED BID REQUEST: _____

INITIATED PRELIMINARY DESIGN: _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 3.7

DESIGN COAL HEAT CONTENT - BTU/LB: 12,100

DESIGN COAL ASH CONTENT - %: 18.0

DESIGN COAL MOISTURE CONTENT - %: 10.0

DESIGN COAL CHLORIDE CONTENT - %: 0.06

FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____

FGD SYSTEM TURNDOWN RATIO: _____

FGD SYSTEM TURNDOWN METHOD: _____

FGD SYSTEM PRESSURE DROP - IN. H2O: _____

FGD SYSTEM OXIDATION - %: _____

FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A

FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: _____

FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT

(MANHOURS/DAY): 120 (COMBINED)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 4

C FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE

PERSONNEL/SHIFT): AS NEEDED

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT

(MAINTENANCE SHIFTS/DAY): VARIES

FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE

TYPE OF FGD SYSTEM MAINTENANCE CREW

(DEDICATED, ETC.): PULLED FROM CONSTRUCTION CREW AS NEEDED

SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

ROTATION TO FGD SYSTEM: N/A

D TYPE OF MAINTENANCE SUPERVISORS

(DEDICATED, ETC.): FGD SUPERVISORS OVERSEE MAINTENANCE

FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES

RESTRICTIONS TO USING BYPASS: 10 DAY LIMIT

TIME SCHEDULE FOR REDUCED BOILER LOAD: _____

TIME SCHEDULE FOR BOILER SHUTDOWNS: _____

PLANNED MAINTENANCE DURING REDUCED

BOILER LOAD (TYPE AND FREQUENCY): _____

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY): _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): _____

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 0
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME: N/A
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: 26.0 X 31.0
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A
BOILER LOAD PER ABSORBER - %: 50
GAS/LIQUID CONTACT DEVICE TYPE: N/A
E NUMBER OF GAS CONTACTING ZONES: 4
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: _____
NUMBER OF SPRAY HEADERS: 4
NOZZLE MATERIAL: _____
NOZZLE PRESSURE DROP - PSI: _____
LIQUID RECIRCULATION RATE - GPM: 59,600
L/G RATIO - GAL/1000 ACF: 88.9
GAS-SIDE PRESSURE DROP - IN. H2O: _____
SUPERFICIAL GAS VELOCITY - FT/SEC: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

ABSORBER TURNDOWN RATIO: _____
ABSORBER TURNDOWN METHOD: _____
INLET GAS FLOW RATE - ACFM: 670,000
INLET GAS TEMPERATURE - F: 300
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 130
OUTLET SO2 LEVEL - PPM: _____
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: _____
SO2 REMOVAL EFFICIENCY - %: 86.6
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-COLLECTOR
(B) PRIMARY COLLECTOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 2 (B) 2
NUMBER OF SPARES: (A) 0 (B) 0
NUMBER PER MODULE: (A) 1 (B) 1
GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT
SPECIFIC TYPE: (A) BAFFLE SLATS (B) BAFFLE
COMMON DESIGN: (A) BULK ENTRAINMENT SEPARATOR (B) CLOSED VANE
MANUFACTURER: (B) ATLANTIC BRIDGE
CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): (B) Z-SHAPED
NUMBER OF STAGES: (A) 1 (B) 1
NUMBER OF PASSES/STAGE: (A) 1 (B) 3
FREEBOARD DISTANCE - FT: (A) 6 (B) _____
DISTANCE BETWEEN STAGES - IN.: N/A
DISTANCE BETWEEN VANES - IN.: _____
VANE ANGLES - DEGREES: _____
PRESSURE DROP - IN. H2O: (B) 0.5
SUPERFICIAL GAS VELOCITY - FT/SEC: _____
CONSTRUCTION MATERIAL GENERIC TYPE: _____
CONSTRUCTION MATERIAL SPECIFIC TYPE: _____
CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (B) FRESH
POINT OF WATER COLLECTION: _____

F WASH DIRECTION (OVERSPRAY/UNDERSPRAY,
FRONTSpray/BACKSPRAY): (B) OVERSPRAY/UNDERSPRAY
WASH FREQUENCY: (B) EACH HOUR
WASH DURATION: (B) 2 MINUTES
WASH RATE - GAL/MIN: (B) 300
WASH COVERAGE - GAL/MIN/SQ FT: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

REHEATER

NUMBER OF REHEATERS: 2
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): STEAM/GLYCOL
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): FIN TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: DOWNSTREAM OF ABSORBER
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: N/A
TEMPERATURE INCREASE - F: 50
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 130
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 180
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: 2
NUMBER OF BUNDLES PER BANK: _____
NUMBER OF TUBES PER BUNDLE: _____
STEAM OR WATER PRESSURE - PSIG: _____
STEAM OR WATER TEMPERATURE - F: _____
SELF CLEANING DEVICE TYPE: STEAM SOOT BLOWER
MATERIAL GENERIC TYPE: _____
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: 2
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: AMERICAN STANDARD
FUNCTION (UNIT/BOOSTER): BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: ABSORBER INLET
FLUE GAS FLOW RATE - ACFM: 670,000
FLUE GAS TEMPERATURE - F: 300
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: _____
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

DAMPERS

G LOCATION: (A) INLET TO ABSORBERS (B) OUTLET FROM ABSORBERS (C) BYPASS
NUMBER OF DAMPERS: (A) 2 (B) 2 (C) 2
FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF (C) SHUT-OFF
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) LOUVER (B) LOUVER (C) LOUVER

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

SPECIFIC TYPE (OPPOSED BLADE,
PARALLEL BLADE, ETC.): (A) PARALLEL BLADE (B) PARALLEL BLADE
(C) PARALLEL BLADE

TRADE/COMMON DESIGN

(SINGLE LOUVER/DOUBLE LOUVER): (A) DOUBLE LOUVER/SEAL AIR
(B) DOUBLE LOUVER/SEAL AIR
(C) DOUBLE LOUVER/SEAL AIR

MANUFACTURER: COMBUSTION ENGINEERING

MODULATION (OPEN/CLOSED, ETC.): OPEN/CLOSED

SEAL AIR - ACFM: 1400-1500

SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____

MATERIAL GENERIC TYPE: _____

MATERIAL SPECIFIC TYPE: _____

MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

DUCTWORK

LOCATION: (A) ABSORBER INLET (B) ABSORBER OUTLET

CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) RECTANGULAR
(B) RECTANGULAR

DIMENSIONS (DIAMETER, LENGTH, ETC.): _____

SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

EXPANSION JOINTS

LOCATION: (A) BOOSTER FAN DISCHARGE (B) DISCHARGE OF COMMON ABSORBER DUCT

TYPE (METALLIC/ELASTOMERIC): (A) ELASTOMERIC (B) ELASTOMERIC

FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): (A) GAS CIRCUIT (B) GAS CIRCUIT

PRESSURE (NEGATIVE/POSITIVE): (A) POSITIVE (B) POSITIVE

OPERATING TEMPERATURE - F: _____

DESIGN CONFIGURATION (V-SHAPED, ETC.): _____

MANUFACTURER: _____

MATERIAL: _____

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME IS DELIVERED AS A
SLURRY BY BARGE

H PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL

DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): TUBE MILL

MANUFACTURER: _____

MATERIALS: _____

NUMBER OF DEVICES: 1 (SHARED AMONG UNITS 1, 2, 3, & 4)

NUMBER OF SPARES: 0

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

FULL LOAD DRY FEED CAPACITY - TPH: N/A
PRODUCT QUALITY - % SOLIDS: 25
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: _____
ON-SITE STORAGE CAPABILITY - DAYS: _____

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): _____
DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: _____

MAJOR VALVES

LOCATION: _____
FUNCTION (ISOLATION, CONTROL, ETC.): _____
TYPE (BALL, GLOBE, PLUG, ETC.): _____
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: _____

THICKENERS

NUMBER OF THICKENERS: 1
NUMBER OF SPARES: 0
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 110 DIA
CAPACITY - GAL: 1,050,000
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____
RAKE MATERIAL: _____
FEED STREAM SOURCE: ABSORBER BLEED
FEED STREAM CHARACTERISTICS
(VOLUME FLOW RATE, PERCENT SOLIDS): 10% SOLIDS
OUTLET STREAM CHARACTERISTICS
(VOLUME FLOW RATE, PERCENT SOLIDS): 25% SOLIDS
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OUTLET STREAM DISPOSITION: VACUUM FILTER
OVERFLOW STREAM DISPOSITION: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

SOLIDS DEWATERING

I DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): DRUM

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): ROTARY

NUMBER OF DEVICES: 5 (SHARED WITH UNITS 1, 2, 3, & 4)

NUMBER OF SPARES: 1 (SHARED WITH UNITS 1, 2, 3, & 4)

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: _____

CAPACITY: _____

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

BELT MATERIAL GENERIC TYPE: _____

BELT MATERIAL SPECIFIC TYPE: _____

BELT MATERIAL TRADE/COMMON NAME: _____

FEED STREAM SOURCE (ABSORBER BLEED,
THICKENER UNDERFLOW, ETC.): THICKENER UNDERFLOW

FEED STREAM CHARACTERISTICS
(VOLUME FLOW RATE, PERCENT SOLIDS): 25% SOLIDS

OUTLET STREAM CHARACTERISTICS
(VOLUME FLOW RATE, PERCENT SOLIDS): 45% SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: PUG MILL

OVERFLOW STREAM DISPOSITION: _____

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAOH2 - DRY: _____

PERCENT CACO3 - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

I METHOD: FIXATION

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): FLY ASH/LIME

DEVICE (OXIDATION TANK, PUG MILL, ETC.): PUG MILL (2 - SHARED WITH UNITS 1,
2, 3, & 4)

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): IUCS

INLET FLOW RATE - GPM: _____

INLET QUALITY - % SOLIDS: 45% SOLIDS

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

I GENERIC TYPE (LANDFILL, POND, ETC.): LANDFILL
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): HEAPED FILL
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): N/A
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): TRUCK
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY LINING
SITE DIMENSIONS - AREA/DEPTH: _____
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 10 (LANDFILL FOR UNITS 1, 2, 3, & 4)

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: _____
CHEMICAL PARAMETERS (PH, ETC.): _____
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____
CONTROL LEVELS: _____
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: _____
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): _____
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): _____

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN

I TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
MAKEUP WATER ADDITION - GPM: _____
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): CARBIDE LIME
PRINCIPAL CONSTITUENTS: 90% Ca(OH)₂
SOURCE/SUPPLIER: AIRCO
SUPPLIER LOCATION: LOUISVILLE
CONSUMPTION (SPECIFY UNITS): _____
UTILIZATION - %: _____
POINT OF ADDITION: RECYCLE TANK

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: _____
CAPITAL COST - \$/KW: _____
OPERATING COST - MILLS/KWH: _____
MAINTENANCE COST: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

LABOR COST: _____
UTILITIES COST: _____
CHEMICALS COST: _____
WASTE DISPOSAL COST: _____

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: 0
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: _____
THICKENER - %: 0
VACUUM FILTER - %: 0
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: 0
SLAKER: N/A
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: _____
THICKENER: 0
VACUUM FILTER: 0
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 8

NUMBER OF SPARES: _____

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: _____

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 16,000

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: _____

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): _____

NUMBER OF PUMPS: _____

NUMBER OF SPARES: _____

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: _____

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: _____

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: _____

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): _____

NUMBER OF PUMPS: _____

NUMBER OF SPARES: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): _____
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): _____
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): _____
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 1

COMMENTS/FOOTNOTES

- A UNITS 1 & 2 SHARE A COMMON 600-FOOT CONCRETE STACK.
- B 90% OF THE MILL CREEK COAL IS RECEIVED FROM PEABODY.
- C FGD OPERATORS PERFORM ROUTINE MAINTENANCE (E.G., PUMP LUBRICATION); HOWEVER, ALL MAJOR FGD SYSTEM MAINTENANCE WORK IS PERFORMED ON AN AS-NEEDED BASIS BY PEOPLE DRAWN FROM THE IN-HOUSE CONSTRUCTION STAFF.
- D THERE ARE THREE ELECTRICIANS FOR THE PLANT WHO PERFORM FGD MAINTENANCE ALSO. THE SUPERVISOR BREAKDOWN IS AS FOLLOWS:
 - 2 SUPERVISORS/DAY SHIFT ONLY (ONE FOR UNIT 1 AND ONE FOR UNIT 3)
 - 1 SUPERVISOR/SHIFT (FOR OTHER TWO SHIFTS; SHARED BETWEEN UNITS 1 AND 3)
 - 1 SUPERVISOR/DAY SHIFT ONLY ON WEEKENDS.
- E ONE GAS CONTACTING ZONE IS RESERVED AS A SPARE.
- F MIST ELIMINATOR WASH PRESSURE IS 120 PSI.
- G ONE INLET AND ONE OUTLET DAMPER PER MODULE WITH TYPE 316L STAINLESS STEEL LOUVERS EACH AND TWO MORE FOR BYPASS.
- H BALL MILL IS USED TO REDUCE MESH SIZE OF CARBIDE LIME WHEN NECESSARY.
- I WHEN IUCS FACILITY BECOMES OPERATIONAL.

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

GENERAL PLANT INFORMATION

COMPANY NAME: LOUISVILLE GAS & ELECTRIC COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: MILL CREEK
UNIT NUMBER: 3
PLANT ADDRESS: P.O. BOX 32010
CITY: LOUISVILLE
COUNTY: JEFFERSON
STATE: KENTUCKY
ZIP CODE: 40232
EPA REGION: 4
RIVER BASIN/LAKE REGION: OHIO
REGULATORY CLASSIFICATION: STATE STD EQUAL/LESS STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: 0.7
NET PLANT GENERATING CAPACITY - MW: 1084
GROSS UNIT GENERATING CAPACITY - MW: 427
NET UNIT GENERATING CAPACITY WITH FGD - MW: 420
NET UNIT GENERATING CAPACITY W/O FGD - MW: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 427

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: BABCOCK & WILCOX
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: _____
WET BOTTOM/DRY BOTTOM: _____
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): _____
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 1978
DESIGN BOILER FLUE GAS FLOW - ACFM: 1,600,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: _____
HEAT RATE - BTU/KWH: 9600
DESIGN FIRING RATE - TPH: 185
EXCESS AIR - %: _____
CAPACITY FACTOR - %: 50-60
STACK HEIGHT - FT: 600
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: CARBON STEEL
FLUE MATERIAL SPECIFIC TYPE: AISI 1110
FLUE MATERIAL TRADE/COMMON NAME: N/A
A FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 21
STACK GAS INLET TEMPERATURE - F: 300
STACK GAS OUTLET VELOCITY - FT/SEC: 97.5

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: PEABODY COAL COMPANY
MINE NAME/AREA: CENTRAL CITY AREA
MINE LOCATION - COUNTY: _____
MINE LOCATION - STATE: KENTUCKY
AVERAGE HEAT CONTENT - BTU/LB: 11,300
RANGE HEAT CONTENT - BTU/LB: 11,000-12,000
AVERAGE ASH CONTENT - %: 15
RANGE ASH CONTENT - %: 13.0-16.0
AVERAGE MOISTURE CONTENT - %: 10.0
RANGE MOISTURE CONTENT - %: 9.0-15.0
AVERAGE SULFUR CONTENT - %: 3.87
RANGE SULFUR CONTENT - %: 3.5-4.0
AVERAGE CHLORIDE CONTENT - %: 0.04
RANGE CHLORIDE CONTENT - %: 0.03-0.06
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): AVERAGE
FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: AMERICAN AIR FILTER
INLET FLUE GAS CAPACITY - ACFM: 800,000
INLET FLUE GAS TEMPERATURE - F: 300
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: 99.5
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME (CARBIDE)
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: AMERICAN AIR FILTER
A-E FIRM: FLUOR POWER SERVICES, INC.
CONSTRUCTION FIRM: IN-HOUSE
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.0

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

SO2 DESIGN REMOVAL EFFICIENCY - %: 85
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A
COMMERCIAL START-UP: 3/79
INITIAL START-UP: 8/78
CONSTRUCTION COMPLETION:
CONSTRUCTION INITIATION: 1976
CONTRACT AWARDED: 11/75
LETTER OF INTENT SIGNED: 4/74
INITIATED BID REQUEST:
INITIATED PRELIMINARY DESIGN:

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.0
DESIGN COAL HEAT CONTENT - BTU/LB: 12,000
DESIGN COAL ASH CONTENT - %: 16.0
DESIGN COAL MOISTURE CONTENT - %: 15.0
DESIGN COAL CHLORIDE CONTENT - %: 0.06
FGD SYSTEM SPACE REQUIREMENTS - SQ FT:
FGD SYSTEM TURNDOWN RATIO:
FGD SYSTEM TURNDOWN METHOD:
FGD SYSTEM PRESSURE DROP - IN. H2O: 12
FGD SYSTEM OXIDATION - %:
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS:
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS:
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): SAME AS BOILER

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT

(MANHOURS/DAY): 120 (COMBINED)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 4

B FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): NONE

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MAINTENANCE SHIFTS/DAY): AS NEEDED

FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE

TYPE OF FGD SYSTEM MAINTENANCE CREW

(DEDICATED, ETC.): PULLED FROM CONSTRUCTION CREW AS NEEDED

SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

ROTATION TO FGD SYSTEM: N/A

C TYPE OF MAINTENANCE SUPERVISORS

(DEDICATED, ETC.): FGD SUPERVISORS OVERSEE MAINTENANCE

FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES

RESTRICTIONS TO USING BYPASS: 10 DAY LIMIT

TIME SCHEDULE FOR REDUCED BOILER LOAD:

TIME SCHEDULE FOR BOILER SHUTDOWNS:

PLANNED MAINTENANCE DURING REDUCED

BOILER LOAD (TYPE AND FREQUENCY):

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY):

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): _____

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: 4

NUMBER OF SPARES: 0

TYPE: VENTURI

LOCATION: IMMEDIATELY IN FRONT OF ABSORBER

SUPPLIER: AMERICAN AIR FILTER

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: INORGANIC

LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED MORTAR

LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8

INLET GAS FLOW - ACFM: 400,000

INLET GAS TEMPERATURE - F: 300

PRESSURE DROP - IN. H₂O: 2

LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.): ABSORBER
SLURRY

LIQUID RECIRCULATION RATE - GPM: 2000

L/G RATIO - GAL/1000 ACF: 5

NUMBER OF SPRAY HEADERS: _____

NOZZLE MATERIAL: _____

NOZZLE PRESSURE DROP - PSI: _____

ABSORBER

NUMBER OF ABSORBERS: 4

NUMBER OF SPARES: 0

D GENERIC TYPE: PACKED TOWER

SPECIFIC TYPE: ENTRAINED PACKING

TRADE/COMMON NAME: MOBILE BED CONTACTOR

SUPPLIER: AMERICAN AIR FILTER

DIMENSIONS - FT: 16.0 X 20.0

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1100

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: INORGANIC

LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED MORTAR

LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8

BOILER LOAD PER ABSORBER - %: 25

GAS/LIQUID CONTACT DEVICE TYPE: SOLID POLYURETHANE BALLS

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN GAS CONTACTING ZONES -IN.: N/A

NUMBER OF SPRAY HEADERS: 2

E NOZZLE MATERIAL: TYPE 316 STAINLESS STEEL

NOZZLE PRESSURE DROP - PSI: _____

LIQUID RECIRCULATION RATE - GPM: 20,400

L/G RATIO - GAL/1000 ACF: 50-60

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

GAS-SIDE PRESSURE DROP - IN. H2O: 6
SUPERFICIAL GAS VELOCITY - FT/SEC: 10
ABSORBER TURNDOWN RATIO: _____
ABSORBER TURNDOWN METHOD: _____
INLET GAS FLOW RATE - ACFM: 340,000-408,000
INLET GAS TEMPERATURE - F: 300
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: 6.5
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 130
OUTLET SO2 LEVEL - PPM: _____
OUTLET SO2 LEVEL - LB/MM BTU: 1.2 (INCLUDES BYPASS)
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: _____
SO2 REMOVAL EFFICIENCY - %: 85.7
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 8
NUMBER OF SPARES: 0
NUMBER PER MODULE: 2
E GENERIC TYPE: IMPINGEMENT
SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CLOSED VANE
MANUFACTURER: ATLANTIC BRIDGE
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): Z-SHAPE
NUMBER OF STAGES: 1
NUMBER OF PASSES/STAGE: 3
FREEBOARD DISTANCE - FT: 7.0
DISTANCE BETWEEN STAGES - IN.: 3.0
DISTANCE BETWEEN VANES - IN.: 1.0
VANE ANGLES - DEGREES: _____
PRESSURE DROP - IN. H2O: 1.0
SUPERFICIAL GAS VELOCITY - FT/SEC: 15.0
F CONSTRUCTION MATERIAL GENERIC TYPE: STAINLESS STEEL
CONSTRUCTION MATERIAL SPECIFIC TYPE: AUSTENITIC
CONSTRUCTION MATERIAL TRADE/COMMON NAME: TYPE 316L
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): FRESH MAKEUP
POINT OF WATER COLLECTION: _____
WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): _____
WASH FREQUENCY: 10% OF THE AREA WASHED EACH 1/2 MINUTE
WASH DURATION: 1 MINUTE
WASH RATE - GAL/MIN: 30-50
WASH COVERAGE - GAL/MIN/SQ FT: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

REHEATER

NUMBER OF REHEATERS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): STEAM
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): BARE TUBES
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: TOP OF ABSORBER
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: N/A -
TEMPERATURE INCREASE - F: 50
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 130
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 180
ENERGY REQUIREMENT - MM BTU/HR: 20
NUMBER OF HEAT EXCHANGER BANKS: _____
NUMBER OF BUNDLES PER BANK: _____
NUMBER OF TUBES PER BUNDLE: _____
STEAM OR WATER PRESSURE - PSIG: _____
STEAM OR WATER TEMPERATURE - F: _____
SELF CLEANING DEVICE TYPE: _____

G MATERIAL GENERIC TYPE: CARBON STEEL TUBES WITH CARBON STEEL TUBE SHEET
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

FANS

NUMBER OF FANS: 2
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: AMERICAN STANDARD
FUNCTION (UNIT/BOOSTER): UNIT
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND QUENCHER
FLUE GAS FLOW RATE - ACFM: 800,000
FLUE GAS TEMPERATURE - F: 300
PRESSURE DROP - IN. H2O: 42.3
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET TO ABSORBER MODULES (B) OUTLET FROM ABSORBER MODULES
(C) BYPASS
NUMBER OF DAMPERS: (A) 2 (B) 2 (C) 2
FUNCTION (CONTROL/SHUT-OFF): SHUT-OFF (ALL)
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): GUILLotine (ALL)

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): TOP-ENTRY GUILLOTINE
(ALL)

TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): N/A

MANUFACTURER: _____

MODULATION (OPEN/CLOSED, ETC.): _____

SEAL AIR - ACFM: N/A

SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____

MATERIAL GENERIC TYPE: STAINLESS STEEL (ALL)

MATERIAL SPECIFIC TYPE: AUSTENITIC (ALL)

MATERIAL TRADE/COMMON NAME: TYPE 316L (ALL)

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) BYPASS

CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____

DIMENSIONS (DIAMETER, LENGTH, ETC.): _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL (ALL)

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: (A) NONE (B) INORGANIC (C) INORGANIC

H LINER MATERIAL SPECIFIC TYPE: (B) HYDRAULICALLY BONDED MORTAR
(C) FOAM GLASS BLOCKS

LINER MATERIAL TRADE/COMMON NAME: (B) PRE-KRETE G-8 (C) PENNGARD

EXPANSION JOINTS

LOCATION: ABSORBER INLET (4); ABSORBER OUTLET (4);

DOWNSTREAM OF REHEATER (4); BYPASS (1)

TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC (ALL)

FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT (ALL)

PRESSURE (NEGATIVE/POSITIVE): _____

OPERATING TEMPERATURE - F: _____

DESIGN CONFIGURATION (V-SHAPED, ETC.): _____

MANUFACTURER: _____

MATERIAL: ORGANIC

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME IS DELIVERED AS A
SLURRY BY BARGE

I PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): BALL MILL

DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): TUBE MILL

MANUFACTURER: _____

MATERIALS: _____

NUMBER OF DEVICES: 1 (SHARED BETWEEN UNITS 1, 2, 3, & 4)

NUMBER OF SPARES: 0

FULL LOAD DRY FEED CAPACITY - TPH: _____

PRODUCT QUALITY - % SOLIDS: 25

FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

PREPARED REAGENT POINT OF ADDITION: ADDITIVE SLURRY DAY TANK
ON-SITE STORAGE CAPABILITY - DAYS: _____

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) ADDITIVE SLURRY TRANSFER
(B) ABSORBER RECIRCULATION (C) ABSORBER BLOWDOWN
(D) SLUDGE DISPOSAL

DIMENSIONS - IN.: _____

MANUFACTURER: _____

MATERIAL: (A) UNLINED CARBON STEEL (B) FRP (C) FRP (D) FRP

MAJOR VALVES

LOCATION: (A) ADDITIVE SLURRY TRANSFER (B) ABSORBER RECIRCULATION
(C) ABSORBER BLOWDOWN (D) SLUDGE DISPOSAL

FUNCTION (ISOLATION, CONTROL, ETC.): ISOLATION (ALL)

TYPE (BALL, GLOBE, PLUG, ETC.): (A) KNIFEGATE (B) KNIFEGATE (C) KNIFEGATE
(D) PLUG

CONTROL MODE (AUTOMATIC/MANUAL): _____

DIMENSIONS - IN.: _____

MANUFACTURER: DEZURIK (ALL)

MATERIAL: CARBON STEEL

THICKENERS

NUMBER OF THICKENERS: 1

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 125 DIA X 10 HIGH

CAPACITY - GAL: _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

RAKE MATERIAL: _____

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 10% SOLIDS

OUTLET STREAM CHARACTERISTICS

(VOLUME FLOW RATE, PERCENT SOLIDS): 20% SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: VACUUM FILTER

OVERFLOW STREAM DISPOSITION: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

SOLIDS DEWATERING

J DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): DRUM

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): ROTARY

NUMBER OF DEVICES: 5 (SHARED WITH UNITS 1, 2, 3, & 4)

NUMBER OF SPARES: 1 (SHARED WITH UNITS 1, 2, 3, & 4)

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: _____

CAPACITY: _____

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

BELT MATERIAL GENERIC TYPE: _____

BELT MATERIAL SPECIFIC TYPE: _____

BELT MATERIAL TRADE/COMMON NAME: _____

FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.): THICKENER
UNDERFLOW

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 20% SOLIDS

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 45%
SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: PUG MILL

OVERFLOW STREAM DISPOSITION: _____

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAO2 - DRY: _____

PERCENT CACO3 - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

J METHOD: FIXATION

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): FLY ASH/LIME

DEVICE (OXIDATION TANK, PUG MILL, ETC.): PUG MILL (2-SHARED WITH UNITS 1,
2, 3, & 4)

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): IUCS

INLET FLOW RATE - GPM: _____

INLET QUALITY - % SOLIDS: 45

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL

J GENERIC TYPE (LANDFILL, POND, ETC.): LANDFILL

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): HEAPED FILL
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): N/A
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): TRUCK
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY LINING
SITE DIMENSIONS - AREA/DEPTH: _____
K SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 10 (LANDFILL UNITS 1, 2, 3, & 4)

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: (A) SLURRY RECYCLE (B) STACK OUTLET
CHEMICAL PARAMETERS (PH, ETC.): (A) PH (B) SO₂
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____
CONTROL LEVELS: _____
MONITOR TYPE (MANUFACTURER, ETC.): (A) UNILOC (B) LEAR SIEGLER
MONITOR LOCATION: (A) REACTION TANK (B) STACK
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): _____
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN
J TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: _____
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
MAKEUP WATER ADDITION - GPM: 150
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____
MAKEUP WATER ADDITION POINTS & AMOUNTS: _____
MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): CARBIDE LIME
PRINCIPAL CONSTITUENTS: 90% Ca(OH)₂
SOURCE/SUPPLIER: AIRCO
SUPPLIER LOCATION: LOUISVILLE
CONSUMPTION (SPECIFY UNITS): _____
UTILIZATION - %: _____
POINT OF ADDITION: RECYCLE TANK

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 26,800,000
CAPITAL COST - \$/KW: 60.5
OPERATING COST - MILLS/KWH: 1.76
MAINTENANCE COST: \$333,000/YR
LABOR COST: \$89,200/YR

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

UTILITIES COST: \$1,740,000/YR
CHEMICALS COST: \$1,826,000/YR
WASTE DISPOSAL COST: _____

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A
ABSORBER - %: 0
MIST ELIMINATOR - %: 0
REHEATER - %: 0
FAN - %: 0
BALL MILL - %: 0
SLAKER - %: N/A
EFFLUENT HOLD TANK - %: 0
RECIRCULATION PUMP - %: 25
THICKENER - %: 0
VACUUM FILTER - %: 0
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 0
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0
BALL MILL: 0
SLAKER: N/A
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 1
THICKENER: 0
VACUUM FILTER: 0
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/8/81

LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): CARBIDE LIME
SLURRY

NUMBER OF TANKS: 2
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: LIVE STORAGE FACILITY
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 35.0 X 100.0 (DIA)
CAPACITY - GAL: 2,000,000
RETENTION TIME - MIN: 4 DAYS
NUMBER OF AGITATORS: 4
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ADDITIVE SLURRY
DAY

NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: OUTDOORS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 35 X 20 (DIA)
CAPACITY - GAL: 80,000
RETENTION TIME - MIN: 8 HR
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION
NUMBER OF TANKS: 4
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: OUTDOORS

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

CONFIGURATION: RECTANGULAR
DIMENSIONS - FT: 20 X 20 X 80-100
CAPACITY - GAL: 270,000
RETENTION TIME - MIN: 30-35
NUMBER OF AGITATORS: 3
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: INORGANIC
SHELL MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED CONCRETE
SHELL MATERIAL TRADE/COMMON NAME: PORTLAND CEMENT
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): THICKENER
OVERFLOW

NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: OUTDOORS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 10 X 15 (DIA)
CAPACITY - GAL: 13,000
RETENTION TIME - MIN: 10
NUMBER OF AGITATORS: NONE
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER RECYCLE

NUMBER OF PUMPS: 10

NUMBER OF SPARES: 2

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT DRIVE

COMMON DESIGN (V-BELT, ETC.): V-BELT

MANUFACTURER: INGERSOLL-RAND

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 11,000

MOTOR BRAKE HP: _____

SPEED - RPM: 685

HEAD - FT: 105

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE SLURRY
TRANSFER

NUMBER OF PUMPS: 3

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WARMAN

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): VARIABLE

CAPACITY - GPM: 277

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE SLURRY
TRANSFER

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MILL CREEK 3

NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ADDITIVE SLURRY
TRANSFER

NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 550
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER BLEED
NUMBER OF PUMPS: 6
NUMBER OF SPARES: 2
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT DRIVE

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MILL CREEK 3

COMMON DESIGN (V-BELT, ETC.): V-BELT
MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 495
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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LOUISVILLE GAS & ELECTRIC
MILL CREEK 3

COMMENTS/FOOTNOTES

- A THE ORIGINAL PLASITE LINER MATERIAL EXFOLIATED AS A RESULT OF THERMAL SHOCK WHEN SWITCHING TO THE BYPASS MODE. THE LINER HAS BEEN ELIMINATED.
- B FGD OPERATORS PERFORM ROUTINE MAINTENANCE (E.G., PUMP LUBRICATION); HOWEVER, ALL MAJOR FGD SYSTEM MAINTENANCE WORK IS PERFORMED ON AN AS-NEEDED BASIS BY PEOPLE DRAWN FROM THE IN-HOUSE CONSTRUCTION STAFF.
- C THERE ARE THREE ELECTRICIANS FOR THE PLANT WHO ALSO PERFORM FGD MAINTENANCE. THE SUPERVISOR BREAKDOWN IS AS FOLLOWS:
 - 2 SUPERVISORS/DAY SHIFT ONLY (ONE ON UNIT 1 AND ONE ON UNIT 3)
 - 1 SUPERVISOR/SHIFT (FOR OTHER TWO SHIFTS; SHARED BETWEEN UNITS 1 AND 3)
 - 1 SUPERVISOR/DAY SHIFT ONLY ON WEEKENDS
- D AMERICAN AIR FILTER MOBILE BED DESIGN.
- E LOWER HEADER HAS FRP PIPE NIPPLES.
- F THE ORIGINAL PLASTIC (NORYL®) CHEVRON MELTED DUE TO THE REHEATER.
- G THE ORIGINAL TUBESHEETS WERE TYPE 316L STAINLESS STEEL AND THE TUBES WERE CARBON STEEL. DUE TO DISSIMILAR METALS, TUBE FAILURE OCCURRED. TO SOLVE THIS PROBLEM THE TUBESHEETS WERE REPLACED WITH ONES CONSTRUCTED OF CARBON STEEL.
- H FOAM GLASS BLOCKS FELL OUT OF BYPASS DUCT AFTER SEVERAL MONTHS OF OPERATION AND WERE REMOVED.
- I BALL MILL IS USED TO REDUCE MESH SIZE OF CARBIDE LIME WHEN NECESSARY.
- J WHEN IUCS FACILITY BECOMES OPERATIONAL.
- K DISPOSAL SITE SPACE REQUIREMENT IS ESTIMATED AT 76 ACRE-FT/YEAR.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Louisville Gas & Electric Mill Creek 1	12/80	744	336	System	331	45		Initial startup/shakedown operations commenced. No major FGD related problems were reported

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Louisville Gas & Electric Mill Creek 3	8/78	744		System				Initial startup/shutdown operations commenced
	9/78	720	714	System	576		Piping	FRP piping problems encountered
							Pump	Shaft and bearing related problems
	10/78	744	710	System	607			
	11/78	720	351	System	299			Unit shut down November 18 for scheduled inspection
	12/78	744	0	System	0			
	1/79	744	0	System	0			
	2/79	672	651	System	117			Unit restarted
	3/79	744	735	System	390			Compliance testing conducted and unit declared commercial
	4/79	720	503	System	320		Dampers and pumps	Failures reported
	5/79	744	492	System	481			
	6/79	720	665	System	345			
	7/79	744	686	System	411			
	8/79	744	550	System	374		Reheater	Reheater problems encountered in July and August (reheaters to be replaced by end of year)
	9/79	720	667	System	604			
	10/79	744	690	System	566			Unit shut down at end of October for turbine repairs
	11/79	720	0	System	0			

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Mill Creek 3 (continued)	12/79	744	0	System	0			
	1/80	744	0	System	0			During turbine overhaul general maintenance was performed on FGD system
	2/80	696	512	System	185			Unit came back on line on February 10, after turbine overhaul work was completed
	3/80	744	618	System	228		Water lines	Frozen water lines
							Reheater	Worn reheater flange gaskets
	4/80	720	715	System	304	43	Condensate pump	Blown gasket
							Reheater tubes	Replacement work continued
	5/80	744	498	System	256	68	Mist eliminator	240 hour outage to replace plastic mist eliminator components with stainless steel
	6/80	720	85	System	0	88	Lime storage tank lines	During a turbine outage the utility decided to replace the lines with larger ones (work was not completed when boiler restarted)
	7/80	744	684	System	625	92	Recycle pump	Failures forced unit to shut down for part of July
	8/80	744	535	System	437	59		
	9/80	720	682	System	412	57	FRP bleed pump line	During the August through September period the pump house was flooded due to the failure of the bleed pump FRP line (23 pumps and 23 pump motors were damaged)
	10/80	744	742	System	721	100		
	11/80	720	611	System	302	57	Pump house	Low availability due to pump damage which resulted from earlier flooding
	12/80	744	455	System	455	100		

LOUISVILLE GAS & ELECTRIC

PADDY'S RUN 6

SECTION 1
BACKGROUND

The Paddy's Run Power Station of Louisville Gas & Electric is located on the Ohio River in Rubbertown, about 10 miles southwest of the center of Louisville, Kentucky. The station has a net generating capacity of 302 MW. Paddy's Run 6 is a dry-bottom boiler that was installed by Foster Wheeler in 1951 and has a gross generating capacity of 72 MW. At the time the unit was constructed, there were no SO₂ and particulate matter emission regulations in effect.

In 1970, LG&E was faced with the dilemma of imminent ambient air standards for SO₂ emissions from their coal-fired plants and a contractual commitment to a long-term supply of high sulfur coal. As such, LG&E requested Combustion Engineering (C-E) to evaluate their marble-bed scrubber design for application in a lime slurry FGD system on a coal-fired boiler at their Paddy's Run Power Station. This evaluation was based on the development of a process design that was compatible with carbide lime as the absorbent. Carbide lime is a by-product of the manufacture of acetylene and is mainly composed of calcium hydroxide and calcium carbonate. The request to develop a process that could use carbide lime stemmed from LG&E's easy access to supplies of this by-product from a local acetylene manufacturing plant operated by Airco.

Louisville Gas & Electric
Paddy's Run 6

As a result of successful pilot and prototype test programs conducted by C-E at their Kreisinger Laboratory, LG&E authorized C-E to proceed with the design and installation of a demonstration-scale FGD system on Paddy's Run 6. This unit was selected for the demonstration because of space available for retrofit. The intent of this demonstration was to determine the design and performance capabilities of a carbide lime slurry FGD system on a full-scale, high sulfur, coal-fired unit.

Based on the outcome of this demonstration program, LG&E proceeded to develop sulfur dioxide control strategies for their coal-fired generating units at Cane Run and Mill Creek in order to comply with ambient air standards.

On-site construction of the Paddy's Run FGD system commenced in June 1972 and was completed in April 1973. Initial startup occurred on April 5, 1973, and system shakedown was completed by the following July. The FGD system was operated through the end of 1973 to determine the overall system viability, after which time the unit was taken off line due to a lack of power demand. This unit (and the other steam generators at Paddy's Run) are operated intermittently to meet peak load demands only. Because of this, there were never plans to retrofit any additional boilers at this station with FGD systems.

An EPA sponsored scrubber/sludge characterization test program was undertaken at Paddy's Run in late 1976 and 1977. The overall objective of the program was to determine quantitatively the reasons for the operating success of the Paddy's Run

Louisville Gas & Electric
Paddy's Run 6

FGD system. Prior to this time, the system had logged 4,000 hours of operation without encountering any major process or mechanical problems. The system was tested in both a carbide lime and commercial lime mode. The program was terminated in August 1977 and the unit returned to intermittent operation.

SECTION 2

PROCESS DESCRIPTION

The emission control system at Paddy's Run 6 consists of an ESP followed by a carbide lime FGD system. The ESP is designed to remove 99.1% of the particulate matter from the boiler flue gas. The FGD system consists of two absorber modules, each designed to handle 60% of the boiler flue gas, which is equivalent to approximately 187,500 acfm of flue gas at 335°F. Each module is equipped with two marble beds which facilitate intimate mixing of the gas and scrubbing slurry.

Flue gas enters each absorber module near the base and contacts nonatomizing sprays which provide a constant supply of slurry. The slurry, which is sprayed cocurrently with the gas stream to the underside of each marble bed, also serves to cool the flue gas to its saturation temperature before it enters the marble bed. The wetted flue gas rises through the bed and carries the slurry with it. The vigorous action of the marbles mixes the flue gas and slurry to form a "turbulent layer" above the marble bed, which provides the necessary retention time and mixing intensity to obtain the required degree of SO₂ and particulate removal. After emerging from the second marble bed, the clean flue gas passes through two sets of two-stage chevron mist eliminators, gas-fired reheaters that provide a 40-50°F temperature boost, a booster fan, and the existing 250-foot stack.

Slurry rejected from below the first marble bed falls onto a sloping screen in the scrubber bottom. Large particles in the slurry, such as mud or stray marbles are pulverized and purged periodically from the system to the thickener via a comminutor unit. Most of the remainder of the reject slurry is returned to the recirculation tank for reuse. All the spent scrubbing slurry that leaves the beds through the overflow pots is fed by gravity back to the reaction tank, where it is contacted with makeup lime. Other streams entering the recirculation tank include weir water from the thickener, return water from the vacuum filter, and makeup water. A surge tank downstream from the recirculation tank provides additional liquid holdup to ensure that tank precipitation of calcium salts will occur in the surge tank rather than in the slurry piping. Slurry is pumped back to the scrubber spray nozzles from the surge tank via two half-size slurry pumps. Part of the slurry is bled to the thickener tank to prevent buildup of waste by-product solids in the scrubber. The underflow from the thickener is sent to a rotary vacuum filter at approximately 23% solids. Filter cake (45-50% solids) is trucked to an off-site landfill area. Vacuum filtrate is recycled to the thickener, and pumped back to the reaction tank to close the liquid effluent loop.

A flow diagram for the Paddy's Run 6 FGD system is shown on the next page.

Flow Diagram: Paddy's Run 6

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/9/81

LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

GENERAL PLANT INFORMATION

COMPANY NAME: LOUISVILLE GAS & ELECTRIC COMPANY
ASSOCIATED UTILITIES: NONE
PLANT NAME: PADDY'S RUN
UNIT NUMBER: 6
PLANT ADDRESS: P.O. BOX 32010
CITY: LOUISVILLE
COUNTY: JEFFERSON
STATE: KENTUCKY
ZIP CODE: 40232
EPA REGION: 4
RIVER BASIN/LAKE REGION: OHIO
REGULATORY CLASSIFICATION:
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: NONE
NET PLANT GENERATING CAPACITY - MW: 302
GROSS UNIT GENERATING CAPACITY - MW: 72
NET UNIT GENERATING CAPACITY WITH FGD - MW: 67
NET UNIT GENERATING CAPACITY W/O FGD - MW: 69
EQUIVALENT SCRUBBED CAPACITY - MW: 72

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: FOSTER WHEELER
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: FRONT FIRED
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED DRAFT
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): PEAK
COMMERCIAL SERVICE DATE: 1952
DESIGN BOILER FLUE GAS FLOW - ACFM: 360,000-380,000
FLUE GAS TEMPERATURE - F: 335
FLUE GAS OXYGEN - %: 6
HEAT RATE - BTU/KWH: 15,000
DESIGN FIRING RATE - TPH: 30
EXCESS AIR - %: 25-30
CAPACITY FACTOR - %: 10-20
STACK HEIGHT - FT: 250
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: INORGANIC
FLUE MATERIAL SPECIFIC TYPE: PRE-FIRED BRICK/SHAPES
FLUE MATERIAL TRADE/COMMON NAME: ACID RESISTANT BRICK
FLUE LINER MATERIAL GENERIC TYPE: INORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: HYDRAULICALLY BONDED CONCRETE AND
CHEMICALLY BONDED MORTAR
FLUE LINER MATERIAL TRADE/COMMON NAME: PRE-KRETE G-8 AND PENNWALT HES
GUNITE
FLUE INNER DIAMETER - FT: 13-14
STACK GAS INLET TEMPERATURE - F: 166-176
STACK GAS OUTLET VELOCITY - FT/SEC: 50-60

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: PEABODY
MINE NAME/AREA: CENTRAL CITY
MINE LOCATION - COUNTY: MUHLENBURG
MINE LOCATION - STATE: KENTUCKY
AVERAGE HEAT CONTENT - BTU/LB: 11,300
RANGE HEAT CONTENT - BTU/LB: 10,400-11,900
AVERAGE ASH CONTENT - %: 14
RANGE ASH CONTENT - %: 10.0-20.0
AVERAGE MOISTURE CONTENT - %: 9.0
RANGE MOISTURE CONTENT - %: 8.0-10.8
AVERAGE SULFUR CONTENT - %: 3.7
RANGE SULFUR CONTENT - %: 3.5-4.0
AVERAGE CHLORIDE CONTENT - %: 0.04
RANGE CHLORIDE CONTENT - %: 0.03-0.06
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: N/A

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 1
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: RESEARCH-COTTRELL
INLET FLUE GAS CAPACITY - ACFM: 360,000-380,000
INLET FLUE GAS TEMPERATURE - F: 335
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: 99.1
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H2O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO2 LEVEL - PPM:
INLET SO2 LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO2 LEVEL - PPM:
OUTLET SO2 LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO2 REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): CARBIDE LIME
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION ENGINEERING
A-E FIRM: FLUOR-PIONEER
CONSTRUCTION FIRM: PIONEER SERVICES
APPLICATION (NEW/RETROFIT): RETROFIT
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.1
SO2 DESIGN REMOVAL EFFICIENCY - %: 90
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

COMMERCIAL START-UP:

INITIAL START-UP: 4/73
CONSTRUCTION COMPLETION: 4/73
CONSTRUCTION INITIATION: 6/72
CONTRACT AWARDED: 7/71
LETTER OF INTENT SIGNED:
INITIATED BID REQUEST: 12/70
INITIATED PRELIMINARY DESIGN: 1970

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.0
DESIGN COAL HEAT CONTENT - BTU/LB: 10,400
DESIGN COAL ASH CONTENT - %:
DESIGN COAL MOISTURE CONTENT - %:
DESIGN COAL CHLORIDE CONTENT - %:
FGD SYSTEM SPACE REQUIREMENTS - SQ FT:
FGD SYSTEM TURNDOWN RATIO: 2.4:1 AND GREATER WITH GAS RECIRCULATION
FGD SYSTEM TURNDOWN METHOD: RECYCLING OF GAS AND SHUT-OFF OF ONE TRAIN
FGD SYSTEM PRESSURE DROP - IN. H₂O: 15
FGD SYSTEM OXIDATION - %: NEGLIGIBLE
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 10
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 192
A FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 6
B FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE PERSONNEL/SHIFT): 4
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): NONE
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): DEDICATED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: N/A
TYPE OF MAINTENANCE SUPERVISORS
(DEDICATED, ETC.): 1 SUPERVISOR FOR FGD SYSTEM AND BOILER
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: 10 DAY LIMIT
C TIME SCHEDULE FOR REDUCED BOILER LOAD: N/A
TIME SCHEDULE FOR BOILER SHUTDOWNS: N/A
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): N/A
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): ALL NECESSARY MAINTENANCE
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE): GENERAL CLEANING

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:

UTILITY EMISSION CONTROL SYSTEM DATA
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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 0
D GENERIC TYPE: PACKED TOWER
SPECIFIC TYPE: STATIC BED PACKING
TRADE/COMMON NAME: MARBLE BED SCRUBBER
SUPPLIER: COMBUSTION ENGINEERING
DIMENSIONS - FT: 17 X 18 X 50 HIGH
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE OR MICA FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103 OR FLAKELINE 151
BOILER LOAD PER ABSORBER - %: 60.0
E GAS/LIQUID CONTACT DEVICE TYPE: GLASS MARBLES
NUMBER OF GAS CONTACTING ZONES: 2
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: _____
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: PLASTIC WITH RUBBER LINING
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 8100
L/G RATIO - GAL/1000 ACF: 16-20 PER BED
GAS-SIDE PRESSURE DROP - IN. H2O: 11.0
SUPERFICIAL GAS VELOCITY - FT/SEC: 10
ABSORBER TURNDOWN RATIO: 1.2:1 WITHOUT GAS RECIRCULATION
ABSORBER TURNDOWN METHOD: RECYCLING OF GAS
INLET GAS FLOW RATE - ACFM: 180,000-190,000
INLET GAS TEMPERATURE - F: 335
INLET SO2 LEVEL - PPM: 1800-2200
INLET SO2 LEVEL - LB/MM BTU: _____

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

INLET PARTICLE LEVEL - GR/SCF: 0.10-0.15
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 126
OUTLET SO2 LEVEL - PPM: 150-300
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: _____
SO2 REMOVAL EFFICIENCY - %: >85
PARTICLE REMOVAL EFFICIENCY - %: >99 OVERALL

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 2
GENERIC TYPE: IMPINGEMENT
SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CHEVRON VANE
MANUFACTURER: COMBUSTION ENGINEERING
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): A-FRAME
NUMBER OF STAGES: 2
NUMBER OF PASSES/STAGE: 3
FREEBOARD DISTANCE - FT: 5.0
DISTANCE BETWEEN STAGES - IN.: 48
F DISTANCE BETWEEN VANES - IN.: 1.7
VANE ANGLES - DEGREES: 45
PRESSURE DROP - IN. H2O: 1.5
SUPERFICIAL GAS VELOCITY - FT/SEC: 10
CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC
CONSTRUCTION MATERIAL SPECIFIC TYPE: POLYPROPYLENE
CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): SERVICE WATER
POINT OF WATER COLLECTION: _____
WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): _____
WASH FREQUENCY: EVERY 8 HOURS
WASH DURATION: 10-15 MIN
WASH RATE - GAL/MIN: 80-200 (40-65 PSIG)
WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 2
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
BURNER
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): DIRECT COMBUSTION
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): NATURAL GAS

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

COMBUSTION FUEL SULFUR CONTENT - %: 0
LOCATION: IN OUTLET DUCT
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 0
TEMPERATURE INCREASE - F: 40-50
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 126
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 166-176
ENERGY REQUIREMENT - MM BTU/HR: 16-18
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: NONE
MATERIAL GENERIC TYPE: CAST IRON BURNERS
MATERIAL SPECIFIC TYPE: N/A
MATERIAL TRADE/COMMON NAME: N/A

FANS

NUMBER OF FANS: 1
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: WESTINGHOUSE
FUNCTION (UNIT/BOOSTER): BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: AFTER REHEATER
FLUE GAS FLOW RATE - ACFM: 175,000
FLUE GAS TEMPERATURE - F: 166-176
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: _____
NUMBER OF DAMPERS: 7
FUNCTION (CONTROL/SHUT-OFF): BOTH
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): SINGLE LOUVER
MANUFACTURER: COMBUSTION ENGINEERING
MODULATION (OPEN/CLOSED, ETC.): _____
SEAL AIR - ACFM: NONE
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: _____

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: INLET, OUTLET, BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): RECTANGULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.):
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

EXPANSION JOINTS

LOCATION:
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS
PRESSURE (NEGATIVE/POSITIVE):
OPERATING TEMPERATURE - F:
DESIGN CONFIGURATION (V-SHAPED, ETC.):
MANUFACTURER:
MATERIAL: RUBBER

REAGENT PREPARATION EQUIPMENT

G FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): NONE
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): N/A
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): N/A
MANUFACTURER: N/A
MATERIALS: N/A
NUMBER OF DEVICES: N/A
NUMBER OF SPARES: N/A
FULL LOAD DRY FEED CAPACITY - TPH: N/A
PRODUCT QUALITY - % SOLIDS: 20-30
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM:
PREPARED REAGENT POINT OF ADDITION: SMALL INNER SECTION OF REACTION TANK
ON-SITE STORAGE CAPABILITY - DAYS:

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) TO ABSORBER
(B) SPRAY HEADERS AND OUTLET PIPING

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: (A) MILD STEEL (B) FRP _____

MAJOR VALVES

LOCATION: _____
FUNCTION (ISOLATION, CONTROL, ETC.): ISOLATION
TYPE (BALL, GLOBE, PLUG, ETC.): KNIFEGATE
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: DEZURIK
MATERIAL: TYPE 316 STAINLESS STEEL

THICKENERS

NUMBER OF THICKENERS: 1
NUMBER OF SPARES: 0
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 50 DIA.
CAPACITY - GAL: 250,000
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A
RAKE MATERIAL: _____
FEED STREAM SOURCE: ABSORBER BLEED
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 10% SOLIDS
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 23% SOLIDS
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OUTLET STREAM DISPOSITION: VACUUM FILTER
OVERFLOW STREAM DISPOSITION: TO REACTION TANK

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): DRUM
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): _____
NUMBER OF DEVICES: 2
NUMBER OF SPARES: 1
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY: 240 TONS/DAY
SHELL MATERIAL GENERIC TYPE: CARBON STEEL FRAME
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

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PADDY'S RUN 6

BELT MATERIAL GENERIC TYPE: ORGANIC
BELT MATERIAL SPECIFIC TYPE: POLYPROPYLENE
BELT MATERIAL TRADE/COMMON NAME: _____
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.): THICKENER
UNDERFLOW
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 23% SOLIDS
OUTLET STREAM CHARACTERISTICS
(VOLUME FLOW RATE, PERCENT SOLIDS): 45-50% SOLIDS
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OUTLET STREAM DISPOSITION: LANDFILL
OVERFLOW STREAM DISPOSITION: TO THICKENER

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: 96.0
PERCENT CASO4 - DRY: 4.0
PERCENT CAOH2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: 3-4
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: FLY ASH MIXING (ON TENTATIVE BASIS ONLY; NONE AT PRESENT)
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): VACUUM FILTER PRODUCT
DEVICE (OXIDATION TANK, PUG MILL, ETC.): LANDFILL
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): NONE
INLET FLOW RATE - GPM: N/A
INLET QUALITY - % SOLIDS: 40

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): LANDFILL
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): HEAPED FILL
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): BORROW PIT
LOCATION (ON-SITE/OFF-SITE): OFF-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): TRUCK
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE
SITE DIMENSIONS - AREA/DEPTH: _____
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: _____

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: INLET, OVERFLOW POT DRAINS, SUMP
CHEMICAL PARAMETERS (PH, ETC.): PH
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): _____
CONTROL LEVELS: PH <6 UPPER BED, PH >4 LOWER BED, PH 8-10 AT INLET, PH
5.8-6.4 IN SUMP
MONITOR TYPE (MANUFACTURER, ETC.): _____

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

MONITOR LOCATION: _____

PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): _____

PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): _____

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN

TYPE (OPEN/CLOSED): CLOSED

EVAPORATION WATER LOSS - GPM: _____

SLUDGE HYDRATION WATER LOSS - GPM: _____

SLUDGE INTERSTITIAL WATER LOSS - GPM: _____

POND SEEPAGE/RUNOFF WATER LOSS - GPM: _____

EFFLUENT WATER LOSS - GPM: _____

RECEIVING WATER STREAM NAME: _____

MAKEUP WATER ADDITION - GPM: 50

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): _____

MAKEUP WATER ADDITION POINTS & AMOUNTS: _____

MAKEUP WATER PRE-TREATMENT TYPE: _____

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT

NAME (LIMESTONE, ADIPIC ACID, ETC.): CARBIDE LIME

PRINCIPAL CONSTITUENTS: $\text{Ca}(\text{OH})_2$

SOURCE/SUPPLIER: AIRCO

SUPPLIER LOCATION: LOUISVILLE, KENTUCKY

CONSUMPTION (SPECIFY UNITS): 4800 LB/HR DRY $\text{Ca}(\text{OH})_2$

UTILIZATION - %: _____

POINT OF ADDITION: ADDITIVE SLURRY TANK

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 8,540,000

CAPITAL COST - \$/KW: 122

OPERATING COST - MILLS/KWH: 7.05

MAINTENANCE COST: \$393,000/YR

LABOR COST: \$424,000/YR

UTILITIES COST: \$328,000/YR

CHEMICALS COST: \$816,000/YR

WASTE DISPOSAL COST: \$71,700/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

ABSORBER - %: 20

MIST ELIMINATOR - %: 0

REHEATER - %: 0

FAN - %: 0

BALL MILL - %: N/A

SLAKER - %: N/A

EFFLUENT HOLD TANK - %: 0

RECIRCULATION PUMP - %: 33

THICKENER - %: 0

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

VACUUM FILTER - %: 0
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER:
MIST ELIMINATOR: 0.3
REHEATER: 0
FAN: 0
BALL MILL: N/A
SLAKER: N/A
EFFLUENT HOLD TANK: 0
RECIRCULATION PUMP: 1
THICKENER: 0
VACUUM FILTER: 0
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: NONE
PARTICIPANTS:
PROCESS:
PLANT DESIGN:
SUPPLIER:
SERVICE DATE:
PERIOD OF OPERATION - MONTHS:
GAS FEED:
EQUIVALENT SCRUBBED CAPACITY - MW:
STATUS (ACTIVE/TERMINATED):

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): OPEN

LOCATION:

H CONFIGURATION: CYLINDRICAL WITH 5 FT DIA CYLINDRICAL COMPARTMENT

DIMENSIONS - FT: 48 DIA

CAPACITY - GAL: 210,000

RETENTION TIME - MIN: 30

NUMBER OF AGITATORS:

AGITATOR CONFIGURATION:

AGITATOR MATERIALS: RUBBER CLAD MILD STEEL

SHELL MATERIAL GENERIC TYPE: MILD STEEL

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ABSORBER RECYCLE

NUMBER OF TANKS:

NUMBER OF SPARES:

TYPE (OPEN/COVERED):

LOCATION:

CONFIGURATION:

DIMENSIONS - FT:

CAPACITY - GAL: 16,300

RETENTION TIME - MIN: 6-8

NUMBER OF AGITATORS:

AGITATOR CONFIGURATION:

AGITATOR MATERIALS:

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION SURGE

NUMBER OF TANKS:

NUMBER OF SPARES:

TYPE (OPEN/COVERED):

LOCATION:

CONFIGURATION:

DIMENSIONS - FT:

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

CAPACITY - GAL: 35,200
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: MILD STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ADDITIVE SLURRY
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: 6400
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): THICKENER
OVERFLOW
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____

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LOUISVILLE GAS & ELECTRIC
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LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

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LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): RECYCLE
NUMBER OF PUMPS: 3
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 6000
MOTOR BRAKE HP: 450
SPEED - RPM: 1000
HEAD - FT: 140
SERVICE (PH, SOLIDS): PH 8-10, 10% SOLIDS
CASING MATERIAL GENERIC TYPE: CAST ALLOY
CASING MATERIAL SPECIFIC TYPE: HIGH NICKEL
CASING MATERIAL TRADE/COMMON NAME: NI-HARD
IMPELLER MATERIAL GENERIC TYPE: CAST ALLOY
IMPELLER MATERIAL SPECIFIC TYPE: HIGH NICKEL
IMPELLER MATERIAL TRADE/COMMON NAME: NI-HARD

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER BLEED
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS: 2
NUMBER OF SPARES: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/9/81

LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): 23% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CARBIDE LIME SLURRY
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER OVERFLOW
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/9/81

LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 7/9/81

LOUISVILLE GAS & ELECTRIC
PADDY'S RUN 6

COMMENTS/FOOTNOTES

- A TOTAL OF SIX INCLUDES THREE PERSONS TO OPERATE FGD SYSTEM AND THREE PERSONS NEEDED TO HAUL SLUDGE.
- B DURING PERIODS OF FGD SYSTEM OPERATION, THERE ARE FOUR DEDICATED MAINTENANCE PEOPLE PER TWELVE HOUR SHIFT.
- C ANTICIPATED LOAD FACTOR FOR 1981 IS LESS THAN 2.0% DUE TO THE FACT THAT IT IS A PEAK BOILER.
- D EARLY COMBUSTION ENGINEERING MARBLE BED DESIGN.
- E 1-INCH DIAMETER GLASS MARBLES.
- F VARIES BETWEEN 1.5 AND 2.0.
- G CARBIDE LIME IS RECEIVED AS A 20-30% SLURRY.
- H SMALL COMPARTMENT IS FOR RAPID MIXING OF ABSORBER BOTTOMS AND CARBIDE LIME FEED.

SECTION 4

PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Louisville Gas & Electric Paddy's Run 6	4/73	720	320	System	118			Initial startup/installation operations commenced
	5/73	744	265	System	101		System	Single module operation continued through May 19, when unit was shut down for modifications
							Clarifier tank	Equipment installed for injection of flocculating agent
	6/73	720	255	System	8			
	7/73	744	240	System	50		Pumps	Slurry pump mechanical problems throughout June-July period
							Strainers	Plugging (disintegrator unit was installed by utility)
	8/73	744	330	System	193		Clarifier system	288 hour outage to replace the clarifier underflow line with larger one and to install additional pump capacity in the clarifier overflow system
	9/73	720	390	System	306		Clarifier system	120 hour outage to finish clarifier system repairs
							Absorber	7 hour outage to repair marble bed support plate
								Unit shut down from September 20 to the end of the month
	10/73	744	690	System	493			
	11/73	720	720	System	486			
	12/73	744	190	System	116			Low FGD/boiler hours due to lack of power demand

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Paddy's Run 6 (continued)	1/74	744	0	System	0			Boiler shut down due to lack of power demand
	2/74	672	0	System	0			
	3/74	744	0	System	0			
	4/74	720	0	System	0			
	5/74	744	0	System	0			
	6/74	720	0	System	0			
	7/74	744	306	System	202			
	8/74	744	31	System	20			Unit on and off frequently due to fluctuation in power demand
	9/74	720	43	System	0			Boiler shut down due to lack of power demand
	10/74	744	245	System	245			Boiler operated to perform limestone tests on the FGD system
	11/74	720	122	System	0			Boiler shut down due to lack of power demand from 11/74 through 8/75
	12/74	744	0	System	0			
	1/75	744	0	System	0			
	2/75	672	0	System	0			
	3/75	744	0	System	0			
	4/75	720	0	System	0			
	5/75	744	0	System	0			
	6/75	720	0	System	0			
	7/75	744	0	System	0			

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Paddy's Run 6 (continued)	8/75	744	0	System	0			
	9/75	720	720	System	720	100		
	10/75							
	11/75	720	720	System	720	100		
	12/75	744	744	System	670		Absorber module	Two minor outages to repair dual strainer switch shaft in the bottom of the scrubber module
	1/76	744	260	System	139			
	2/76	696	102	System	68			System shut down in preparation for an ex- tensive sludge study program. Scrubber to operate only when study begins or boiler required for peak loading
	3/76	744	0	System	0			
	4/76	720	2	System	0			
	5/76	744	20	System	17			
	6/76	720	161	System	153			Scrubber was available 100 percent of time during peak loading
	7/76	744	261	System	229			
	8/76	744	69	System	64			No major problems reported
	9/76	720	0	System	0			
	10/76	744	167	System	158			EPA-funded scrubber/sludge program commenced on October 25
	11/76	720	720	System	715			
	12/76	744	539	System	531			

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Paddy's Run 6 (continued)	1/77	744	103	System	0			Because of severe weather conditions the unit was down from December 31 until March 15
	2/77	672	62	System	0			
	3/77	744	389	System	308			
	4/77	720	328	System	307			
	5/77	744	280	System	119			Scrubber/sludge evaluation study continued
	6/77	720	334	System	312			
	7/77	744	736	System	713			
	8/77	744	582	System	547			
	9/77	720	162	System	42			Unit not operating due to lack of power demand
	10/77	744	32	System	15			
	11/77	720	0	System	0			
	12/77	744	0	System	0			
	1/78	744	0	System	0			
	2/78	672	0	System	0			
	3/78	744	0	System	0			Unit was out of service due to cold weather and lack of power demand
	4/78	720	0	System	0			
	5/78	744	0	System	0			
	6/78	720	52	System	51			Unit back on line with no FGD related problems
	7/78	744	190	System	189			Unit only operated for 192 to 240 hours

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Paddy's Run 6 (continued)	8/78	744	0	System	0			
	9/78	720	339	System	339			Unit operated so a new flocculant could be tested out
	10/78	744	0	System	0			
	11/78	720	0	System	0			
	12/78	744	0	System	0			
	1/79	744	0	System	0			
	2/79	672	0	System	0			
	3/79	744	0	System	0			
	4/79	720	0	System	0			Unit was not operated due to lack of power demand
	5/79	744	0	System	0			
	6/79	720	0	System	0			
	7/79	19	0	System	0			
	8/79	744	218	System	99			No problem encountered with respect to operation
	9/79	720	36	System	0			Peaking unit down (will be phased out in 1987)
	10/79	744	0	System	0			
	11/79	720	0	System	0			
	12/79	744	0	System	0			
	1/80	744	0	System	0			
	2/80	696	0	System	0			
	3/80	744	0	System	0			

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Paddy's Run 6 (continued)	4/80	720	0	System	0	100		FGD system available 100% of the time, but was not operated due to boiler related problems
	5/80	744	67	System	58	100		
	6/80	720	51	System	48	100		Boiler brought on line before FGD system
	7/80	744	0	System	0	100		Boiler did not operate due to lack of demand, FGD system was available 100% of the time
	8/80	744	0	System	0	100		
	9/80	720	0	System	0	100		
	10/80	744	0	System	0	100		
	11/80	720	0	System	0	100		
	12/80	744	0	System	0	100		

MINNESOTA POWER & LIGHT

CLAY BOSWELL 4

SECTION 1

BACKGROUND

The Clay Boswell Generating Station of Minnesota Power & Light Company (MP&L) consists of four units having a total net generating capacity of 1000 MW. Located in Cohasset, Minnesota, these units fire a Colstrip coal with an average sulfur content of 0.9%.

In the late 1970's when Clay Boswell 4, a 554-MW (gross) unit, was constructed, the 1971 Federal NSPS required MP&L to limit SO₂ emissions to 1.2 pound per million Btu and particulate matter emissions to 0.1 pound per million Btu. The initial design of the plant called for an ESP followed by a spray-tower SO₂ absorber to achieve compliance. However, after MP&L solicited bids on this basis, they found the costs to be higher than anticipated. In addition, MP&L had some doubts that an ESP could provide the required level of particulate matter removal. Both of these factors prompted MP&L to explore the concept of using a wet venturi integrated with the SO₂ spray tower absorber in order to take advantage of the flyash alkalinity. As a result, in November 1977, MP&L awarded a contract to Peabody Process Systems for the design and installation of a venturi scrubber and spray tower absorber emission control system. MP&L also authorized Peabody to design, install, and supervise a

pilot plant study for the evaluation of this system. The 1-MW pilot plant was installed on Clay Boswell 3. The system was evaluated using two different types of western coals. After a 18-month test program, an evaluation of the pilot plant experience revealed that a venturi for particulate matter removal was most economical and that the required emission standards could be met with this strategy.

A full-scale system was installed at Clay Boswell 4 and commercial operation commenced in April 1980.

SECTION 2

PROCESS DESCRIPTION

The Clay Boswell 4 wet lime/alkaline flyash FGD system consists of four scrubber modules designed to treat a total flue gas flow rate of 2,302,000 acfm at 300°F. Each scrubber module consists of a variable throat venturi scrubber for primary particulate matter control followed by a spray tower SO₂ absorber. The system is designed to operate with three modules in service at full load and one module as a spare. Reheat for the system is provided by means of a 5% hot flue gas bypass which is treated for particulate removal via a small hot-side ESP.

The boiler flue gas first enters the FGD system through the venturi scrubber at a flow rate of 835,000 acfm at 300°F, where it is contacted with a lime slurry spray. The gas and slurry leaving the venturi flows to the base of the spray tower absorber where the gas and slurry separate. The slurry drains to the recycle tank, the gas flows upward through the absorber where it is further contacted by sprays of recirculated slurry. The gas then passes through a sieve tray and a chevron mist eliminator section. The cleaned gas is reheated by the bypassed gas before entering a balanced draft fan and exiting to the 600-foot stack.

Fly ash collected in the fabric filters on Clay Boswell 1 and 2 is used as a source of alkali additive for the Clay Boswell 4 FGD system. The sludge from this closed water loop system is piped to a lined pond one mile from the unit.

A flow diagram for the Clay Boswell 4 FGD system is shown on the next page.

Flow Diagram: Clay Boswell 4

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/9/81

MINNESOTA POWER & LIGHT
CLAY BOSWELL 4

GENERAL PLANT INFORMATION

COMPANY NAME: MINNESOTA POWER & LIGHT COMPANY
ASSOCIATED UTILITIES: _____
PLANT NAME: CLAY BOSWELL
UNIT NUMBER: 4
PLANT ADDRESS: P.O. BOX 128
CITY: COHASSET
COUNTY: ITASCA
STATE: MINNESOTA
ZIP CODE: 55721
EPA REGION: 5
RIVER BASIN/LAKE REGION: MISSISSIPPI
REGULATORY CLASSIFICATION: REVISED NSPS (6/79)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: _____
NET PLANT GENERATING CAPACITY - MW: 1000
GROSS UNIT GENERATING CAPACITY - MW: 554
NET UNIT GENERATING CAPACITY WITH FGD - MW: 504
NET UNIT GENERATING CAPACITY W/O FGD - MW: 511
EQUIVALENT SCRUBBED CAPACITY - MW: 475

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): _____
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 2/80
DESIGN BOILER FLUE GAS FLOW - ACFM: 2,302,000
FLUE GAS TEMPERATURE - F: 300
FLUE GAS OXYGEN - %: _____
HEAT RATE - BTU/KWH: _____
DESIGN FIRING RATE - TPH: 290
EXCESS AIR - %: 25
CAPACITY FACTOR - %: _____
STACK HEIGHT - FT: 600
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: INORGANIC
FLUE MATERIAL SPECIFIC TYPE: ACID-RESISTANT BRICK AND MORTAR
FLUE MATERIAL TRADE/COMMON NAME: _____
FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 37
STACK GAS INLET TEMPERATURE - F: 155
STACK GAS OUTLET VELOCITY - FT/SEC: 29

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/9/81

MINNESOTA POWER & LIGHT
CLAY BOSWELL 4

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS
NAME OF SUPPLIER: PEABODY COAL CO.
MINE NAME/AREA: BIG SKY MINE
MINE LOCATION - COUNTY: COLSTRIP
MINE LOCATION - STATE: MONTANA
AVERAGE HEAT CONTENT - BTU/LB: 8287
RANGE HEAT CONTENT - BTU/LB: 7509-9923
AVERAGE ASH CONTENT - %: 9.4
RANGE ASH CONTENT - %:
AVERAGE MOISTURE CONTENT - %: 24.5
RANGE MOISTURE CONTENT - %: 20.3-28.3
AVERAGE SULFUR CONTENT - %: 0.94
RANGE SULFUR CONTENT - %:
AVERAGE CHLORIDE CONTENT - %: 0.01
RANGE CHLORIDE CONTENT - %:
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL):
FUEL ANALYSIS DATE:

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED
SPACE REQUIREMENTS - SQ FT:

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 1
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): HOT SIDE
SUPPLIER: WESTERN PRECIPITATOR DIVISION, JOY
INLET FLUE GAS CAPACITY - ACFM: 200,000
INLET FLUE GAS TEMPERATURE - F: 750
PRESSURE DROP - IN. H2O: 2.5
PARTICLE OUTLET LOAD - GR/SCF: 0.03
PARTICLE REMOVAL EFFICIENCY - %: 99.7
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: 4
NUMBER OF SPARES: 1

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/9/81

MINNESOTA POWER & LIGHT
CLAY BOSWELL 4

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI
SPECIFIC TYPE (FIXED THROAT,
MOBILE BED, ETC.): VARIABLE THROAT/ADJUSTABLE DRUM
TRADE/Common NAME: RADIAL FLOW VENTURI
SUPPLIER: PEABODY PROCESS SYSTEMS
DIMENSIONS - FT: 30 DIA X 40 HIGH
SHELL MATERIAL GENERIC TYPE: STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: TYPE 316L
SHELL MATERIAL TRADE/Common NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: RUBBER
LINER MATERIAL TRADE/Common NAME: _____
BOILER LOAD PER SCRUBBER (DESIGN) - %: 33.3
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): NONE
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: _____
NOZZLE MATERIAL: N/A
NOZZLE PRESSURE DROP - PSI: N/A
LIQUID RECIRCULATION RATE - GPM: 13,360
L/G RATIO - GAL/1000 ACF: 30
PH CONTROL ADDITIVE: ABSORBER SLURRY
GAS-SIDE PRESSURE DROP - IN. H₂O: 12
SUPERFICIAL GAS VELOCITY - FT/SEC: _____
INLET GAS FLOW RATE - ACFM: 836,000
INLET GAS TEMPERATURE - F: 300
INLET SO₂ LEVEL - PPM: 2900
INLET SO₂ LEVEL - LB/MM BTU: 6.4
INLET PARTICLE LEVEL - GR/SCF: 3.0
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: _____
OUTLET SO₂ LEVEL - PPM: _____
OUTLET SO₂ LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: 0.03
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.1
SO₂ REMOVAL EFFICIENCY - %: _____
PARTICLE REMOVAL EFFICIENCY - %: 99.7

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME/ALKALINE FLY ASH
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: PEABODY PROCESS SYSTEMS
A-E FIRM: EBASCO
CONSTRUCTION FIRM: PEABODY PROCESS SYSTEMS
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.7
SO₂ DESIGN REMOVAL EFFICIENCY - %: 89
CURRENT STATUS: OPERATIONAL

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/9/81

MINNESOTA POWER & LIGHT
CLAY BOSWELL 4

TERMINATION DATE: N/A
COMMERCIAL START-UP: 4/80
INITIAL START-UP: 2/80
CONSTRUCTION COMPLETION: 2/80
CONSTRUCTION INITIATION: 5/78
CONTRACT AWARDED: _____
LETTER OF INTENT SIGNED: 2/77
INITIATED BID REQUEST: 4/76
INITIATED PRELIMINARY DESIGN: 6/75

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 2.8
DESIGN COAL HEAT CONTENT - BTU/LB: 8590
DESIGN COAL ASH CONTENT - %: 9.4
DESIGN COAL MOISTURE CONTENT - %: 25
DESIGN COAL CHLORIDE CONTENT - %: 0.01
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: 160,000
FGD SYSTEM TURNDOWN RATIO: INFINITE
FGD SYSTEM TURNDOWN METHOD: _____
FGD SYSTEM PRESSURE DROP - IN. H2O: 20
FGD SYSTEM OXIDATION - %: 30
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: _____
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: _____
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): SAME
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MANHOURS/DAY): 72 ON OPERATION PLUS 16 PLUS 28 MAINTENANCE
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(OPERATORS/SHIFT): 3 OPERATORS
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): 3-4/SHIFT (ONLY ON DAY SHIFT)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): EXCESSIVE
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): MAINTENANCE POOLED
FOR BOTH

SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

ROTATION TO FGD SYSTEM: _____
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): A POOL SUPERVISOR
FGD SYSTEM BYPASS CAPABILITY (YES/NO): NO
RESTRICTIONS TO USING BYPASS: _____
TIME SCHEDULE FOR REDUCED BOILER LOAD: NONE
TIME SCHEDULE FOR BOILER SHUTDOWNS: ONCE/6 MONTHS
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): SEE OTHER DATA SHEET
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): SEE OTHER DATA SHEET
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): SEE OTHER DATA SHEET

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/9/81

MINNESOTA POWER & LIGHT
CLAY BOSWELL 4

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:
LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 4
NUMBER OF SPARES: 1
GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME:
SUPPLIER: PEABODY PROCESS SYSTEMS
DIMENSIONS - FT: 35 DIA X 60 HIGH
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
A LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: RUBBER
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER ABSORBER - %: 33.3
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: 6
NOZZLE MATERIAL: REFRAX (SILICON CARBIDE)
NOZZLE PRESSURE DROP - PSI: 12
LIQUID RECIRCULATION RATE - GPM: 33,400
L/G RATIO - GAL/1000 ACF: 40
GAS-SIDE PRESSURE DROP - IN. H2O:
SUPERFICIAL GAS VELOCITY - FT/SEC: 12
ABSORBER TURNDOWN RATIO:
ABSORBER TURNDOWN METHOD:

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INLET GAS FLOW RATE - ACFM: 640,130
INLET GAS TEMPERATURE - F: 128
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: 0.03
INLET PARTICLE LEVEL - LB/MM BTU: 0.1
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: _____
OUTLET SO2 LEVEL - PPM: _____
OUTLET SO2 LEVEL - LB/MM BTU: 0.750
OUTLET PARTICLE LEVEL - GR/SCF: 0.03
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.1
SO2 REMOVAL EFFICIENCY - %: 89
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 4 (B) 4

NUMBER OF SPARES: _____

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) BULK SEPARATION (B) IMPINGEMENT

SPECIFIC TYPE: (A) PERFORATED PLATE (B) BAFFLE

COMMON DESIGN: (A) SIEVE TRAY (B) CHEVRON VANE

MANUFACTURER: _____

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): _____

NUMBER OF STAGES: (A) 1 (B) 1

NUMBER OF PASSES/STAGE: (A) 1 (B) 3

FREEBOARD DISTANCE - FT: (A) _____ (B) 5

DISTANCE BETWEEN STAGES - IN.: N/A

DISTANCE BETWEEN VANES - IN.: (A) N/A (B) 1.3

VANE ANGLES - DEGREES: (A) N/A (B) 90

PRESSURE DROP - IN. H2O: (A) 1 (B) _____

SUPERFICIAL GAS VELOCITY - FT/SEC: (A) 11 (B) 11

CONSTRUCTION MATERIAL GENERIC TYPE: (A) STAINLESS STEEL (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) TYPE 316 (B) _____

CONSTRUCTION MATERIAL TRADE/COMMON NAME: (A) N/A (B) NORYL®

WASH WATER SOURCE (FRESH, BLENDED,

SUPERNATANT): (A) MAKEUP OVERSPRAY AND MAKEUP/SUPERNATANT MIXTURE
UNDERSPRAY

(B) MAKEUP

POINT OF WATER COLLECTION: _____

WASH DIRECTION (OVERSPRAY/UNDERSPRAY,

FRONTSpray/BACKSPRAY): (A) OVERSPRAY AND UNDERSPRAY

(B) HOSE CONNECTION FOR MANUAL WASHING

WASH FREQUENCY: _____

WASH DURATION: _____

WASH RATE - GAL/MIN: (A) 42 OVERSPRAY AND 432 UNDERSPRAY

WASH COVERAGE - GAL/MIN/SQ FT: _____

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REHEATER

NUMBER OF REHEATERS: 1
NUMBER OF SPARES: _____
NUMBER PER MODULE: _____
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): BYPASS
B SPECIFIC TYPE (STEAM, HOT WATER, ETC.): HOT SIDE
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): N/A
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: EXIT OF EACH TRAIN
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 5
TEMPERATURE INCREASE - F: 26
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: _____
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: _____
ENERGY REQUIREMENT - MM BTU/HR: _____
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: NONE
MATERIAL GENERIC TYPE: HIGH ALLOY
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: INCONEL 625

FANS

NUMBER OF FANS: 4
NUMBER OF SPARES: 1
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: GREEN FAN
FUNCTION (UNIT/BOOSTER): UNIT
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): WET
TYPE OF WASH: _____
LOCATION WRT MAJOR COMPONENTS: DOWNSTREAM OF ABSORBER
FLUE GAS FLOW RATE - ACFM: 678,800
FLUE GAS TEMPERATURE - F: 144
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: HIGH ALLOY
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: INCONEL 625 WHEELS AND INCOLOY 825 HOUSINGS

DAMPERS

LOCATION: (A) INLET (B) OUTLET (C) BYPASS
NUMBER OF DAMPERS: (A) 4 (B) 4 (C) 4
FUNCTION (CONTROL/SHUT-OFF): _____
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) GUILLLOTINE (B) GUILLLOTINE
(C) LOUVER

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SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): _____
MANUFACTURER: _____
MODULATION (OPEN/CLOSED, ETC.): _____
SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____
MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) HIGH ALLOY
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: (B) INCOLOY 825
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

DUCTWORK

LOCATION: (A) ABSORBER TO REHEATER (B) REHEAT SECTION
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____
DIMENSIONS (DIAMETER, LENGTH, ETC.): (A) 12 FT DIA
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: (A) _____ (B) TYPE 316L
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: (A) ORGANIC (B) NONE
LINER MATERIAL SPECIFIC TYPE: (A) GLASS FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: _____

EXPANSION JOINTS

LOCATION: _____
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: _____
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: _____
MATERIAL: VITON®/ASBESTOS

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: PEABODY PROCESS SYSTEMS
MATERIALS: _____

C NUMBER OF DEVICES: 5

NUMBER OF SPARES: _____
FULL LOAD DRY FEED CAPACITY - TPH: 20
PRODUCT QUALITY - % SOLIDS: 20
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: RECYCLE TANK
ON-SITE STORAGE CAPABILITY - DAYS: _____

TANKS

*SEE ATTACHMENT A

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PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) RECYCLE SLURRY (B) SUPERNATE
DIMENSIONS - IN.: _____
MANUFACTURER: _____
MATERIAL: (A) RUBBER-LINED CARBON STEEL (B) FRP

MAJOR VALVES

LOCATION: (A) RECYCLE (B) FLY ASH AND LIME SLURRY
FUNCTION (ISOLATION, CONTROL, ETC.): (A) ISOLATION (B) CONTROL
TYPE (BALL, GLOBE, PLUG, ETC.): (A) PLUG (B) PINCH
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: (A) DEZURIK (B) R.K.L.
MATERIAL: (A) NEOPRENE LINED (B) RUBBER-LINED

THICKENERS

NUMBER OF THICKENERS: NONE
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:

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SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: 21.7
MOISTURE CONTENT - % TOTAL FREE WATER: 45
PERCENT CASO3 - DRY: 5
PERCENT CASO4 - DRY: 3
PERCENT CAO₂ - DRY: 0
PERCENT CACO₃ - DRY: 1
PERCENT ASH - DRY: 91
PERCENT OTHER COMPOUNDS - DRY: TRACE

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.):
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.):
LOCATION (ON-SITE/OFF-SITE):
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.):
SITE DIMENSIONS - AREA/DEPTH: 276 ACRES
SITE CAPACITY - VOLUME/ACRE-FT/TONS: 7814 ACRE-FT
D SITE SERVICE LIFE - YEARS: 35

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM:
CHEMICAL PARAMETERS (PH, ETC.): PH AND SO₂
PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): DENSITY IN
RECYCLE TANK

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CONTROL LEVELS: PH 3-6, 7-9% SOLIDS
MONITOR TYPE (MANUFACTURER, ETC.): DUPONT AND LEAR SIEGLER FOR SO₂
MONITOR LOCATION:
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): AUTOMATIC (NOT USED)
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

E WATER BALANCE ENTRIES (DESIGN/ACTUAL):

TYPE (OPEN/CLOSED): CLOSED

EVAPORATION WATER LOSS - GPM: 438

SLUDGE HYDRATION WATER LOSS - GPM: 1

SLUDGE INTERSTITIAL WATER LOSS - GPM: 69

POND SEEPAGE/RUNOFF WATER LOSS - GPM: N/A

EFFLUENT WATER LOSS - GPM: N/A

RECEIVING WATER STREAM NAME:

MAKEUP WATER ADDITION - GPM: 508

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): RIVER WATER

MAKEUP WATER ADDITION POINTS & AMOUNTS: SLAKING SYSTEM - 17 GPM

PUMP SEALS - 42 GPM

WASH TANK - 375 GPM

UPPER TRAY SPRAY - 7 GPM

MAKEUP WATER PRE-TREATMENT TYPE:

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT

NAME (LIMESTONE, ADIPIC ACID, ETC.): LIME

PRINCIPAL CONSTITUENTS: CaO

SOURCE/SUPPLIER:

SUPPLIER LOCATION:

CONSUMPTION (SPECIFY UNITS): NONE (ALKALINITY PROVIDED BY FLY ASH)

UTILIZATION - %:

POINT OF ADDITION: SLAKER

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$:

CAPITAL COST - \$/KW:

OPERATING COST - MILLS/KWH:

MAINTENANCE COST:

LABOR COST:

UTILITIES COST:

CHEMICALS COST:

WASTE DISPOSAL COST:

FGD SPARE CAPACITY INDICES

SCRUBBER - %: 33.0

ABSORBER - %: 33.0

MIST ELIMINATOR - %:

REHEATER - %:

FAN - %:

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BALL MILL - %: N/A
SLAKER - %: _____
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: N/A
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: 1.0
ABSORBER: 1.0
MIST ELIMINATOR: _____
REHEATER: _____
FAN: _____
BALL MILL: N/A
SLAKER: _____
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: N/A
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: CONDUCTED ON UNIT 3
PARTICIPANTS: PEABODY PROCESS SYSTEMS
PROCESS: _____
PLANT DESIGN: VENTURI
SUPPLIER: PEABODY PROCESS SYSTEMS
SERVICE DATE: 1978
PERIOD OF OPERATION - MONTHS: 18
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 1.0
STATUS (ACTIVE/TERMINATED): _____

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECYCLE
NUMBER OF TANKS: 4
NUMBER OF SPARES: 1
TYPE (OPEN/COVERED): COVERED
LOCATION: BELOW ABSORBER TOWER
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 50 DIA X 37 HIGH
CAPACITY - GAL: 514,000
RETENTION TIME - MIN: 5
NUMBER OF AGITATORS: 4
AGITATOR CONFIGURATION: TOP ENTRY
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLURRY
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED):
LOCATION: LIME PREPARATION SYSTEM
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 55 DIA X 25 HIGH
CAPACITY - GAL: 409,000
RETENTION TIME - MIN:
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION:
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): WASH WATER
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: SPRAY WATER TO BOTTOM OF SIEVE TRAY
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 15 DIA X 16 HIGH

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CAPACITY - GAL: 18,500
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: INORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): FLY ASH SLURRY
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): _____
LOCATION: FLY ASH PREPARATION SYSTEM
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 24 DIA X 24 HIGH
CAPACITY - GAL: 74,500
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): _____
NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: _____
CAPACITY - GAL: _____
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____

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LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

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ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ALKALI FEED

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: ER-142

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 1025

MOTOR BRAKE HP: 50

SPEED - RPM: 1420

HEAD - FT: 81

SERVICE (PH, SOLIDS): 20% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): FLY ASH SLURRY FEED

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 4R-122

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 325

MOTOR BRAKE HP: 25

SPEED - RPM: 1450

HEAD - FT: 113

SERVICE (PH, SOLIDS): 20% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): VENTURI RECYCLE

NUMBER OF PUMPS: 8

NUMBER OF SPARES: 2

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GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 18R-416

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 13,360

MOTOR BRAKE HP: 500

SPEED - RPM: 430

HEAD - FT: 86

SERVICE (PH, SOLIDS): 15% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER RECYCLE

NUMBER OF PUMPS: 12

NUMBER OF SPARES: 3

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 18R-416

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 16,700

MOTOR BRAKE HP: 1200

SPEED - RPM: 460

HEAD - FT: 161

SERVICE (PH, SOLIDS): 15% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): WASH WATER

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 4FRB-141

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PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 1577
MOTOR BRAKE HP: 100
SPEED - RPM: 1400
HEAD - FT: 155
SERVICE (PH, SOLIDS): CLEAR WATER
CASING MATERIAL GENERIC TYPE: HIGH ALLOY
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: ALLOY 20
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): _____
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/9/81

MINNESOTA POWER & LIGHT
CLAY BOSWELL 4

COMMENTS/FOOTNOTES

- A EMERGENCY QUENCH WATER AVAILABLE FROM HEAD TANKS TO PROTECT ABSORBER LININGS IF PUMP FAILURE OCCURS.
- B THE SYSTEM IS DESIGNED TO OPERATE WITH REHEAT VIA BYPASS FROM THE HOT SIDE PRECIPITATOR OF 5% OF THE FLUE GAS OR WITH ALL FLUE GASES TREATED IN THE SCRUBBER SYSTEM. THE PLAN IS TO DISPENSE WITH REHEAT.
- C FOUR SLAKERS FOR LIME AND ONE FOR FLY ASH. LIME SLAKERS ARE NOT USED.
- D UNITS 1 AND 2 FLY ASH STORAGE INCLUDED. FLY ASH COLLECTED VIA BAGHOUSES ON UNITS 1 AND 2 (70 MW EACH) WILL BE USED FOR ALKALI IN FGD SYSTEM OR SENT TO UNIT 4 WASTE DISPOSAL POND.
- E WATER LOSSES TOTAL 515 GPM.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Minnesota Power & Light Clay Boswell 4	4/80	720		System				Initial startup/shakedown operations commenced (unit was shut down in mid-April to rectify minor mechanical problems)
	5/80	744		System				
	6/80	720		System				Startup/shakedown operations continued
	7/80	720	712	System	684			
	8/80	744	652	System	492			
	9/80	744	737	System	592			
	10/80	744	531	System	272			Startup/shakedown operation continued (outage time due to miscellaneous maintenance and an inspection)
	11/80	720	650	1		94		
				2		86		
				3		98		
				4		55		
				System	450	100	Module	General repairs and cleaning
	12/80	744	735	1		100		
				2		93		
				3		19	Module	Outage was due to general maintenance and repairs to the venturi liner
				4		97		
				System	621	100		

MINNKOTA POWER COOPERATIVE

MILTON R. YOUNG 2

SECTION 1

BACKGROUND

The Milton R. Young Power Station, owned and operated by Minnkota Power Cooperative and Square Butte Electric Cooperative, is located near Center, North Dakota. This mine-mouth plant, which has a total generating capacity of 690 MW (net), consists of two separate coal-fired units that fire a North Dakota lignite with an average sulfur content of 0.6%. Both units are equipped with ESP's for primary particulate matter control. However, construction of Milton R. Young 2, a 440-MW (gross) unit, commenced after the implementation of the 1971 Federal NSPS. In order to comply with this regulation, the utility was required to install an FGD system. A contract was awarded to Combustion Equipment Associates and Arthur D. Little to supply a lime/alkaline flyash system. Design and operating parameters for this full-scale FGD system were determined during an extensive pilot plant (5000 acfm) test program conducted by the owning/operating utility companies and the system supplier in conjunction with the Minnesota Power and Light Co. and Grand Forks Energy Research Center (now known as Grand Forks Energy Technology Center). The pilot plant program was structured to

test the feasibility of using alkaline flyash from lignite coals and different types of lignite. In September 1977, the wet lime/alkaline flyash FGD system at Milton R. Young 2 commenced operations.

SECTION 2

PROCESS DESCRIPTION

The Milton R. Young lime/alkaline flyash FGD system consists of two spray tower absorbers, each designed to treat approximately 60% of the total boiler flue gas flow.

The flue gas first passes through the ESP at 1,952,000 ACFM and 348°F, where primary particulate removal takes place. The ESP is designed to remove 99.8% of the inlet particulate matter. After it passes through the ESP, approximately 85% of the flue gas is routed to the FGD system and the remaining 15% is bypassed for reheat. The flue gas contacts the scrubbing slurry through a series of spray zones arranged vertically in the absorbers. After the scrubbed gases pass through the spray zone of the absorbers, they enter a chevron mist eliminator. A wash tray located beneath the mist eliminator dilutes any entrainment carried into the mist eliminator to prevent plugging and eventual restriction of gas flow. The wash tray operates off a separate recirculation loop and tank to insure a high-quality wash water low in suspended solids and dissolved salts. To prevent plugging, sprays irrigate the mist eliminators with a mixture of makeup water and clarified liquor from the tray loop.

The scrubbed gas stream is reheated by mixing it with the bypass flue gas stream. This raises the temperature of the

saturated scrubbed gas stream from 135° to 170°F. The gases are then discharged to the atmosphere through the 550 foot stack.

The spent scrubbing solution is discharged to a recycle tank at the bottom of the spray towers. Spent scrubbing slurry are bled from the recycle loop and are discharged to a thickener. The overflow is returned to the process to slurry the fly ash. Unlike most lime/alkaline flyash processes, this system is unique in that the flyash is collected first in the unit 1 and 2 ESP's and then slurried. The thickener underflow, which has a solids content of 30 to 50%, is piped to a vacuum thickener building, which houses two rotary-drum vacuum filters for additional dewatering. Filter cake with a solids content of approximately 60% is transported by conveyor to off-the-road trucks, which haul it to a surface mine fill for final disposal. Water recovered in the vacuum filters is also used for of flyash slurry preparation.

A flow diagram for the Milton R. Young 2 FGD system is shown on the next page.

Flow Diagram: Milton R. Young 2

-1057- Minnkota Power Cooperative
Milton R. Young 2

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

GENERAL PLANT INFORMATION

COMPANY NAME: MINNKOTA POWER COOPERATIVE
ASSOCIATED UTILITIES: SQUARE BUTTE ELECTRIC COOPERATIVE, MINNESOTA POWER &
LIGHT
PLANT NAME: MILTON R YOUNG
UNIT NUMBER: 2
PLANT ADDRESS: P.O. BOX 127
CITY: CENTER
COUNTY: OLIVER
STATE: NORTH DAKOTA
ZIP CODE: 58530
EPA REGION: 8
RIVER BASIN/LAKE REGION: MISSOURI
REGULATORY CLASSIFICATION: STATE STD EQUAL/LESS STRINGENT THAN NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: _____
NET PLANT GENERATING CAPACITY - MW: 690
GROSS UNIT GENERATING CAPACITY - MW: 440
NET UNIT GENERATING CAPACITY WITH FGD - MW: 402
NET UNIT GENERATING CAPACITY W/O FGD - MW: 409
EQUIVALENT SCRUBBED CAPACITY - MW: 374

UNIT DATA (ROTIFER AND STACK)

BOILER SUPPLIER: BABCOCK & WILCOX
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): CYCLONE
FURNACE FIRING METHOD:
WET BOTTOM/DRY BOTTOM: WET BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 5/77
DESIGN BOILER FLUE GAS FLOW - ACFM: 2,030,800
FLUE GAS TEMPERATURE - F: 350
FLUE GAS OXYGEN - %: 5-6
HEAT RATE - BTU/KWH: 10,500
DESIGN FIRING RATE - TPH: 375
EXCESS AIR - %: 22-28
CAPACITY FACTOR - %: 65
STACK HEIGHT - FT: 550
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: CARBON STEEL
FLUE MATERIAL SPECIFIC TYPE: LOW ALLOY
FLUE MATERIAL TRADE/COMMON NAME: COR-TEN
FLUE LINER MATERIAL GENERIC TYPE: NONE
FLUE LINER MATERIAL SPECIFIC TYPE: N/A
FLUE LINER MATERIAL TRADE/COMMON NAME: N/A
FLUE INNER DIAMETER - FT: 25
A STACK GAS INLET TEMPERATURE - F: 170
STACK GAS OUTLET VELOCITY - FT/SEC: 60-70

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): LIGNITE
NAME OF SUPPLIER: BAUKOL NOONAN, INC.
MINE NAME/AREA: CENTER - AREA B
MINE LOCATION - COUNTY: OLIVER
MINE LOCATION - STATE: NORTH DAKOTA
AVERAGE HEAT CONTENT - BTU/LB: 6500
RANGE HEAT CONTENT - BTU/LB: 6000-6800
AVERAGE ASH CONTENT - %: 8.9
RANGE ASH CONTENT - %: 7.2-14.3
AVERAGE MOISTURE CONTENT - %: 38
RANGE MOISTURE CONTENT - %: 30-45
AVERAGE SULFUR CONTENT - %: 0.6
RANGE SULFUR CONTENT - %: 0.4-0.8
AVERAGE CHLORIDE CONTENT - %: _____
RANGE CHLORIDE CONTENT - %: _____
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: DESIGN FOR BOILER (1973 TO 1974)

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: WHEELABRATOR-FRYE
INLET FLUE GAS CAPACITY - ACFM: 976,000
INLET FLUE GAS TEMPERATURE - F: 348
PRESSURE DROP - IN. H2O: 1.4
PARTICLE OUTLET LOAD - GR/SCF: 0.0162
PARTICLE REMOVAL EFFICIENCY - %: 99.8
FLUE GAS CONDITIONING TYPE: _____

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): ALKALINE FLY ASH/LIME BACKUP
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES
A-E FIRM: SANDERSON & PORTER
CONSTRUCTION FIRM: COMBUSTION EQUIPMENT ASSOCIATES
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.6
SO₂ DESIGN REMOVAL EFFICIENCY - %: 78
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

COMMERCIAL START-UP: 6/78
INITIAL START-UP: 9/77
CONSTRUCTION COMPLETION: 2/78
CONSTRUCTION INITIATION: 9/75
CONTRACT AWARDED: 4/75
LETTER OF INTENT SIGNED:
INITIATED BID REQUEST: 1/74
INITIATED PRELIMINARY DESIGN: 1/75

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: _____
DESIGN COAL HEAT CONTENT - BTU/LB: _____
DESIGN COAL ASH CONTENT - %: _____
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: _____
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
FGD SYSTEM TURNDOWN RATIO: 2:1
FGD SYSTEM TURNDOWN METHOD: _____
FGD SYSTEM PRESSURE DROP - IN. H₂O: 8.0
FGD SYSTEM OXIDATION - %: 100
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 12 (SUSPENDED, 18-22 TOTAL)
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR
HIGHER): SAME
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 92
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 2
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE
PERSONNEL/SHIFT): 5-1/2
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS
(MANHOURS/YEAR): 14,000-15,000 (THIS YEAR)
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): DEDICATED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: NONE
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): DEDICATED
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: MINIMUM OF 10% OF GAS NEEDED FOR REHEAT
TIME SCHEDULE FOR REDUCED BOILER LOAD: NONE - UPON DEMAND
TIME SCHEDULE FOR BOILER SHUTDOWNS: ANNUAL - 2 TO 3 WEEKS
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): SEE OTHER DATA SHEETS
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): SEE OTHER DATA SHEETS
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): SEE OTHER DATA SHEETS

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE
NUMBER OF SPARES:
TYPE:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

LOCATION:
SUPPLIER:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
INLET GAS FLOW - ACFM:
INLET GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):
LIQUID RECIRCULATION RATE - GPM:
I/G RATIO - GAL/1000 ACF:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 2
NUMBER OF SPARES: 1
B GENERIC TYPE: SPRAY TOWER
SPECIFIC TYPE: OPEN COUNTERCURRENT SPRAY
TRADE/COMMON NAME:
SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES
DIMENSIONS - FT: 40 DIA X 140
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 500
BOILER LOAD PER ABSORBER - %: 56
GAS/LIQUID CONTACT DEVICE TYPE: NONE
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS: 6
NOZZLE MATERIAL: SPRAYCO REFRAX
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 54,850
L/G RATIO - GAL/1000 ACF: 80
GAS-SIDE PRESSURE DROP - IN. H2O: 1.0
SUPERFICIAL GAS VELOCITY - FT/SEC: 9.1
ABSORBER TURNDOWN RATIO: 2:1
ABSORBER TURNDOWN METHOD:
INLET GAS FLOW RATE - ACFM: 847,000
INLET GAS TEMPERATURE - F: 335
INLET SO2 LEVEL - PPM: 1875 (MAXIMUM)

UTILITY EMISSION CONTROL SYSTEM DATA
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MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

INLET SO2 LEVEL - LB/MM BTU: 3.56 (DESIGN)
INLET PARTICLE LEVEL - GR/SCF: 0.0162
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 140
OUTLET SO2 LEVEL - PPM: 480 (MAXIMUM)
OUTLET SO2 LEVEL - LB/MM BTU: 0.7-1.1
OUTLET PARTICLE LEVEL - GR/SCF: 0.0002-0.0035
OUTLET PARTICLE LEVEL - LB/MM BTU: _____
SO2 REMOVAL EFFICIENCY - %: 85
PARTICLE REMOVAL EFFICIENCY - %: 55-85

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 2 (B) 2

NUMBER OF SPARES: _____

NUMBER PER MODULE: (A) 1 (B) 1

GENERIC TYPE: (A) KNOCK-OUT TRAY (B) IMPINGEMENT

SPECIFIC TYPE: (A) PERFORATED PLATE (B) BAFFLE

COMMON DESIGN: (B) CHEVRON VANE

MANUFACTURER: _____

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (B) Z-SHAPE

NUMBER OF STAGES: (A) 1 (B) 1

NUMBER OF PASSES/STAGE: (B) 5

FREEBOARD DISTANCE - FT: (A) 5.0 (B) 8.0

DISTANCE BETWEEN STAGES - IN.: N/A

DISTANCE BETWEEN VANES - IN.: _____

VANE ANGLES - DEGREES: (B) 120

PRESSURE DROP - IN. H2O: (A) 3.5 (B) 1.0

SUPERFICIAL GAS VELOCITY - FT/SEC: (A) 9.1 (B) 9.1

CONSTRUCTION MATERIAL GENERIC TYPE: (A) STAINLESS STEEL (B) ORGANIC

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) TYPE 316L (B) POLYPHENYLENE OXIDE

CONSTRUCTION MATERIAL TRADE/COMMON NAME: (A) N/A (B) NORYL®

WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): (A) SUPERNATANT
(B) BLENDED

POINT OF WATER COLLECTION: WASH TRAY

WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): UNDERSPRAY
(BOTH)

WASH FREQUENCY: CONTINUOUS (BOTH)

WASH DURATION: N/A

C WASH RATE - GAL/MIN: (A) 220 (B) 800

WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: 1

NUMBER OF SPARES: 0

NUMBER PER MODULE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): BYPASS
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): COLD SIDE
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): N/A
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: OUTLET DUCT
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 12
TEMPERATURE INCREASE - F: 30
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: _____
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 170
ENERGY REQUIREMENT - MM BTU/HR: N/A
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: _____

D MATERIAL GENERIC TYPE: CARBON STEEL LINED WITH ORGANIC
MATERIAL SPECIFIC TYPE: GLASS FLAKE/POLYESTER
MATERIAL TRADE/COMMON NAME: FLAKELINE 103

FANS

NUMBER OF FANS: (A) 2 (B) 2
NUMBER OF SPAKES: (A) 1 (B) _____
DESIGN (CENTRIFUGAL, AXIAL, ETC.): (A) AXIAL (B) AXIAL
SUPPLIER: (A) BUFFALO FORGE (B) TLT - BABCOCK
FUNCTION (UNIT/BOOSTER): (A) UNIT (B) BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
(BOTH)

SERVICE (WET/DRY): DRY (BOTH)
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND ABSORBER (BOTH)
FLUE GAS FLOW RATE - ACFM: (A) 1,100,000
FLUE GAS TEMPERATURE - F: (A) 350
PRESSURE DROP - IN. H₂O: (A) 10.6 (B) 28.8
MATERIAL GENERIC TYPE: CARBON STEEL (BOTH)
MATERIAL SPECIFIC TYPE: (A) AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET (B) OUTLET (C) INLET BYPASS (D) OUTLET BYPASS
NUMBER OF DAMPERS: _____
FUNCTION (CONTROL/SHUT-OFF): _____
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) GUILLotine (B) GUILLotine
(C) LOUVER (D) BUTTERFLY
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): _____
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): _____
MANUFACTURER: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

MODULATION (OPEN/CLOSED, ETC.): _____

SEAL AIR - ACFM: _____

SERVICE CONDITIONS (MAX GAS TEMP/TIME): _____

MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) TYPE 316L STAINLESS STEEL
(C) CARBON STEEL (D) TYPE 316L STAINLESS STEEL

MATERIAL SPECIFIC TYPE: _____

MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) BYPASS

CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____

DIMENSIONS (DIAMETER, LENGTH, ETC.): _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL (ALL)

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: N/A

D LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) NONE

LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) GLASS FLAKE/POLYESTER (C) N/A

LINER MATERIAL TRADE/COMMON NAME: (A) N/A (B) FLAKELINE 103 (C) N/A

EXPANSION JOINTS

LOCATION: (A) INLET SIDE (B) OUTLET SIDE

TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC (BOTH)

FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT (BOTH)

PRESSURE (NEGATIVE/POSITIVE): _____

OPERATING TEMPERATURE - F: _____

DESIGN CONFIGURATION (V-SHAPED, ETC.): _____

MANUFACTURER: _____

MATERIAL: (A) VITON®-ASBESTOS (B) CHLOROBUTYL RUBBER AND ASBESTOS

E REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING

PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER

DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____

MANUFACTURER: WALLACE & TIERNAN

MATERIALS: CARBON STEEL

NUMBER OF DEVICES: 1

NUMBER OF SPARES: 0

FULL LOAD DRY FEED CAPACITY - TPH: 4 (AT 1.5% S IN LIGNITE)

PRODUCT QUALITY - % SOLIDS: 13

FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____

PREPARED REAGENT POINT OF ADDITION: BASE OF SPRAY TOWER

ON-SITE STORAGE CAPABILITY - DAYS: _____

TANKS

*SEE ATTACHMENT A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) LIME SLURRY (B) OTHER (C) SMALL LINES
DIMENSIONS - IN.: (A) _____ (B) ≥ 3 (C) < 3
MANUFACTURER: _____
MATERIAL: (A) CARBON STEEL (B) RUBBER-LINED CARBON STEEL
(C) TYPE 316 STAINLESS STEEL

MAJOR VALVES

LOCATION: (A) SLURRY RECYCLE (B) OTHERS
FUNCTION (ISOLATION, CONTROL, ETC.): (A) CONTROL (B) ISOLATION
TYPE (BALL, GLOBE, PLUG, ETC.): (A) PINCH (B) PLUG
CONTROL MODE (AUTOMATIC/MANUAL): _____
DIMENSIONS - IN.: _____
MANUFACTURER: (A) R.K.L. (B) DEZURIK
MATERIAL: (A) RUBBER-LINED (B) RUBBER-LINED

THICKENERS

F NUMBER OF THICKENERS: 2
NUMBER OF SPARES: _____
CONFIGURATION: _____
DIMENSIONS - FT: 130 DIA X 15 HIGH
CAPACITY - GAL: 3,000,000
SHELL MATERIAL GENERIC TYPE: INORGANIC
SHELL MATERIAL SPECIFIC TYPE: CONCRETE
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: FIBERGLASS-REINFORCED RESIN
LINER MATERIAL TRADE/COMMON NAME: _____
RAKE MATERIAL: RUBBER-CLAD CARBON STEEL
FEED STREAM SOURCE: ABSORBER BLEED
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 12% SOLIDS
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 50-90%
SOLIDS
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OUTLET STREAM DISPOSITION: TO VACUUM FILTER
OVERFLOW STREAM DISPOSITION: TO FLY ASH SLURRY, VACUUM FILTER WASH, AND ME
WASH

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): VACUUM FILTER
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.): _____
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.): _____
NUMBER OF DEVICES: 2
NUMBER OF SPARES: _____
CONFIGURATION: _____

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DIMENSIONS - FT: _____

CAPACITY: 750 TPD

SHELL MATERIAL GENERIC TYPE: MILD STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: RUBBER

LINER MATERIAL TRADE/COMMON NAME: _____

BELT MATERIAL GENERIC TYPE: ORGANIC

BELT MATERIAL SPECIFIC TYPE: POLYPROPYLENE

BELT MATERIAL TRADE/COMMON NAME: _____

FEED STREAM SOURCE (ABSORBER BLEED,

THICKENER UNDERFLOW, ETC.): THICKENER AND CLARIFIER UNDERFLOW

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 30-50%
SOLIDS

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 40-60%
SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: TO LANDFILL

OVERFLOW STREAM DISPOSITION: TO THICKENER

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: 21

MOISTURE CONTENT - % TOTAL FREE WATER: 40

PERCENT CASO3 - DRY: 0

PERCENT CASO4 - DRY: _____

PERCENT CAO₂ - DRY: _____

PERCENT CACO₃ - DRY: _____

PERCENT ASH - DRY: _____

PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE

COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):

DEVICE (OXIDATION TANK, PUG MILL, ETC.):

PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):

INLET FLOW RATE - GPM:

INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): (A) INTERIM (B) FINAL

GENERIC TYPE (LANDFILL, POND, ETC.): (A) POND (B) LANDFILL

SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): (A) DIKED (B) ABANDONED MINE

COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): SURFACE MINE

LOCATION (ON-SITE/OFF-SITE): (A) ON-SITE (B) OFF-SITE

TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): (A) PIPELINE (B) TRUCK

SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): CLAY (BOTH)

SITE DIMENSIONS - AREA/DEPTH: _____

SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____

SITE SERVICE LIFE - YEARS: (A) 6 MONTHS

UTILITY EMISSION CONTROL SYSTEM DATA
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MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM:

CHEMICAL PARAMETERS (PH, ETC.): PH

PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): PERCENT SOLIDS

CONTROL LEVELS: PH 4.0-5.5 AT ABSORBER OUTLET, SOLIDS 5.5-12%

MONITOR TYPE (MANUFACTURER, ETC.):

MONITOR LOCATION:

PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): MANUAL

PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD):

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL):

TYPE (OPEN/CLOSED): CLOSED

EVAPORATION WATER LOSS - GPM: 550

SLUDGE HYDRATION WATER LOSS - GPM:

SLUDGE INTERSTITIAL WATER LOSS - GPM:

POND SEEPAGE/RUNOFF WATER LOSS - GPM:

EFFLUENT WATER LOSS - GPM:

RECEIVING WATER STREAM NAME:

MAKEUP WATER ADDITION - GPM: 700

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.):

MAKEUP WATER ADDITION POINTS & AMOUNTS:

MAKEUP WATER PRE-TREATMENT TYPE:

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT

NAME (LIMESTONE, ADIPIC ACID, ETC.): (A) FLY ASH (B) LIME

PRINCIPAL CONSTITUENTS: (A) 20-25% CaO, 5-9% MgO

SOURCE/SUPPLIER:

SUPPLIER LOCATION: (B) RAPID CITY, SOUTH DAKOTA

CONSUMPTION (SPECIFY UNITS): (A) 16 TPH

UTILIZATION - %: 83 (BASED ON TOTAL Ca)

POINT OF ADDITION: (A) SLURRY FEED TANK (B) SLAKER

ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 62,900,000

CAPITAL COST - \$/KW: 143

OPERATING COST - MILLS/KWH: 1.24

MAINTENANCE COST: \$318,000/YR

LABOR COST: \$564,000/YR

UTILITIES COST: \$1,250,000/YR

CHEMICALS COST: \$107,000/YR

WASTE DISPOSAL COST: \$33,200/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

ABSORBER - %: 100

MIST ELIMINATOR - %:

REHEATER - %:

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FAN - %: _____
BALL MILL - %: N/A
SLAKER - %: _____
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: _____
VACUUM FILTER - %: _____
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: 1.0
MIST ELIMINATOR: _____
REHEATER: _____
FAN: _____
BALL MILL: N/A
SLAKER: _____
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: _____
VACUUM FILTER: _____
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: _____
PARTICIPANTS: CEA, ADL, GFETC, MINNESOTA P&L, SQUARE BUTTE ELECTRIC COOP,
AND MINNKOTA POWER COOP
PROCESS: LIME/ALKALINE FLY ASH
PLANT DESIGN: _____
SUPPLIER: _____
SERVICE DATE: _____
PERIOD OF OPERATION - MONTHS: _____
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 1.6
STATUS (ACTIVE/TERMINATED): TERMINATED

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MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): REACTION/RECYCLE
NUMBER OF TANKS: 2
NUMBER OF SPARES: 1
TYPE (OPEN/COVERED): N/A
LOCATION: TANK IS LOWER PART OF ABSORBER TOWER
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 40 DIA X 36 HIGH
CAPACITY - GAL: 450,000
RETENTION TIME - MIN: 8
NUMBER OF AGITATORS: 2 (ONE PER TANK)
AGITATOR CONFIGURATION: VERTICAL
AGITATOR MATERIALS: TYPE 316L STAINLESS STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): FLY ASH SLURRY
FEED
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: NEXT TO FLY ASH SILO
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 23 DIA X 20 HIGH
CAPACITY - GAL: 56,000
RETENTION TIME - MIN:
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: VERTICAL
AGITATOR MATERIALS: CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLAKER
TRANSFER
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: INDOORS

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CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 5 DIA X 5 HIGH
CAPACITY - GAL: 600
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: VERTICAL
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): LIME SLURRY FEED
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: INDOORS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 23 DIA X 20 HIGH
CAPACITY - GAL: 5600
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: VERTICAL
AGITATOR MATERIALS: CARBON STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): THICKENER
OVERFLOW
NUMBER OF TANKS: 1
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): COVERED
LOCATION: INDOORS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 12 DIA X 16 HIGH
CAPACITY - GAL: 8000 (ORIGINAL)
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: NONE
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: CARBON STEEL

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MILTON R. YOUNG 2

SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD,
SCRUBBER RECYCLE, ETC.): CLARIFIER OVERFLOW/ME WASH
NUMBER OF TANKS: 1
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): COVERED
LOCATION: INDOORS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 13 DIA X 13 HIGH
CAPACITY - GAL: 11,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: NONE
AGITATOR CONFIGURATION: N/A
AGITATOR MATERIALS: N/A
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): TRAY RECYCLE
NUMBER OF TANKS: 2
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: INDOORS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 14 DIA X 12 HIGH
CAPACITY - GAL: 12,600
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 2 (ONE PER TANK)
AGITATOR CONFIGURATION: VERTICAL
AGITATOR MATERIALS: TYPE 316L STAINLESS STEEL
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE/POLYESTER
LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 103

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MILTON R. YOUNG 2

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 8

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT GEAR REDUCTION

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER: 20 X 20 GH

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 13,900

MOTOR BRAKE HP: 700

SPEED - RPM: 460

HEAD - FT: 118

SERVICE (PH, SOLIDS): PH 2-11, 12% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): TRAY RECIRCULATION

NUMBER OF PUMPS: 4

NUMBER OF SPARES: 2

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 10R 234

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 3868

MOTOR BRAKE HP: 200

SPEED - RPM: 850

HEAD - FT: 120

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): CLARIFIER UNDERFLOW

NUMBER OF PUMPS: 2

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NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): PNEUMATIC
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: DORR-OLIVER
PUMP MODEL NUMBER: 20DS
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): PNEUMATIC
CAPACITY - GPM: 15.2
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED,
ABSORBER RECIRCULATION, ETC.): TRAY SPRAY/CLARIFIER OVERFLOW
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 4FR 162
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 1109
MOTOR BRAKE HP: 150
SPEED - RPM: 1750
HEAD - FT: 224
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT
COMMON DESIGN (V-BELT, ETC.): _____

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MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 4R 122
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 445
MOTOR BRAKE HP: 25
SPEED - RPM: 1180
HEAD - FT: 24
SERVICE (PH, SOLIDS): 30-50% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER OVERFLOW
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 5R 142
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 1000
MOTOR BRAKE HP: 30
SPEED - RPM: 1000
HEAD - FT: 60
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLAKER
TRANSFER
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 4 X 3 X 6
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 158

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MOTOR BRAKE HP: 5
SPEED - RPM: 1750
HEAD - FT: 35
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY FEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT
COMMON DESIGN (V-BELT, ETC.):
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 13 X 2 X 6
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):
CAPACITY - GPM: 370
MOTOR BRAKE HP: 20
SPEED - RPM: 3540
HEAD - FT: 126
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
CASING MATERIAL SPECIFIC TYPE:
CASING MATERIAL TRADE/COMMON NAME:
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE:
IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): FLY ASH SLURRY FEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT
COMMON DESIGN (V-BELT, ETC.):
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: 5M 142
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):
CAPACITY - GPM: 12,500
MOTOR BRAKE HP: 30
SPEED - RPM: 1000
HEAD - FT: 45
SERVICE (PH, SOLIDS):
CASING MATERIAL GENERIC TYPE: HARD METAL ALLOY

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CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: HARD METAL ALLOY

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ME SPRAY

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 4FR 162

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 1597

MOTOR BRAKE HP: 125

SPEED - RPM: 1750

HEAD - FT: 191

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): FILTER BELT WASH

NUMBER OF PUMPS: 2

NUMBER OF SPARES: 1

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: WORTHINGTON

PUMP MODEL NUMBER: 2-1/2 R091

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 132

MOTOR BRAKE HP: 20

SPEED - RPM: 2189

HEAD - FT: 152

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): BLOW DOWN SUMP
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): BELT
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WARMAN
PUMP MODEL NUMBER: 8/6EAM
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 1500/1200
MOTOR BRAKE HP: _____
SPEED - RPM: 980/685
HEAD - FT: 155/73
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): FILTRATE
NUMBER OF PUMPS: 2
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): CENTRIFUGAL
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): DIRECT
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: DURCO
PUMP MODEL NUMBER: 4 X 3
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 335
MOTOR BRAKE HP: 15
SPEED - RPM: 1750
HEAD - FT: 60
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: HARD METAL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: DURIIRON
IMPELLER MATERIAL GENERIC TYPE: HARD METAL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: DURIIRON

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 9/11/81

MINNKOTA POWER COOPERATIVE
MILTON R. YOUNG 2

COMMENTS/FOOTNOTES

- A RANGES FROM 160 TO 350 F DEPENDING UPON THE AMOUNT OF FLUE GAS BYPASSED AROUND THE FGD SYSTEM. USUAL CASE IS 220 TO 230 F WITH ONE MODULE ON LINE.
- B PRIMARY SO₂ REMOVAL OCCURS IN THE SPRAY SECTION OF THE TOWER AND SECONDARY REMOVAL ON THE ME WASH TRAY.
- C MIST ELIMINATOR IS WASHED WITH 220 GPM OF FRESH WATER PLUS 160 GPM OF WASH-TRAY CLARIFIER OVERFLOW AT A PRESSURE OF 80 PSIG; SAME PRESSURE IS USED FOR WASH TRAY.
- D THE OUTLET DUCT HAS A TYPE 316L STAINLESS STEEL REHEAT BUSTLE.
- E SUPPLEMENTAL EQUIPMENT; PRIMARY EQUIPMENT IS FLY ASH SLURRY TANK.
- F ONE IS CLARIFIER FOR WASH TRAY. THICKENER IS NO LONGER BEING USED. CLARIFIER FOR WASH TRAY IS STILL EMPLOYED. DATA IS FOR THICKENER.

SECTION 4

PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Minnkota Power Cooperative Milton R. Young 2	9/77	720		System				Initial startup-shakedown operations commenced
	10/77	744		System				
	11/77	720		System			Piping	Winter weather related problems (frozen and ruptured lines); heat tracing in the liquid circuit was installed by the utility
							Flow meter	Rotameters malfunctioned
							Dampers	Utility encountered problems with the guillotine gas damper guides during October and November
	12/77	744		System				Unit shut down due to turbine bearing repairs (during outage installation of electrical heat tracing on slurry lines and water piping continued)
	1/78	744		System				Turbine repairs continued
	2/78	672		System			Booster fan	FGD booster fan taken off line due to oil leak and shaft alignment problems
							Vacuum filter	Vacuum filter malfunctioned, allowing larger size particles to escape the filter. This caused the rubber lining downstream to peel which, in turn, created a plugging problem
	3/78	744		System				
	4/78	720		System			Booster fan	The damaged booster fan was reinstalled. Affected module was down from February 23 through April 10 (384 hours)
	5/78	744		System				

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Milton R. Young 2 (continued) Commercial start-up	6/78	720		System			Damper	24 hour outage due to underdesigned chains which open and close guillotine dampers
	7/78	744		System				
	8/78	744		System				Performance figures have not been available due to intermittent operation
	9/78	720		System				
	10/78	744		System			Thickener	Polyethylene liner was accidentally pierced while repairs were being made to some other components. Utility reported that operation of the boiler and FGD system continued on an intermittent basis
	11/78	720		System			Thickener	Thickener problems continued. Rubber liner peeled off the thickener cone and had to be drained for repairs
							Booster fan	Corrosion and moisture related problems (there is no damper between the module and fan and wet gas had been getting back into the fan during certain operating condition;)
	12/78	744	673	A B System	225	5 38 42	Thickener	B-Tower was shut down due to plugging in the thickener underflow by rubber lining (thickener was pumped out and repaired)
	1/79	744	673	A		5	Damper and booster fan	A-Tower was out of service for most of January to repair broken inlet isolation damper chains and booster fan servo mechanism
				B		38	Booster fan	B-Tower was out of service from December 27 through January 31 (864 hours) due to fan motor failure

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Milton R. Young 2 (continued)				System	225	43	FGD system	Winter weather related problems (freeze-ups)
				Absorber				Holes in absorbers due to erroson
	2/79	672	491	A		19		
				B		32		
				System	346	51		
	3/79	744	543	A		19	Booster fan	Booster fan motor fire occurred
				B		32	Absorber	Holes repaired
				System	383	51	Thickener	48 hour outage to remove loose rubber from thickener piping
							System	Cold weather inhibited scrubber startups after repairs had been conducted
	4/79	720	668	A		3		
				B		57		
				System	432	60		
	5/79	744	690	A		3	Fan	Fan alignment problems (utility thought it might be related to the fan foundation)
							Absorber	Holes repaired
				B		57		
				System		60	Valves	Repaired
							Thickener	Drive gear repaired
	6/79	720	720	A		17	Lining	A tower down for flake lining repairs
							Header	Tray recycle distribution header cleaned
							Absorber bleed line	Plugged due to water balance problems
							Absorber/agitator gears	Failed due to overloaded A-side absorber clarifier
				B		36		
				System	380	53	FGD system	System forced out of service when boiler related problems caused slag to carry-over into the FGD equipment resulting in plugging of several lines and stopping the thickener rake

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Milton R. Young 2 (continued)	7/79	744	744	A B System	331	45 0 45	Valves Mist eliminators, thickener and absorber feed lines Booster fan Vacuum filter and seal water pump Absorber agitator	Tray recycle control valve and absorber valve failed Plugging problems Tripped Malfunction problems Replaced
	8/79	744	744	A B System	293	29 11 40	Booster fan Thickener Flyash tank and lime slurry feed line Tower Lime supply	Vibration and high bearing temperature problems B-side thickener rake became buried and had to be dug out Plugging caused some B-side outage time Holes in tower repaired Lack of lime caused some system outage
	9/79	720	717	A B System	163	21 1 22	Thickener and clarifier Booster fan Thickener and clarifier	Heavy solids problem Vibration problems continued Heavy solids problem
	10/79	744	743	A B System	233	0 31 31	Clarifier Clarifier Thickener	Cleaned Agitator drive gear failed Bleed line plugged and gear housing failed
	11/79	720	661	A B System	115	1 15 16	Thickener and clarifier	Excess solids caused plugging problems

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Milton R. Young 2 (continued)	12/79	744	628	A B System	270	27 10 37	Block valve Booster fan Seal water system Thickener	Hole in valve had to be repaired Vibration problems Plugging Gear housing failed on the thickener lift
	1/80	744	504	A B System	53	7 0 7	Booster fan and slurry lines Thickener	Cold weather related problems (equipment iced up) Worn gear replaced (cleaning of thickener and mechanical repairs were hampered due to cold weather)
	2/80	696	696	System	0	0	Booster fan Spray recycle pumps Agitator Damper	Cold weather related problems (ice had to be melted off) Shaft sleeves on several spray recycle pumps were replaced Gear reducer failed on the B-side absorber agitator Isolation damper chains failed
	3/80	744	743	A B System	214	23 6 29	Absorber Damper Absorber bleed lines and thickener Spray recycle pumps	A-side absorber agitator anchor bolts failed Torque switches replaced Plugging problems due to coarse particles continued Sleeves replaced (sleeves were not holding the pump gland packing)
	4/80	720	154	A B System	0	100 0 100	Pumps	Unit down 504 hours for annual inspection Repairs to pump sleeves caused FGD system to remain off line during the time the boiler operated

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Milton R. Young 2 (continued)	5/80	744	700	A		0		Module B was operated while repairs were conducted on Module A
							Recycle header	Repaired
							Recycle nozzle piping	Repaired
	6/80	720	701				Valves	Spray recycle pump and the discharge spray cycle pump valves repaired
							Absorber	Lining repaired and agitator tunnel cleared
							Thickener and clarifier	Drained and cleaned
	7/80	744	600	B		47		
				System	339	47		
				A		0	Thickener	Module A repairs continued
	8/80	744	739	B		42		High solids caused problems with rake mechanism and the limit switch
							Lining	Repaired
				System	283	42	Vacuum filter	Malfunctioned
				A		0		
				B		65		
				System	387	65	Thickener and under-flow pumps	High solids buildup due to the addition of flyash with lime in the absorber tower (utility switches back to straight lime when this occurs)
							Vacuum filter pumps	Both pumps have run poorly (one is being rebuilt)
							Absorber tower	Leak repaired
							Recycle pump	Motor and discharge valve on the tray recycle pump malfunctioned
				A		91		
				B		57		
				System	729	99	Recycle pumps	Teflon packing repaired
							Miscellaneous equipment	General maintenance work on the vacuum filter drum, spray nozzles, the absorber agitator, the clarifier cone, and the thickener rake mechanism

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Milton R. Young 2 (continued)	9/80	720	664	A B System	650	70 67 100		
	10/80	744	664	A B System	744	90 18 100	Absorber	Tower leakage
	11/80	720	690	A B System	720	42 99 100	Absorber	Tower leakage
	12/80	744	716	A B System	450	42 30 72	Thickener	Availability was low due to down time necessary to convert from a thickener to sludge ponds
							Absorber Isolation damper	Control of overflow level Malfunctioned

MONONGAHELA POWER

PLEASANTS 1, 2

SECTION 1

BACKGROUND

The Pleasants Power Station, located in Willow Island, West Virginia, is operated by Monongahela Power Company, which is part of the Allegheny Power System. The station consists of two identical coal-fired units. The units have gross generating capacities of 628 and 618 MW, respectively, and fire a bituminous coal with an average sulfur content of 3.0%.

During the design phase, the utility was faced with regulations regarding flue gas emissions. The 1971 Federal NSPS limited SO₂ emissions to 1.2 pounds per million Btu. The State of West Virginia also required particulate matter emissions to be limited to 0.05 pounds per million Btu. In order to comply with the SO₂ regulation it was determined that an FGD system would be needed. In September 1975, the utility contracted with Babcock and Wilcox to design and supply a lime FGD system for both Pleasants 1 and 2. Air Correction Division, UOP was awarded the contract to supply an ESP to provide particulate matter control. Dravo was awarded the contract to supply the mag-modified lime and to provide sludge stabilization.

Pleasants 1 and 2 commenced initial operations in December 1978 and October 1980, respectively.

SECTION 2

PROCESS DESCRIPTION

The magnesium-promoted wet lime FGD systems installed on Pleasants 1 and 2 are identical in design. Each system consists of a cold side ESP followed by four tray tower absorber modules. Each module was designed to handle a maximum flue gas flow rate of 600,000 acfm at 270°F. Two bypass ducts off the plenum allow for approximately 16% (at full load) of the gas to be bypassed around the modules and used to reheat the scrubbed portion of the gas before it enters the stack. The bypass ducts allow the scrubbing system to be totally bypassed if necessary.

Following the ESP, the gas enters the venturi quencher section of the absorber module and passes through a stage of sprays. The gas flow then continues through the sump, turns 90 degrees in an upward direction, and proceeds through a single stage sieve tray. Slurry is pumped at approximately 16,000 gpm to the absorber through spray nozzles, where it cascades through the tray counter to the flue gas flow. Excess slurry and reaction by-products are collected below in the sump. The flue gas then passes through a two stage chevron mist eliminator and is combined with the bypass gas before exiting to a 1000-foot stack.

The sludge disposal system, designed by Dravo, uses a Calcilox additive to stabilize the sludge. The sludge from this open loop system is disposed of in an off-site unlined pond.

A flow diagram for the Pleasants 1, 2 FGD systems is shown on the next page.

Flow Diagram: Pleasants 1 or 2

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

GENERAL PLANT INFORMATION

COMPANY NAME: MONONGAHELA POWER

ASSOCIATED UTILITIES:

PLANT NAME: PLEASANTS

UNIT NUMBER: 1

PLANT ADDRESS: P.O. BOX 9

CITY: WILLOW ISLAND

COUNTY: PLEASANTS

STATE: WEST VIRGINIA

ZIP CODE: 26190

EPA REGION: 3

RIVER BASIN/LAKE REGION: OHIO

A REGULATORY CLASSIFICATION: NSPS (12/71)

PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.05

SO2 EMISSION LIMITATION - LB/MM BTU: 1.2

NOX EMISSION LIMITATION - LB/MM BTU: 0.7

NET PLANT GENERATING CAPACITY - MW: 1250

GROSS UNIT GENERATING CAPACITY - MW: 626

NET UNIT GENERATING CAPACITY WITH FGD - MW: 580

NET UNIT GENERATING CAPACITY W/O FGD - MW: 595

EQUIVALENT SCRUBBED CAPACITY - MW: 626

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: FOSTER WHEELER

FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL

FURNACE FIRING METHOD: TANGENTIAL

WET BOTTOM/DRY BOTTOM: DRY BOTTOM

FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED

SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE

COMMERCIAL SERVICE DATE: 3/79

DESIGN BOILER FLUE GAS FLOW - ACFM: 2,400,000

FLUE GAS TEMPERATURE - F: 270

FLUE GAS OXYGEN - %: 6

HEAT RATE - BTU/KWH: 10,100

DESIGN FIRING RATE - TPH: 262

EXCESS AIR - %: 20 (PLUS 7% LEAKAGE)

CAPACITY FACTOR - %: 60

STACK HEIGHT - FT: 1000

SHELL MATERIAL: CONCRETE

B FLUE MATERIAL GENERIC TYPE: CARBON STEEL

FLUE MATERIAL SPECIFIC TYPE:

FLUE MATERIAL TRADE/COMMON NAME:

FLUE LINER MATERIAL GENERIC TYPE: ORGANIC

FLUE LINER MATERIAL SPECIFIC TYPE: INERT FLAKE/VINYL ESTER

FLUE LINER MATERIAL TRADE/COMMON NAME: PLASITE 4005

FLUE INNER DIAMETER - FT: 20

STACK GAS INLET TEMPERATURE - F: 125-160 (AVERAGE 150)

STACK GAS OUTLET VELOCITY - FT/SEC: 110

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: _____
MINE NAME/AREA: _____
MINE LOCATION - COUNTY: _____
MINE LOCATION - STATE: WEST VIRGINIA
AVERAGE HEAT CONTENT - BTU/LB: 12,500
RANGE HEAT CONTENT - BTU/LB: 11,000-13,300
AVERAGE ASH CONTENT - %: _____
RANGE ASH CONTENT - %: 14.7-16.0
AVERAGE MOISTURE CONTENT - %: 4.5
RANGE MOISTURE CONTENT - %: 3.0-5.0
AVERAGE SULFUR CONTENT - %: 3.0
RANGE SULFUR CONTENT - %: 2.5-3.5
AVERAGE CHLORIDE CONTENT - %: 0.05
RANGE CHLORIDE CONTENT - %: _____
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES: _____
TYPE _____
SUPPLIER: _____
INLET FLUE GAS CAPACITY - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: _____
PRESSURE DROP - IN. H2O: _____
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: _____

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: AIR CORRECTION DIVISION, UOP
INLET FLUE GAS CAPACITY - ACFM: 2,443,000
INLET FLUE GAS TEMPERATURE - F: 270
PRESSURE DROP - IN. H2O: _____
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: 99.5
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME (THIOSORBIC®)
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: BABCOCK & WILCOX
A-E FIRM: UNITED ENGINEERS & CONSTRUCTORS
CONSTRUCTION FIRM: UNITED ENGINEERS & CONSTRUCTORS
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.55
SO₂ DESIGN REMOVAL EFFICIENCY - %: 90
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

COMMERCIAL START-UP: 12/80
INITIAL START-UP: 12/78
CONSTRUCTION COMPLETION: _____
CONSTRUCTION INITIATION: _____
CONTRACT AWARDED: 9/75
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST: _____
INITIATED PRELIMINARY DESIGN: _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.5
DESIGN COAL HEAT CONTENT - BTU/LB: 12,400
DESIGN COAL ASH CONTENT - %: 16.0
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: 0.05
C FGD SYSTEM SPACE REQUIREMENTS - SQ FT: 218,000
FGD SYSTEM TURNDOWN RATIO: 13:1
FGD SYSTEM TURNDOWN METHOD: TRAINS TAKEN OFF LINE MANUALLY
FGD SYSTEM PRESSURE DROP - IN. H₂O: 10-11
FGD SYSTEM OXIDATION - %: 20
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 4-8 (AVERAGE 6)
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 208 (BOTH UNITS)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 5 (BOTH UNITS)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE PERSONNEL/SHIFT): 10 (BOTH UNITS)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): _____
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): SHARED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL ROTATION TO FGD SYSTEM: NONE
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): SHARED
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: REHEAT ONLY (15% BYPASS)
TIME SCHEDULE FOR REDUCED BOILER LOAD: 1/2 LOAD AT NIGHT
TIME SCHEDULE FOR BOILER SHUTDOWNS: 1/YR; 3 TO 4 WEEKS
PLANNED MAINTENANCE DURING REDUCED BOILER LOAD (TYPE AND FREQUENCY): SEE OTHER DATA SHEETS
PLANNED MAINTENANCE DURING BOILER SHUTDOWNS (TYPE AND FREQUENCY): SEE OTHER DATA SHEETS
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE): SEE OTHER DATA SHEETS

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: 4
NUMBER OF SPARES: _____
TYPE: VENTURI

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

LOCATION: INLET TO ABSORBER
SUPPLIER: BABCOCK & WILCOX
D SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC UNDER INORGANIC
LINER MATERIAL SPECIFIC TYPE: EPOXY PHENOLIC AND HYDRAULICALLY BONDED
CONCRETE
LINER MATERIAL TRADE/COMMON NAME: PLASITE 7122H AND KAOCRETE HS
INLET GAS FLOW - ACFM: 600,000
INLET GAS TEMPERATURE - F: 270
PRESSURE DROP - IN. H2O: 4.5
LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER,
ABSORBER SLURRY, ETC.): ABSORBER SLURRY
LIQUID RECIRCULATION RATE - GPM: 8000
L/G RATIO - GAL/1000 ACF: 15 (MINIMUM)
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: CERAMIC INSERTS
NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 4
NUMBER OF SPARES:
GENERIC TYPE: TRAY TOWER
SPECIFIC TYPE: SIEVE TRAY
TRADE/COMMON NAME: B & W SIEVE TRAY DESIGN
SUPPLIER: BABCOCK & WILCOX
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1100
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
E LINER MATERIAL SPECIFIC TYPE: NATURAL RUBBER
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER ABSORBER - %: 25
GAS/LIQUID CONTACT DEVICE TYPE: PERFORATED TRAYS
NUMBER OF GAS CONTACTING ZONES: 1
DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM: 16,000
L/G RATIO - GAL/1000 ACF: 30 (MINIMUM)
GAS-SIDE PRESSURE DROP - IN. H2O: 5.0
SUPERFICIAL GAS VELOCITY - FT/SEC: >10
ABSORBER TURNDOWN RATIO: 3.3:1
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F: 125

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

INLET SO2 LEVEL - PPM: 2000
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: 0.05
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 125
OUTLET SO2 LEVEL - PPM: _____
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.05
SO2 REMOVAL EFFICIENCY - %: 90 (FOR SCRUBBED GAS)
PARTICLE REMOVAL EFFICIENCY - %: NONE

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE: IMPINGEMENT
SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CHEVRON VANE
MANUFACTURER: BABCOCK & WILCOX
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): Z-SHAPE
NUMBER OF STAGES: 2
NUMBER OF PASSES/STAGE: 3
FREEBOARD DISTANCE - FT: _____
DISTANCE BETWEEN STAGES - IN.: 84
DISTANCE BETWEEN VANES - IN.: _____
VANE ANGLES - DEGREES: _____
PRESSURE DROP - IN. H2O: _____
SUPERFICIAL GAS VELOCITY - FT/SEC: 10 (MAX)
CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC
CONSTRUCTION MATERIAL SPECIFIC TYPE: REINFORCED POLYESTER RESIN
CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): THICKENER OVERFLOW/MAKEUP
POINT OF WATER COLLECTION: _____
WASH DIRECTION (OVERSPRAY/UNDERSPRAY, _____
FRONTSpray/BACKSPRAY): (A) BELOW FIRST STAGE (B) ABOVE FIRST STAGE
WASH FREQUENCY: (A) CONTINUOUSLY (B) ONCE EVERY 2 HOURS
WASH DURATION: (A) CONTINUOUSLY (B) ONE MINUTE
WASH RATE - GAL/MIN: (A) 200 (B) 1800
WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: _____
NUMBER OF SPARES: _____
NUMBER PER MODULE: _____
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): BYPASS

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MONONGAHELA POWER
PLEASANTS 1

SPECIFIC TYPE (STEAM, HOT WATER, ETC.): N/A
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): N/A
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: AHEAD OF STACK
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NORMALLY 10-20 (DEPENDS ON SCRUBBING REQUIREMENTS)

TEMPERATURE INCREASE - F: 0-35
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 125
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 125-160
ENERGY REQUIREMENT - MM BTU/HR: NONE
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: N/A
MATERIAL GENERIC TYPE: _____
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: (A) 2 (B) 4
NUMBER OF SPARES: _____
DESIGN (CENTRIFUGAL, AXIAL, ETC.): (A) _____ (B) CENTRIFUGAL
SUPPLIER: (A) AMERICAN STANDARD (B) AMERICAN STANDARD
FUNCTION (UNIT/BOOSTER): (A) UNIT (B) BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: (A) AHEAD OF SCRUBBERS
(B) AHEAD OF EACH TRAIN
FLUE GAS FLOW RATE - ACFM: (A) 1,045,000 (B) 566,000
FLUE GAS TEMPERATURE - F: (A) 270 (B) 270
PRESSURE DROP - IN. H2O: (A) 25 (B) 26
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET TO SCRUBBER (B) OUTLET FROM SCRUBBER
NUMBER OF DAMPERS: 2 PER TRAIN
FUNCTION (CONTROL/SHUT-OFF): SHUT-OFF (BOTH)
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER (BOTH)
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): PARALLEL
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): DOUBLE LOUVER (BOTH)
MANUFACTURER: FOURNEY
MODULATION (OPEN/CLOSED, ETC.): _____

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 1

SEAL AIR - ACFM:

SERVICE CONDITIONS (MAX GAS TEMP/TIME): (A) 270 F (B) 125 F
MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) STAINLESS STEEL
MATERIAL SPECIFIC TYPE: (A) _____ (B) TYPE 317L
MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) OUTLET AFTER BYPASS JUNCTION
(D) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
F SHELL MATERIAL GENERIC TYPE: CARBON STEEL (ALL)
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC AND INORGANIC
(C) INORGANIC (C) NONE
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) GUNITE (C) REFRACTORY (D) N/A
LINER MATERIAL TRADE/COMMON NAME: (A) N/A
(B) PLASITE AND PENNWALT SDX GUNITE
(C) _____ (D) N/A

EXPANSION JOINTS

LOCATION: (A) SCRUBBERS (B) BYPASS
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: _____
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: (A) RAYBESTOS-MANHATTAN (B) GARLOCK
G MATERIAL: VITON®

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: DORR-OLIVER
MATERIALS: _____
NUMBER OF DEVICES: 3
NUMBER OF SPARES: 1
FULL LOAD DRY FEED CAPACITY - TPH: _____
PRODUCT QUALITY - % SOLIDS: 12-15
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: REACTION TANK
ON-SITE STORAGE CAPABILITY - DAYS: 25

TANKS

*SEE ATTACHMENT A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) ABSORBER (B) LIME SLURRY AND WASTE DISPOSAL
(C) SPRAY HEADERS (D) SLUDGE TRANSFER

DIMENSIONS - IN.: (D) 48

MANUFACTURER:

MATERIAL: (A) RUBBER-LINED CARBON STEEL (B) CARBON STEEL
(C) TYPE 316L STAINLESS STEEL

MAJOR VALVES

LOCATION: (A) ABSORBER SLURRY (B) ABSORBER SLURRY (C) OTHER SLURRY VALVES
FUNCTION (ISOLATION, CONTROL, ETC.): (A) ISOLATION (B) CONTROL (C) _____
TYPE (BALL, GLOBE, PLUG, ETC.): (A) BUTTERFLY (B) DIAPHRAGM
(C) ECCENTRIC PLUG-TYPE

CONTROL MODE (AUTOMATIC/MANUAL): _____

DIMENSIONS - IN.: _____

MANUFACTURER: (A) DAMPCO (B) BURRELL (C) DEZURIK

MATERIAL: (A) RUBBER-LINED (B) _____ (C) RUBBER-LINED

THICKENERS

NUMBER OF THICKENERS: 2

NUMBER OF SPARES: 0

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 175 DIA X 10 DEEP

CAPACITY - GAL: 2,190,000

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: COAL TAR EPOXY

LINER MATERIAL TRADE/COMMON NAME: _____

RAKE MATERIAL: RUBBER CLAD CARBON STEEL

FEED STREAM SOURCE: ABSORBER BLEED

FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE,
PERCENT SOLIDS): 4-8% SOLIDS (NORMALLY 6%)

OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE,
PERCENT SOLIDS): 30% SOLIDS

OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____

OUTLET STREAM DISPOSITION: TO SLUDGE TREATMENT

OVERFLOW STREAM DISPOSITION: RECIRCULATION TANK

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE

DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):

DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):

NUMBER OF DEVICES:

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 1

NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAO2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: CALCILOX TREATMENT
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): THICKENER UNDERFLOW
DEVICE (OXIDATION TANK, PUG MILL, ETC.): MIX TANK
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): DRAVO
INLET FLOW RATE - GPM: _____
INLET QUALITY - % SOLIDS: 30

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DAM
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): DIKED VALLEY
LOCATION (ON-SITE/OFF-SITE): OFF-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE
SITE DIMENSIONS - AREA/DEPTH: 200 ACRES X 200 FT
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 31 (PLANT LIFE)

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: OUTLET FROM ABSORBER

CHEMICAL PARAMETERS (PH, ETC.): PH, SO₂

PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): DENSITY, FLOW

CONTROL LEVELS: PH 6.0

MONITOR TYPE (MANUFACTURER, ETC.): UNILOC FLOW THROUGH TYPE FOR PH, LEAR
SIEGLER AND DUPONT FOR SO₂, TEXAS
NUCLEAR FOR DENSITY, AND LEAR SIEGLER
FM 10 FOR FLOW

MONITOR LOCATION: ABSORBER DOWNCOMER FOR PH

PROCESS CONTROL MANNER (AUTOMATIC/MANUAL):

PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD):

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL):

TYPE (OPEN/CLOSED): OPEN

EVAPORATION WATER LOSS - GPM:

SLUDGE HYDRATION WATER LOSS - GPM:

SLUDGE INTERSTITIAL WATER LOSS - GPM:

POND SEEPAGE/RUNOFF WATER LOSS - GPM:

EFFLUENT WATER LOSS - GPM:

RECEIVING WATER STREAM NAME: OHIO RIVER

MAKEUP WATER ADDITION - GPM:

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): RIVER WATER AND COOLING TOWER
BLOWDOWN

MAKEUP WATER ADDITION POINTS & AMOUNTS:

MAKEUP WATER PRE-TREATMENT TYPE:

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): (A) ABSORBENT
(B) SLUDGE FIXATION

NAME (LIMESTONE, ADIPIC ACID, ETC.): (A) THIOSORBIC® LIME (B) CALCILOX

PRINCIPAL CONSTITUENTS: (A) >90% CaO, 4-7% MgO

SOURCE/SUPPLIER: DRAVO

SUPPLIER LOCATION: (A) MAYSVILLE, KY

CONSUMPTION (SPECIFY UNITS): (A) 11.1 TPH (FOR BOTH UNITS AT FULL LOAD)
(B) 1.7 TPH (FOR BOTH UNITS AT FULL LOAD)

UTILIZATION - %: (A) 94

POINT OF ADDITION: (A) SLAKER (B) MIXING TANK

H ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 113,000,000

CAPITAL COST - \$/KW: 181

OPERATING COST - MILLS/KWH:

MAINTENANCE COST: \$709,000/YR

LABOR COST:

UTILITIES COST:

CHEMICALS COST: \$3,042,000/YR

WASTE DISPOSAL COST: \$8,000/YR

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 1

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A
ABSORBER - %: _____
MIST ELIMINATOR - %: _____
REHEATER - %: N/A
FAN - %: _____
BALL MILL - %: N/A
SLAKER - %: _____
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: _____
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: _____
MIST ELIMINATOR: _____
REHEATER: N/A
FAN: _____
BALL MILL: N/A
SLAKER: _____
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: _____
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: TRAY TOWER D
PARTICIPANTS: ALLEGHENY POWER SYSTEMS, BABCOCK & WILCOX
PROCESS: LIME
PLANT DESIGN: TRAY TOWER
SUPPLIER: BABCOCK & WILCOX
SERVICE DATE: 1974
PERIOD OF OPERATION - MONTHS: 12
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 1.6
STATUS (ACTIVE/TERMINATED): TERMINATED

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 1

ATTACHMENT A.

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECIRCULATION

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 40 DIA X 24 HIGH

CAPACITY - GAL: 225,600

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: RUBBER CLAD ALLOY

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: NATURAL RUBBER

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ME WASH

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: _____

DIMENSIONS - FT: _____

CAPACITY - GAL: _____

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: NATURAL RUBBER

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY TRANSFER

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 22 DIA X 17 HIGH

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 1

CAPACITY - GAL: 37,000

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY FEED

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 30 DIA X 24 HIGH

CAPACITY - GAL: 127,000

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: _____

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): THICKENER
OVERFLOW

NUMBER OF TANKS: 2

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: _____

DIMENSIONS - FT: 65 X 14 H

CAPACITY - GAL: 347,000

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

LINER MATERIAL GENERIC TYPE: COAL TAR EPOXY
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLUDGE
STABILIZATION

NUMBER OF TANKS: 2

NUMBER OF SPARES: 1

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: _____

DIMENSIONS - FT: _____

CAPACITY - GAL: _____

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: _____

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED,
ABSORBER RECIRCULATION, ETC.): QUENCHER SLURRY RECYCLE

NUMBER OF PUMPS: 8

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 8100

MOTOR BRAKE HP: 450

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED,
ABSORBER RECIRCULATION, ETC.): ABSORBER SLURRY RECYCLE

NUMBER OF PUMPS: 16

NUMBER OF SPARES: 4

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 8000

MOTOR BRAKE HP: 450

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW

NUMBER OF PUMPS:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 1

NUMBER OF SPARES:

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: DENVER

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 600

MOTOR BRAKE HP:

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY
TRANSFER

NUMBER OF PUMPS: 2

NUMBER OF SPARES:

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: DENVER

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 925

MOTOR BRAKE HP:

SPEED - RPM: VARIABLE

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY FEED

NUMBER OF PUMPS:

NUMBER OF SPARES:

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 1

MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 1500
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE TRANSFER
NUMBER OF PUMPS: 4
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WARMAN
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: ALLOY
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: ALLOY
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): RETURN WATER
NUMBER OF PUMPS: 3
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: JOHNSTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____

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MONONGAHELA POWER
PLEASANTS 1

MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

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MONONGAHELA POWER
PLEASANTS 1

COMMENTS/FOOTNOTES

- A UTILITY CAN BYPASS AS MUCH AS 30% AND STILL BE IN COMPLIANCE.
- B TOP SECTION AND RAIN HOOD ARE STAINLESS STEEL.
- C REQUIRED AREA (FOR UNITS 1 AND 2) IS 2 ACRES FOR FGD SYSTEM, 6 ACRES FOR SLUDGE TREATMENT, 2 ACRES FOR LIME HANDLING, AND 200 ACRES FOR SLUDGE DISPOSAL EXCLUDING FLY ASH.
- D TYPE 316L STAINLESS STEEL FOR THE EXPOSED WETTED PARTS AT THE INLET.
- E ONE MODULE (MODULE A) ON UNIT 1 IS LINED WITH CHLOROBUTYL.
- F SHORT SECTION OF TYPE 316L STAINLESS STEEL ON INLET DUCT AHEAD OF QUENCHER.
- G ALL EXPANSION JOINTS WILL BE CHANGED TO VITON®/FABRIC WITH INCONEL 625 FLANGES.
- H PRIMARILY UNIT 1 COSTS FOR 1980.

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

GENERAL PLANT INFORMATION

COMPANY NAME: MONONGAHELA POWER

ASSOCIATED UTILITIES: _____

PLANT NAME: PLEASANTS

UNIT NUMBER: 2

PLANT ADDRESS: P.O. BOX 9

CITY: WILLOW ISLAND

COUNTY: PLEASANTS

STATE: WEST VIRGINIA

ZIP CODE: 26190

EPA REGION: 3

RIVER BASIN/LAKE REGION: OHIO

A REGULATORY CLASSIFICATION: NSPS (12/71)

PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.05

SO2 EMISSION LIMITATION - LB/MM BTU: 1.2

NOX EMISSION LIMITATION - LB/MM BTU: 0.7

NET PLANT GENERATING CAPACITY - MW: _____

GROSS UNIT GENERATING CAPACITY - MW: 618

NET UNIT GENERATING CAPACITY WITH FGD - MW: 580

NET UNIT GENERATING CAPACITY W/O FGD - MW: _____

EQUIVALENT SCRUBBED CAPACITY - MW: 618

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: FOSTER WHEELER

FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL

FURNACE FIRING METHOD: TANGENTIAL

WET BOTTOM/DRY BOTTOM: DRY BOTTOM

FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED

SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE

COMMERCIAL SERVICE DATE: 12/80

DESIGN BOILER FLUE GAS FLOW - ACFM: 2,400,000

FLUE GAS TEMPERATURE - F: 270

FLUE GAS OXYGEN - %: 6

HEAT RATE - BTU/KWH: 10,100

DESIGN FIRING RATE - TPH: 262

EXCESS AIR - %: 20

CAPACITY FACTOR - %: 60

STACK HEIGHT - FT: 1000

SHELL MATERIAL: CONCRETE

FLUE MATERIAL GENERIC TYPE: ACID-RESISTANT BRICK AND MORTAR

FLUE MATERIAL SPECIFIC TYPE: _____

FLUE MATERIAL TRADE/COMMON NAME: _____

FLUE LINER MATERIAL GENERIC TYPE: NONE

FLUE LINER MATERIAL SPECIFIC TYPE: N/A

FLUE LINER MATERIAL TRADE/COMMON NAME: N/A

FLUE INNER DIAMETER - FT: 18

STACK GAS INLET TEMPERATURE - F: _____

STACK GAS OUTLET VELOCITY - FT/SEC: _____

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MONONGAHELA POWER
PLEASANTS 2

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): BITUMINOUS
NAME OF SUPPLIER: _____
MINE NAME/AREA: _____
MINE LOCATION - COUNTY: _____
MINE LOCATION - STATE: WEST VIRGINIA
AVERAGE HEAT CONTENT - BTU/LB: 12,500
RANGE HEAT CONTENT - BTU/LB: 11,000-13,300
AVERAGE ASH CONTENT - %: 13.5
RANGE ASH CONTENT - %: 12-15
AVERAGE MOISTURE CONTENT - %: 4.5
RANGE MOISTURE CONTENT - %: 3.0-5.0
AVERAGE SULFUR CONTENT - %: 3.0
RANGE SULFUR CONTENT - %: 2.5-3.5
AVERAGE CHLORIDE CONTENT - %: 0.05
RANGE CHLORIDE CONTENT - %: _____
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): TYPICAL
FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): SEGREGATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: 2
NUMBER OF SPARES: 0
TYPE (HOT SIDE/COLD SIDE): COLD SIDE
SUPPLIER: AIR CORRECTION DIVISION, UOP
INLET FLUE GAS CAPACITY - ACFM: 2,400,000
INLET FLUE GAS TEMPERATURE - F: 270
PRESSURE DROP - IN. H2O: _____
PARTICLE OUTLET LOAD - GR/SCF: _____
PARTICLE REMOVAL EFFICIENCY - %: 99.5
FLUE GAS CONDITIONING TYPE: NONE

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: NONE
NUMBER OF SPARES:

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 2

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.):
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.):
TRADE/COMMON NAME:
SUPPLIER:
DIMENSIONS - FT:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BOILER LOAD PER SCRUBBER (DESIGN) - %:
GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.):
NUMBER OF GAS CONTACTING ZONES:
DISTANCE BETWEEN CONTACTING ZONES - IN.:
NUMBER OF SPRAY HEADERS:
NOZZLE MATERIAL:
NOZZLE PRESSURE DROP - PSI:
LIQUID RECIRCULATION RATE - GPM:
L/G RATIO - GAL/1000 ACF:
PH CONTROL ADDITIVE:
GAS-SIDE PRESSURE DROP - IN. H₂O:
SUPERFICIAL GAS VELOCITY - FT/SEC:
INLET GAS FLOW RATE - ACFM:
INLET GAS TEMPERATURE - F:
INLET SO₂ LEVEL - PPM:
INLET SO₂ LEVEL - LB/MM BTU:
INLET PARTICLE LEVEL - GR/SCF:
INLET PARTICLE LEVEL - LB/MM BTU:
OUTLET GAS FLOW RATE - ACFM:
OUTLET GAS TEMPERATURE - F:
OUTLET SO₂ LEVEL - PPM:
OUTLET SO₂ LEVEL - LB/MM BTU:
OUTLET PARTICLE LEVEL - GR/SCF:
OUTLET PARTICLE LEVEL - LB/MM BTU:
SO₂ REMOVAL EFFICIENCY - %:
PARTICLE REMOVAL EFFICIENCY - %:

FGD SYSTEM GENERAL DATA

PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME (THIOSORBIC®)
PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE
SYSTEM SUPPLIER: BABCOCK & WILCOX
A-E FIRM: UNITED ENGINEERS & CONSTRUCTORS
CONSTRUCTION FIRM: _____
APPLICATION (NEW/RETROFIT): NEW
PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.55
SO₂ DESIGN REMOVAL EFFICIENCY - %: 90
CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 2

COMMERCIAL START-UP: 1981
INITIAL START-UP: 10/80
CONSTRUCTION COMPLETION: _____
CONSTRUCTION INITIATION: _____
CONTRACT AWARDED: 9/75
LETTER OF INTENT SIGNED: _____
INITIATED BID REQUEST: _____
INITIATED PRELIMINARY DESIGN: _____

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 4.5
DESIGN COAL HEAT CONTENT - BTU/LB: 12,400
DESIGN COAL ASH CONTENT - %: 16.0
DESIGN COAL MOISTURE CONTENT - %: _____
DESIGN COAL CHLORIDE CONTENT - %: 0.05
B FGD SYSTEM SPACE REQUIREMENTS - SQ FT: 218,000
FGD SYSTEM TURNDOWN RATIO: 13:1
FGD SYSTEM TURNDOWN METHOD: TRAINS TAKEN OFF LINE MANUALLY
FGD SYSTEM PRESSURE DROP - IN. H2O: 10-11
FGD SYSTEM OXIDATION - %: 20
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: N/A
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 4-8 (AVERAGE 6)
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MANHOURS/DAY): 208 (BOTH UNITS)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(OPERATORS/SHIFT): 5 (BOTH UNITS)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE PERSONNEL/SHIFT): 10 (BOTH UNITS)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 1
FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): _____
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): SHARED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
ROTATION TO FGD SYSTEM: NONE
TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): SHARED
FGD SYSTEM BYPASS CAPABILITY (YES/NO): YES
RESTRICTIONS TO USING BYPASS: REHEAT ONLY (15% BYPASS)
TIME SCHEDULE FOR REDUCED BOILER LOAD: 1/2 LOAD AT NIGHT
TIME SCHEDULE FOR BOILER SHUTDOWNS: 1/YR; 3 TO 4 WEEKS
PLANNED MAINTENANCE DURING REDUCED
BOILER LOAD (TYPE AND FREQUENCY): SEE OTHER DATA SHEETS
PLANNED MAINTENANCE DURING BOILER
SHUTDOWNS (TYPE AND FREQUENCY): SEE OTHER DATA SHEETS
TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING CAUSE OF FAILURE): SEE OTHER DATA SHEETS

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: 4
NUMBER OF SPARES: _____
TYPE: VENTURI

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MONONGAHELA POWER
PLEASANTS 2

LOCATION: INLET TO ABSORBER

SUPPLIER: BABCOCK & WILCOX

C SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC UNDER INORGANIC

LINER MATERIAL SPECIFIC TYPE: EPOXY PHENOLIC AND HYDRAULICALLY BONDED
CONCRETE

LINER MATERIAL TRADE/COMMON NAME: PLASITE 7122H AND KAOCRETE HS

INLET GAS FLOW - ACFM: 600,000

INLET GAS TEMPERATURE - F: 270

PRFSSURE DROP - IN. H2O: 4.5

LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER,
ABSORBER SLURRY, ETC.): ABSORBER SLURRY

LIQUID RECIRCULATION RATE - GPM: 8000

L/G RATIO - GAL/1000 ACF: 15 (MINIMUM)

NUMBER OF SPRAY HEADERS: _____

NOZZLE MATERIAL: CERAMIC INSERTS

NOZZLE PRESSURE DROP - PSI: _____

ABSORBER

NUMBER OF ABSORBERS: 4

NUMBER OF SPARES: 1

GENERIC TYPE: TRAY TOWER

SPECIFIC TYPE: SIEVE TRAY

TRADE/COMMON NAME: B & W SIEVE TRAY DESIGN

SUPPLIER: BABCOCK & WILCOX

DIMENSIONS - FT: _____

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1100

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: NATURAL RUBBER

LINER MATERIAL TRADE/COMMON NAME: _____

BOILER LOAD PER ABSORBER - %: 28

GAS/LIQUID CONTACT DEVICE TYPE: PERFORATED TRAYS

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: N/A

NUMBER OF SPRAY HEADERS: _____

NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL

NOZZLE PRESSURE DROP - PSI: _____

LIQUID RECIRCULATION RATE - GPM: 16,000

L/G RATIO - GAL/1000 ACF: 30 (MINIMUM)

GAS-SIDE PRESSURE DROP - IN. H2O: 5.0

SUPERFICIAL GAS VELOCITY - FT/SEC: >10

ABSORBER TURNDOWN RATIO: 3.3:1

ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW

INLET GAS FLOW RATE - ACFM: _____

INLET GAS TEMPERATURE - F: 125

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MONONGAHELA POWER
PLEASANTS 2

INLET SO2 LEVEL - PPM: 2000
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: 0.05
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 125
OUTLET SO2 LEVEL - PPM: _____
OUTLET SO2 LEVEL - LB/MM BTU: _____
OUTLET PARTICLE LEVEL - GR/SCF: _____
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.05
SO2 REMOVAL EFFICIENCY - %: 90 (FOR SCRUBBED GAS)
PARTICLE REMOVAL EFFICIENCY - %: _____

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): MIST ELIMINATOR
TOTAL NUMBER OF MIST ELIMINATORS: 4
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE: IMPINGEMENT
SPECIFIC TYPE: BAFFLE
COMMON DESIGN: CHEVRON VANE
MANUFACTURER: BARCOCK & WILCOX
CONFIGURATION (HORIZONTAL/VERTICAL): HORIZONTAL
SHAPE (Z-SHAPE/A-FRAME): Z-SHAPE
NUMBER OF STAGES: 2
NUMBER OF PASSES/STAGE: 3
FREEBOARD DISTANCE - FT: _____
DISTANCE BETWEEN STAGES - IN.: 84
DISTANCE BETWEEN VANES - IN.: _____
VANE ANGLES - DEGREES: _____
PRESSURE DROP - IN. H2O: _____
SUPERFICIAL GAS VELOCITY - FT/SEC: 10 (MAX.)
CONSTRUCTION MATERIAL GENERIC TYPE: ORGANIC
CONSTRUCTION MATERIAL SPECIFIC TYPE: REINFORCED POLYESTER RESIN
CONSTRUCTION MATERIAL TRADE/COMMON NAME: _____
WASH WATER SOURCE (FRESH, BLENDED, SUPERNATANT): THICKENER OVERFLOW/MAKEUP
POINT OF WATER COLLECTION: _____
WASH DIRECTION (OVERSPRAY/UNDERSPRAY, FRONTSpray/BACKSPRAY): _____
WASH FREQUENCY: _____
WASH DURATION: _____
WASH RATE - GAL/MIN: _____
WASH COVERAGE - GAL/MIN/SQ FT: _____

REHEATER

NUMBER OF REHEATERS: _____
NUMBER OF SPARES: _____
NUMBER PER MODULE: _____
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): BYPASS
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): N/A

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MONONGAHELA POWER
PLEASANTS 2

COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): N/A
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: AHEAD OF STACK
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: 15
TEMPERATURE INCREASE - F: 20
INLET FLUE GAS FLOW RATE - ACFM: _____
INLET FLUE GAS TEMPERATURE - F: 125
OUTLET FLUE GAS FLOW RATE - ACFM: _____
OUTLET FLUE GAS TEMPERATURE - F: 145
ENERGY REQUIREMENT - MM BTU/HR: NONE
NUMBER OF HEAT EXCHANGER BANKS: N/A
NUMBER OF BUNDLES PER BANK: N/A
NUMBER OF TUBES PER BUNDLE: N/A
STEAM OR WATER PRESSURE - PSIG: N/A
STEAM OR WATER TEMPERATURE - F: N/A
SELF CLEANING DEVICE TYPE: N/A
MATERIAL GENERIC TYPE: _____
MATERIAL SPECIFIC TYPE: _____
MATERIAL TRADE/COMMON NAME: _____

FANS

NUMBER OF FANS: 4
NUMBER OF SPARES: _____
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: AMERICAN STANDARD
FUNCTION (UNIT/BOOSTER): BOOSTER
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: FORCED DRAFT
SERVICE (WET/DRY): DRY
TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN ESP AND QUENCHER
FLUE GAS FLOW RATE - ACFM: _____
FLUE GAS TEMPERATURE - F: _____
PRESSURE DROP - IN. H2O: _____
MATERIAL GENERIC TYPE: CARBON STEEL
MATERIAL SPECIFIC TYPE: AISI 1110
MATERIAL TRADE/COMMON NAME: N/A

DAMPERS

LOCATION: (A) INLET TO SCRUBBER (B) OUTLET FROM SCRUBBER
NUMBER OF DAMPERS: 2 PER TRAIN
FUNCTION (CONTROL/SHUT-OFF): SHUT-OFF (BOTH)
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): LOUVER (BOTH)
SPECIFIC TYPE (OPPOSED BLADE, PARALLEL BLADE, ETC.): PARALLEL
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): DOUBLE LOUVER (BOTH)
MANUFACTURER: FOURNEY
MODULATION (OPEN/CLOSED, ETC.): _____
SEAL AIR - ACFM: _____
SERVICE CONDITIONS (MAX GAS TEMP/TIME): (A) 270 F (B) 125 F
MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) STAINLESS STEEL

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MONONGAHELA POWER
PLEASANTS 2

MATERIAL SPECIFIC TYPE: (A) _____ (B) TYPE 317L
MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) OUTLET AFTER BYPASS JUNCTION
(D) BYPASS
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): _____
DIMENSIONS (DIAMETER, LENGTH, ETC.): _____
D SHELL MATERIAL GENERIC TYPE: CARBON STEEL (ALL)
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC AND INORGANIC
(C) INORGANIC (D) NONE
LINER MATERIAL SPECIFIC TYPE: (A) N/A (B) GUNITE (C) REFRACTORY (D) N/A
LINER MATERIAL TRADE/COMMON NAME: (A) N/A
(B) PLASITE AND PENNWALT SDX GUNITE
(C) _____ (D) N/A

EXPANSION JOINTS

LOCATION: (A) SCRUBBERS (B) BYPASS
TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS
PRESSURE (NEGATIVE/POSITIVE): _____
OPERATING TEMPERATURE - F: _____
DESIGN CONFIGURATION (V-SHAPED, ETC.): _____
MANUFACTURER: (A) RAYBESTOS-MANHATTAN (B) GARLOCK
E MATERIAL: VITON®

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): _____
MANUFACTURER: _____
MATERIALS: _____
NUMBER OF DEVICES: 3
NUMBER OF SPARES: 1
FULL LOAD DRY FEED CAPACITY - TPH: _____
PRODUCT QUALITY - % SOLIDS: 12-15
FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____
PREPARED REAGENT POINT OF ADDITION: REACTION TANK
ON-SITE STORAGE CAPABILITY - DAYS: 25

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

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MONONGAHELA POWER
PLEASANTS 2

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): (A) ABSORBER (B) LIME SLURRY AND WASTE DISPOSAL
(C) SPRAY HEADERS (D) SLUDGE TRANSFER
DIMENSIONS - IN.: (D) 48
MANUFACTURER:
MATERIAL: (A) RUBBER-LINED CARBON STEEL (B) CARBON STEEL
(C) TYPE 316L STAINLESS STEEL

MAJOR VALVES

LOCATION: (A) ABSORBER SLURRY (B) ABSORBER SLURRY (C) OTHER SLURRY VALVES
FUNCTION (ISOLATION, CONTROL, ETC.): (A) ISOLATION (B) CONTROL (C) _____
TYPE (BALL, GLOBE, PLUG, ETC.): (A) BUTTERFLY (B) DIAPHRAGM
(C) ECCENTRIC PLUG-TYPE
CONTROL MODE (AUTOMATIC/MANUAL):
DIMENSIONS - IN.:
MANUFACTURER: (A) DAMPCO (B) BURRELL (C) DEZURIK
MATERIAL: (A) RUBBER-LINED (B) _____ (C) RUBBER-LINED

THICKENERS

NUMBER OF THICKENERS: 2
NUMBER OF SPARES: 0
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 175 DIA X 10 DEEP
CAPACITY - GAL: 2,190,000
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____
RAKE MATERIAL: _____
FEED STREAM SOURCE: _____
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): 6% SOLIDS
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE,
PERCENT SOLIDS): 30% SOLIDS
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS): _____
OUTLET STREAM DISPOSITION: _____
OVERFLOW STREAM DISPOSITION: _____

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAOH2 - DRY: _____
PERCENT CACO3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: CALCILOX
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.): THICKENER UNDERFLOW
DEVICE (OXIDATION TANK, PUG MILL, ETC.): MIX TANK
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.): DRAVO
INLET FLOW RATE - GPM: _____
INLET QUALITY - % SOLIDS: _____

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DAM
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): DIKED VALLEY
LOCATION (ON-SITE/OFF-SITE): OFF-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): NONE
SITE DIMENSIONS - AREA/DEPTH: 200 ACRES X 200 FEET
SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 31, PLANT LIFE

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: OUTLET FROM ABSORBER
CHEMICAL PARAMETERS (PH, ETC.): PH, SO₂

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY, FLOW, ETC.): DENSITY, FLOW
CONTROL LEVELS: PH 6.0

MONITOR TYPE (MANUFACTURER, ETC.): UNILOC FLOW THROUGH TYPE FOR PH, LEAR
SIEGLER AND DUPONT FOR SO₂, TEXAS
NUCLEAR FOR DENSITY, AND LEAR SIEGLER
FM 10 FOR FLOW

MONITOR LOCATION: ABSORBER DOWNCOMER FOR PH

PROCESS CONTROL MANNER (AUTOMATIC/MANUAL):

PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD):

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL):

TYPE (OPEN/CLOSED): OPEN

EVAPORATION WATER LOSS - GPM:

SLUDGE HYDRATION WATER LOSS - GPM:

SLUDGE INTERSTITIAL WATER LOSS - GPM:

POND SEEPAGE/RUNOFF WATER LOSS - GPM:

EFFLUENT WATER LOSS - GPM:

RECEIVING WATER STREAM NAME: OHIO RIVER

MAKEUP WATER ADDITION - GPM:

SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): RIVER WATER AND COOLING TOWER
BLOWDOWN

MAKEUP WATER ADDITION POINTS & AMOUNTS:

MAKEUP WATER PRE-TREATMENT TYPE:

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): (A) ABSORBENT

(B) SLUDGE FIXATION

NAME (LIMESTONE, ADIPIC ACID, ETC.): (A) THIOSORBIC® LIME (B) CALCILOX

PRINCIPAL CONSTITUENTS: (A) >90% CaO, 4-7% MgO

SOURCE/SUPPLIER: DRAVO

SUPPLIER LOCATION: (A) MAYSVILLE, KENTUCKY

CONSUMPTION (SPECIFY UNITS): (A) 11.1 TPH (FOR BOTH UNITS AT FULL LOAD)

(B) 1.7 TPH (FOR BOTH UNITS AT FULL LOAD)

UTILIZATION - %: 94

POINT OF ADDITION: (A) SLAKER (B) MIXING TANK

F ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 113,000,000

CAPITAL COST - \$/KW: 181

OPERATING COST - MILLS/KWH:

MAINTENANCE COST: \$709,000/YR

LABOR COST:

UTILITIES COST:

CHEMICALS COST: \$3,042,000/YR

WASTE DISPOSAL COST: \$8,000/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

ABSORBER - %: _____
MIST ELIMINATOR - %: _____
REHEATER - %: N/A
FAN - %: _____
BALL MILL - %: N/A
SLAKER - %: _____
EFFLUENT HOLD TANK - %: _____
RECIRCULATION PUMP - %: _____
THICKENER - %: _____
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: N/A
ABSORBER: _____
MIST ELIMINATOR: _____
REHEATER: N/A
FAN: _____
BALL MILL: N/A
SLAKER: _____
EFFLUENT HOLD TANK: _____
RECIRCULATION PUMP: _____
THICKENER: _____
VACUUM FILTER: N/A
CENTRIFUGE: N/A

PILOT PLANT

UNIT NUMBER: TRAY TOWER D
PARTICIPANTS: ALLEGHENY POWER SYSTEMS, BABCOCK & WILCOX
PROCESS: LIME
PLANT DESIGN: TRAY TOWER
SUPPLIER: BARCOCK & WILCOX
SERVICE DATE: 1974
PERIOD OF OPERATION - MONTHS: 12
GAS FEED: _____
EQUIVALENT SCRUBBED CAPACITY - MW: 1.6
STATUS (ACTIVE/TERMINATED): TERMINATED

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): RECIRCULATION

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 40 DIA X 24 HIGH

CAPACITY - GAL: 225,600

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: _____

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): ME WASH

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: _____

DIMENSIONS - FT: _____

CAPACITY - GAL: _____

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: RUBBER-CLAD CARBON STEEL

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: NATURAL RUBBER

LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY TRANSFER

NUMBER OF TANKS: _____

NUMBER OF SPARES: _____

TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 22 DIA X 17 HIGH

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

CAPACITY - GAL: 37,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY FEED

NUMBER OF TANKS: _____
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 30 DIA X 24 HIGH
CAPACITY - GAL: 127,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: _____
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____
LINER MATERIAL GENERIC TYPE: _____
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): THICKENER
OVERFLOW

NUMBER OF TANKS: 2
NUMBER OF SPARES: _____
TYPE (OPEN/COVERED): _____
LOCATION: _____
CONFIGURATION: _____
DIMENSIONS - FT: 65 X 14 H
CAPACITY - GAL: 347,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: _____
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: _____
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: _____
SHELL MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

LINER MATERIAL GENERIC TYPE: COAL TAR EPOXY
LINER MATERIAL SPECIFIC TYPE: _____
LINER MATERIAL TRADE/COMMON NAME: _____

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLUDGE
STABILIZATION

NUMBER OF TANKS: 2
NUMBER OF SPARES: 1
TYPE (OPEN/COVERED): _____

LOCATION: _____

CONFIGURATION: _____

DIMENSIONS - FT: _____

CAPACITY - GAL: _____

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: _____

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: _____

SHELL MATERIAL GENERIC TYPE: _____

SHELL MATERIAL SPECIFIC TYPE: _____

SHELL MATERIAL TRADE/COMMON NAME: _____

LINER MATERIAL GENERIC TYPE: _____

LINER MATERIAL SPECIFIC TYPE: _____

LINER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): QUENCHER SLURRY
RECYCLE

NUMBER OF PUMPS: 8

NUMBER OF SPARES: 0

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 8100

MOTOR BRAKE HP: 450

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER SLURRY
RECYCLE

NUMBER OF PUMPS: 16

NUMBER OF SPARES: 4

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.):

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.):

COMMON DESIGN (V-BELT, ETC.):

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER:

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.):

CAPACITY - GPM: 8000

MOTOR BRAKE HP: 450

SPEED - RPM:

HEAD - FT:

SERVICE (PH, SOLIDS):

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE:

CASING MATERIAL TRADE/COMMON NAME:

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE:

IMPELLER MATERIAL TRADE/COMMON NAME:

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): THICKENER UNDERFLOW
NUMBER OF PUMPS:

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

NUMBER OF SPARES: _____

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: DENVER

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 600

MOTOR BRAKE HP: _____

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY
TRANSFER

NUMBER OF PUMPS: 2

NUMBER OF SPARES: _____

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

MANUFACTURER: DENVER

PUMP MODEL NUMBER: _____

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____

CAPACITY - GPM: 925

MOTOR BRAKE HP: _____

SPEED - RPM: VARIABLE

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: RUBBER-LINED

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SLURRY FEED

NUMBER OF PUMPS: _____

NUMBER OF SPARES: _____

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____

COMMON DESIGN (V-BELT, ETC.): _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

MANUFACTURER: _____
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: 1500
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: _____
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: _____
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): SLUDGE TRANSFER
NUMBER OF PUMPS: 4
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WARMAN
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: ALLOY
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: ALLOY
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): RETURN WATER
NUMBER OF PUMPS: 3
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: JOHNSTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____

UTILITY EMISSION CONTROL SYSTEM DATA
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MONONGAHELA POWER
PLEASANTS 2

SPEED - RPM: _____

HEAD - FT: _____

SERVICE (PH, SOLIDS): _____

CASING MATERIAL GENERIC TYPE: ALLOY _____

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: ALLOY _____

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 11/10/81

MONONGAHELA POWER
PLEASANTS 2

COMMENTS/FOOTNOTES

- A UTILITY CAN BYPASS AS MUCH AS 30% AND STILL BE IN COMPLIANCE.
- B REQUIRED AREA (FOR UNITS 1 AND 2) IS 2 ACRES FOR FGD SYSTEM, 6 ACRES FOR SLUDGE TREATMENT, 2 ACRES FOR LIME HANDLING, AND 200 ACRES FOR SLUDGE DISPOSAL EXCLUDING FLY ASH.
- C TYPE 316L STAINLESS STEEL FOR THE EXPOSED WETTED PARTS AT THE INLET.
- D SHORT SECTION OF TYPE 316L STAINLESS STEEL ON INLET DUCT AHEAD OF QUENCHER.
- E ALL EXPANSION JOINTS WILL BE CHANGED TO VITON®/FABRIC WITH INCONEL 625 FLANGES.
- F PRIMARILY UNIT 1 COSTS FOR 1980.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Monongahela Power Pleasants 1	3/79	744		System				Initial startup/commercial operations commenced
	4/79	720		System			A-Module	Removed from service due to weld failure on the absorber downcomer section
	5/79	744		System				
	6/79	720		System			Stack	Unit taken out of service on June 19 because severe stack liner failure (unit projected to be out of service until the middle of August)
	7/79	744	0	System	0	0		
	8/79	744	0	System	0	0		
	9/79	720	0	System	0	0	Stack	Repairs completed
	10/79	744		System				Information was unavailable from 10/79 to 7/80
	11/79	720		System				
	12/79	744		System				
	1/80	744		System				
	2/80	690		System				
	3/80	744		System				
	4/80	720		System				
	5/80	744		System				
	6/80	720		System				
	7/80	744		System				

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Pleasants 1 (continued)	8/80	744	216	System	158			
	9/80	720	0	System	0			An 8-14 week boiler and FGD system scheduled outage began during the week of August 11 to perform various repairs
							Expansion joints	Fabric joints to be replaced with elastomer joints
							Outlet ductwork	Lined with gunite
							Absorbers	Relining of absorber modules
							Thickener overflow tank	Coated with coal tar epoxy
							Pumps and valves	Repaired (maintenance)
	10/80	744	0	System	0		Isolation dampers	Upgraded
	11/80	720		System				Unit off line for repairs
	12/80	744		System				Information was not available for months of November and December

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Monongahela Power Pleasants 2	10/80	744		System				Initial startup/shakedown operations commenced
	11/80	720		System				
	12/80	744		System				Utility reported that no major problems were encountered

MONTANA POWER

COLSTRIP 1, 2

SECTION 1

BACKGROUND

The Colstrip Power Station of Montana Power Company is currently a two-unit station (with plans for two additional units) located near Colstrip, Montana with a combined net generating capacity of 664 MW. The identical units have a gross generating capacity of 360 MW each and fire a subbituminous coal with an average sulfur content of 0.78%.

The two mine mouth units included combined SO₂ and particulate matter removal equipment in their initial design. The emission control systems on both units were designed to comply with the 1971 Federal NSPS. Due to the timing of the new standards, Colstrip 1 appeared to Montana Power to be exempt from them. However, the State agency responsible for issuing the permit for the Colstrip project determined that it was necessary for both SO₂ removal and particulate matter control. Both units were designed with SO₂ and particulate matter emission guarantees that exceeded the limitations specified by the NSPS. The guaranteed maximum SO₂ limitation is 1.0 lb per million Btu. The guaranteed particulate matter emission limitation is 0.018 grains per actual cubic foot (0.016 lb per million Btu) at the reheater outlet (175°F).

In order to successfully incorporate the FGD system into the design of the full scale plant, a pilot study had to be run to determine the flyash collectibility and the use of flyash alkalinity. Pilot operations on the 3,000 acfm scale were conducted over approximately two years at the J. E. Corette Plant of The Montana Power Company in Billings, Montana. Colstrip coal was burned in the furnace similar in design but smaller than the ones that were to be constructed at Colstrip. Operation of the pilot proved the initial premise that the alkalinity present in the ash could be used to react with the SO_2 present in the flue gas. The pilot investigation also showed that integration of a wash tray into the design was required to successfully keep the mist eliminators clean, yet remain within the water balance required for closed loop scrubber operation.

The FGD systems for both units were supplied by Combustion Equipment Associates. The full-scale systems on Colstrip 1 and 2 commenced initial operation in September 1975 and May 1976, respectively.

SECTION 2

PROCESS DESCRIPTION

The FGD systems now in operation on Colstrip 1 and 2 are used for both particulate matter and SO_2 control and the captured ash provides the bulk of the alkalinity for SO_2 removal. Both systems include three scrubbing modules, each consisting of a downflow venturi scrubber centered within an upflow spray tower absorber.

Following the boiler air heater, the flue gas enters the top of the module at a flow rate of 476,667 acfm at 291°F. In the variable throat venturi, the scrubbing slurry is dispersed by the high velocity flue gas and serves to wet and trap the incoming particulate matter. In the spray tower the gas contacts a recycle spray of scrubbing slurry. The slurry from the venturi and the spray tower is collected and held in the base of the scrubber and recirculated at an L/G rate of 15 for the venturi and 18 for the spray tower.

After the spray zone, the gas passes through a water wash tray which serves to trap and dilute the entrainment. After the wash tray, the gas rises up through a four-pass horizontal chevron and a mesh pad mist eliminator. The gas leaves the absorption section at a temperature of about 120°F and enters an in-line steam coil reheat system that boosts the wet gas temper-

ature 50 to 70°F. The reheated gas then passes through the dry ID fans and is discharged to the atmosphere from the top of the 503-ft stack. The spent absorbent from this closed loop system is pumped to an on-site pond.

Slurry is bled from the recycle tank to maintain a 12% suspended solids level. Slaked lime is added as lime slurry only if needed to augment the flyash alkali and maintain the desired slurry pH. The slurry discharged from the absorption loop is passed to an intermediate retention pond where the solids settle and from which the clarified water is returned to the absorption system. At intermittent intervals, a floating dredge is used to reclaim the settled solids from the intermediate settling pond and transport them as a 30% slurry by pipeline to the permanent disposal pond located approximately three miles from the plant site. Supernatant from the disposal pond is returned, also intermittently, through the same slurry pipeline to the intermediate pond for recycle to the absorption system. No stabilization of the sludge is required and a closed water loop is maintained.

A flow diagram for the Colstrip 1, 2 FGD systems is shown on the next page.

-1143-
 Montana Power
 Colstrip 1,2

Flow Diagram: Colstrip 1 or 2

SECTION 3
DESIGN DATA

UTILITY EMISSION CONTROL SYSTEM DATA MONTANA POWER
DATE: 8/18/81 COLSTRIP 1

GENERAL PLANT INFORMATION

COMPANY NAME: MONTANA POWER COMPANY
ASSOCIATED UTILITIES: PUGET SOUND POWER & LIGHT
PLANT NAME: COLSTRIP
UNIT NUMBER: 1
PLANT ADDRESS: COLSTRIP POWER STATION
CITY: COLSTRIP
COUNTY: ROSEBUD
STATE: MONTANA
ZIP CODE: 59323
EPA REGION: 8
RIVER BASIN/LAKE REGION: YELLOWSTONE
REGULATORY CLASSIFICATION: NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: 0.7
NET PLANT GENERATING CAPACITY - MW: 664
GROSS UNIT GENERATING CAPACITY - MW: 360
NET UNIT GENERATING CAPACITY WITH FGD - MW: 332
NET UNIT GENERATING CAPACITY W/O FGD - MW: 344
EQUIVALENT SCRUBBED CAPACITY - MW: 360

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 11/75
DESIGN BOILER FLUE GAS FLOW - ACFM: 1,430,000 (MAX. DESIGN)
FLUE GAS TEMPERATURE - F: 291
FLUE GAS OXYGEN - %: 5
HEAT RATE - BTU/KWH: 9400
DESIGN FIRING RATE - TPH: 180-198
EXCESS AIR - %: 21
CAPACITY FACTOR - %: 82 (1980); 72 (AVG. PLANNED FOR LIFE OF PLANT)
STACK HEIGHT - FT: 503
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: CARBON STEEL
FLUE MATERIAL SPECIFIC TYPE: AISI 1110
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: ORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: MICA FLAKE-FILLED POLYESTER
FLUE LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 252
FLUE INNER DIAMETER - FT: 16.5
A STACK GAS INLET TEMPERATURE - F: 200
STACK GAS OUTLET VELOCITY - FT/SEC: 95

UTILITY EMISSION CONTROL SYSTEM DATA
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MONTANA POWER
COLSTRIP 1

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS
NAME OF SUPPLIER: WESTERN ENERGY COMPANY
MINE NAME/AREA: COLSTRIP
MINE LOCATION - COUNTY: ROSEBUD
MINE LOCATION - STATE: MONTANA
AVERAGE HEAT CONTENT - BTU/LB: 8843
RANGE HEAT CONTENT - BTU/LB: 8162-8897
AVERAGE ASH CONTENT - %: 8.6
RANGE ASH CONTENT - %: 6.1-12.6
AVERAGE MOISTURE CONTENT - %: 23.9
RANGE MOISTURE CONTENT - %: 21-25
AVERAGE SULFUR CONTENT - %: 0.78
RANGE SULFUR CONTENT - %: 0.4-1.0
AVERAGE CHLORIDE CONTENT - %: 0.01
RANGE CHLORIDE CONTENT - %:
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): AVERAGE
FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE
NUMBER OF SPARES:
TYPE (HOT SIDE/COLD SIDE):
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:
FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

NUMBER OF PARTICLE SCRUBBERS: 3
NUMBER OF SPARES: 0

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MONTANA POWER
COLSTRIP 1

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.): VARIABLE-THROAT/TOP ENTRY
PLUMB BOB

TRADE/COMMON NAME: N/A

SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES

DIMENSIONS - FT: 15 DIA THROAT (TRAY OUTSIDE DIA - 35; INSIDE DIA - 15)

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

C LINER MATERIAL GENERIC TYPE: INORGANIC

LINER MATERIAL SPECIFIC TYPE: PREFIRED BRICK/SHAPES

LINER MATERIAL TRADE/COMMON NAME: ACID-RESISTANT BRICK (LOW H₂O
ABSORPTION)

BOILER LOAD PER SCRUBBER (DESIGN) - %: 40

GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): NONE

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A

D NUMBER OF SPRAY HEADERS: 2

NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL

NOZZLE PRESSURE DROP - PSI:

LIQUID RECIRCULATION RATE - GPM: 6600

L/G RATIO - GAL/1000 ACF: 15

PH CONTROL ADDITIVE: LIME/ALKALINE FLY ASH

GAS-SIDE PRESSURE DROP - IN. H₂O: 17 (15-21 RANGE)

SUPERFICIAL GAS VELOCITY - FT/SEC: 170-220

INLET GAS FLOW RATE - ACFM: 477,000

INLET GAS TEMPERATURE - F: 291

INLET SO₂ LEVEL - PPM: 600 (AVG.)

INLET SO₂ LEVEL - LB/MM BTU: 2.3

INLET PARTICLE LEVEL - GR/SCF: 1.9-3.6

INLET PARTICLE LEVEL - LB/MM BTU: 8.03

OUTLET GAS FLOW RATE - ACFM:

OUTLET GAS TEMPERATURE - F: 130

OUTLET SO₂ LEVEL - PPM:

OUTLET SO₂ LEVEL - LB/MM BTU:

OUTLET PARTICLE LEVEL - GR/SCF: 0.018

OUTLET PARTICLE LEVEL - LB/MM BTU: 0.06

SO₂ REMOVAL EFFICIENCY - %:

PARTICLE REMOVAL EFFICIENCY - %: 99.5

FGD SYSTEM GENERAL DATA

E PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME/ALKALINE FLY ASH

PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE

SYSTEM SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES

A-E FIRM: BECHTEL

CONSTRUCTION FIRM: BECHTEL

APPLICATION (NEW/RETROFIT): NEW

PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.5

F SO₂ DESIGN REMOVAL EFFICIENCY - %: 60

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MONTANA POWER
COLSTRIP 1

CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A
COMMERCIAL START-UP: 11/75
INITIAL START-UP: 9/75
CONSTRUCTION COMPLETION: 8/75
CONSTRUCTION INITIATION: 6/73
CONTRACT AWARDED: 10/72
LETTER OF INTENT SIGNED: N/A
INITIATED BID REQUEST: 1972 (SUMMER)
INITIATED PRELIMINARY DESIGN: 10/72

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 1.0
DESIGN COAL HEAT CONTENT - BTU/LB: 8162
DESIGN COAL ASH CONTENT - %: 12.6
DESIGN COAL MOISTURE CONTENT - %: 25.0
DESIGN COAL CHLORIDE CONTENT - %: 0.01
FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____
FGD SYSTEM TURNDOWN RATIO: 6:1
FGD SYSTEM TURNDOWN METHOD: TAKE TRAINS OFF LINE
FGD SYSTEM PRESSURE DROP - IN. H2O: 38
FGD SYSTEM OXIDATION - %: >99
FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: 12
FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 12
FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MANHOURS/DAY): 152 (UNITS 1 & 2 COMBINED)
G FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (OPERATORS/SHIFT): 3 (UNITS 1 & 2 COMBINED)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
H (MAINTENANCE PERSONNEL/SHIFT): 3 (1 & 2 COMBINED)
FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT (MAINTENANCE SHIFTS/DAY): 3 (AS NEEDED)
I FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS (MANHOURS/YEAR): 3456 (PER UNIT)
TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): NON-DEDICATED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL
J ROTATION TO FGD SYSTEM: N/A, THE ENTIRE STATION MAINTENANCE IS QUALIFIED FOR SCRUBBER WORK.
K TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): NON-DEDICATED EXCEPT DURING OUTAGES
FGD SYSTEM BYPASS CAPABILITY (YES/NO): NO
RESTRICTIONS TO USING BYPASS: N/A
TIME SCHEDULE FOR REDUCED BOILER LOAD: NIGHTLY
TIME SCHEDULE FOR BOILER SHUTDOWNS: ONCE/YEAR (4 WEEKS)
PLANNED MAINTENANCE DURING REDUCED BOILER LOAD (TYPE AND FREQUENCY): GENERAL CLEANING, EVERY MODULE IS CLEANED AND INSPECTED AT LEAST ONCE/12 WEEKS

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MONTANA POWER
COLSTRIP 1

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY):

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): IF THERE IS A BACKLOG OF MAINTENANCE, ONLY HIGH
PRIORITY ITEMS WOULD BE ADDRESSED. ITEMS NOT LIMITING
STATION OPERATIONS WOULD BE ADDRESSED LATER.

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE

NUMBER OF SPARES:

TYPE:

LOCATION:

SUPPLIER:

SHELL MATERIAL GENERIC TYPE:

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE:

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME:

INLET GAS FLOW - ACFM:

INLET GAS TEMPERATURE - F:

PRESSURE DROP - IN. H2O:

LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):

LIQUID RECIRCULATION RATE - GPM:

L/G RATIO - GAL/1000 ACF:

NUMBER OF SPRAY HEADERS:

NOZZLE MATERIAL:

NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 3

NUMBER OF SPARES: 0

L GENERIC TYPE: COMBINATION

SPECIFIC TYPE: VENTURI SPRAY

TRADE/COMMON NAME: N/A

SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES

DIMENSIONS - FT: 35 DIA X 70.5 HIGH

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

M LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: INERT FLAKE/VINYL ESTER AND GLASS
FLAKE/POLYESTER

LINER MATERIAL TRADE/COMMON NAME: PLASITE 4030, PLASITE 4020, AND
RIGIFLAK 4850

BOILER LOAD PER ABSORBER - %: 40

GAS/LIQUID CONTACT DEVICE TYPE: VENTURI THROAT AND SPRAY ZONE

NUMBER OF GAS CONTACTING ZONES: 2

DISTANCE BETWEEN GAS CONTACTING ZONES - IN.. 240 BETWEEN VENTURI AND SPRAY
ZONE

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MONTANA POWER
COLSTRIP 1

NUMBER OF SPRAY HEADERS: 10-14
NOZZLE MATERIAL: ALUMINUM OXIDE
N NOZZLE PRESSURE DROP - PSI: 40
LIQUID RECIRCULATION RATE - GPM: 7600
L/G RATIO - GAL/1000 ACF: 18
O GAS-SIDE PRESSURE DROP - IN. H2O: 17.5
P SUPERFICIAL GAS VELOCITY - FT/SEC: >9.0
Q ABSORBER TURNDOWN RATIO: 2:1
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM: 426,600
INLET GAS TEMPERATURE - F: 120
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 110-120
OUTLET SO2 LEVEL - PPM: 200
OUTLET SO2 LEVEL - LB/MM BTU: 0.6
R OUTLET PARTICLE LEVEL - GR/SCF: 0.03-0.13
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.06
SO2 REMOVAL EFFICIENCY - %: 75-80
PARTICLE REMOVAL EFFICIENCY - %: 99.5

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR
(C) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 3 (B) 3 (C) 3

NUMBER OF SPARES: 0

NUMBER PER MODULE: (A) 1 (B) 1 (C) 1

GENERIC TYPE: (A) KNOCK-OUT (B) IMPINGEMENT (C) IMPINGEMENT

SPECIFIC TYPE: (A) WASH TRAY (B) BAFFLE (C) MESH

COMMON DESIGN: (A) IRRIGATION TRAY (B) CLOSED VANE
(C) KNITTED WIRE MESH PAD

MANUFACTURER: (A) KOCH (B) HEIL

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (A) N/A (B) SINUSOIDAL

NUMBER OF STAGES: (A) 1 (B) 1 (C) 1

NUMBER OF PASSES/STAGE: (A) N/A (B) 4 (C) 1

FREEBOARD DISTANCE - FT: (B) 13

DISTANCE BETWEEN STAGES - IN.: N/A

DISTANCE BETWEEN VANES - IN.: (B) 1.0

VANE ANGLES - DEGREES: (B) 120

PRESSURE DROP - IN. H2O: (A) 2.5 (B) 0.2-0.4

P SUPERFICIAL GAS VELOCITY - FT/SEC: 5.8-11.9 (BOTH)

CONSTRUCTION MATERIAL GENERIC TYPE: (A) STAINLESS STEEL (B) ORGANIC
(C) STAINLESS STEEL

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) AUSTENITIC (B) POLYPHENYLENE
(C) AUSTENITIC

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MONTANA POWER
COLSTRIP 1

CONSTRUCTION MATERIAL TRADE/COMMON NAME: (A) TYPE 316L (B) NORYL® EN-265
(C) TYPE 316

S WASH WATER SOURCE (FRESH, BLENDED,
SUPERNATANT): (A) WASH TRAY RECYCLE (B) FRESH ABOVE AND BLENDED BELOW
POINT OF WATER COLLECTION: WASH TRAY
WASH DIRECTION (OVERSPRAY/UNDERSPRAY,
FRONTSpray/BACKSPRAY): (A) UNDERSPRAY (B) UNDERSPRAY AND OVERSPRAY
WASH FREQUENCY: (A) CONTINUOUS
(B) CONTINUOUS UNDERSPRAY AND ONCE/DAY OVERSPRAY
WASH DURATION: (A) N/A (B) 20 MINUTES OVERSPRAY (2 MIN/SECTION,
10 SECTIONS)
WASH RATE - GAL/MIN: (A) _____ (B) 360 UNDERSPRAY AND 450 OVERSPRAY
WASH COVERAGE - GAL/MIN/SQ FT: (A) _____ (B) _____

REHEATER

NUMBER OF REHEATERS: 3
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): STEAM (150 PSIG)
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): PLATECOIL®
COMBUSTION FUEL SULFUR CONTENT - %: N/A
LOCATION: IN DUCT AFTER ABSORBER
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 70
INLET FLUE GAS FLOW RATE - ACFM: 426,600
INLET FLUE GAS TEMPERATURE - F: 120
OUTLET FLUE GAS FLOW RATE - ACFM:
OUTLET FLUE GAS TEMPERATURE - F: 170-180 (175 TYPICAL)
ENERGY REQUIREMENT - MM BTU/HR:

T NUMBER OF HEAT EXCHANGER BANKS: 6 PER ROW; 2 ROWS
NUMBER OF BUNDLES PER BANK: 11 PLATECOILS®
NUMBER OF TUBES PER BUNDLE:

STEAM OR WATER PRESSURE - PSIG: 150
STEAM OR WATER TEMPERATURE - F: 450

U SELF CLEANING DEVICE TYPE: STEAM SOOT BLOWERS (ONCE/HOUR)

V MATERIAL GENERIC TYPE: HIGH ALLOY; HIGH ALLOY
MATERIAL SPECIFIC TYPE: NICKEL BASE/CHROMIUM-IRON-MOLYBDENUM; NICKEL
BASE/CHROMIUM-IRON-COPPER-MOLYBDENUM
MATERIAL TRADE/COMMON NAME: INCONEL 625; HASTELLOY G

FANS

NUMBER OF FANS: 3
NUMBER OF SPARES: 0
DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL
SUPPLIER: BUFFALO FORGE
FUNCTION (UNIT/BOOSTER): UNIT
APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT
SERVICE (WET/DRY): DRY

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COLSTRIP 1

TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN REHEATER AND STACK
FLUE GAS FLOW RATE - ACFM: 473,000
FLUE GAS TEMPERATURE - F: 170-180
PRESSURE DROP - IN. H2O: 36
W MATERIAL GENERIC TYPE: CARBON STEEL; ORGANIC-LINED HOUSING
MATERIAL SPECIFIC TYPE: AISI 1110; SYNTHETIC RUBBER
MATERIAL TRADE/COMMON NAME: N/A; CHLOROBUTYL

DAMPERS

X LOCATION: (A) SCRUBBER INLET (B) SCRUBBER OUTLET (C) FAN INLET
NUMBER OF DAMPERS: (A) 3 (B) 3 (C) 6
FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF (C) CONTROL
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) BUTTERFLY (B) GUILLotine
(C) LOUVER
SPECIFIC TYPE (OPPOSED BLADE,
PARALLEL BLADE, ETC.): (A) N/A (B) SIDE-ENTRY GUILLotine
(C) PARALLEL BLADE MULTILOUVER
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): (A) N/A (B) N/A
(C) SINGLE LOUVER
MANUFACTURER: (A) ALLIS-CHALMERS (B) MOSSER (C) BUFFALO FORGE
MODULATION (OPEN/CLOSED, ETC.): (A) OPEN/CLOSED (B) OPEN/CLOSED
(C) VARIOUS
SEAL AIR - ACFM: N/A
SERVICE CONDITIONS (MAX GAS TEMP/TIME):
MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) STAINLESS STEEL
(C) CARBON STEEL (D) CARBON STEEL
MATERIAL SPECIFIC TYPE: (A) AISI 1110 (B) AUSTENITIC (C) AISI 1110
MATERIAL TRADE/COMMON NAME: (A) N/A (B) TYPE 316 (C) N/A
LINER MATERIAL GENERIC TYPE: NONE
LINER MATERIAL SPECIFIC TYPE: N/A
LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) REHEATER
CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) CIRCULAR (B) RECTANGULAR
(C) RECTANGULAR
DIMENSIONS (DIAMETER, LENGTH, ETC.):
SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
(C) STAINLESS STEEL
SHELL MATERIAL SPECIFIC TYPE: (A) AISI 1110 (B) AISI 1110 (C) AUSTENITIC
SHELL MATERIAL TRADE/COMMON NAME: (A) N/A (B) N/A (C) TYPE 316L
LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) NONE
LINER MATERIAL SPECIFIC TYPE: (B) GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: (B) RIGIFLAK 4850

EXPANSION JOINTS

Y LOCATION: (A) PLENUM INLET (B) PLENUM OUTLET (C) SCRUBBER INLET
(D) SCRUBBER OUTLET (E) FAN INLET (F) FAN OUTLET
(G) STACK INLET

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MONTANA POWER
COLSTRIP 1

TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): NEGATIVE
OPERATING TEMPERATURE - F: (A) 291 (B) 291 (C) 291 (D) 130 (E) 175
(F) 200 (G) 200

DESIGN CONFIGURATION (V-SHAPED, ETC.): _____

MANUFACTURER: _____

Z MATERIAL: INCONEL MESH AND RUBBER (VITON®)

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING
PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER
DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): PASTE SLAKER
MANUFACTURER: BIF

MATERIALS: _____

NUMBER OF DEVICES: 2

NUMBER OF SPARES: 1

FULL LOAD DRY FEED CAPACITY - TPH: _____

PRODUCT QUALITY - % SOLIDS: 10

FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____

AA PREPARED REAGENT POINT OF ADDITION: RECYCLE TANK (BOTTOM OF ABSORBER)

BB ON-SITE STORAGE CAPABILITY - DAYS: 1

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED
WATER, SLUDGE, ETC.): SLURRY RECYCLE, SLURRY TRANSFER, AND CLEAR WATER
DIMENSIONS - IN.: _____

MANUFACTURER: _____

CC MATERIAL: RUBBER-LINED CARBON STEEL; TYPE 316 STAINLESS STEEL

MAJOR VALVES

LOCATION: (A) VENTURI RETURN LINES (B) BEFORE AND AFTER RECYCLE PUMPS
(C) TRAY RECYCLE HEADER

FUNCTION (ISOLATION, CONTROL, ETC.): (A) CONTROL (B) ISOLATION
(C) ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): (A) PINCH (B) PLUG (C) PLUG

CONTROL MODE (AUTOMATIC/MANUAL): AUTOMATIC/MANUAL

DIMENSIONS - IN.: (A) 3-4 (B) 12-18 (C) 12-18

MANUFACTURER: (A) R.K.L. (B) DEZURIK (C) DEZURIK

MATERIAL: (A) FIBER-REINFORCED RUBBER LINED (B) RUBBER LINED CARBON STEEL
(C) TYPE 316 STAINLESS STEEL (SOME ARE RUBBER LINED)

THICKENERS

NUMBER OF THICKENERS: NONE

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MONTANA POWER
COLSTRIP 1

NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

DD SLUDGE

FULL LOAD QUANTITY - TPH/DRY: _____
MOISTURE CONTENT - % TOTAL FREE WATER: _____
PERCENT CASO3 - DRY: _____
PERCENT CASO4 - DRY: _____
PERCENT CAO2 - DRY: _____

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MONTANA POWER
COLSTRIP 1

PERCENT CaCO_3 - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
EE GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DIKED
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): BELOW GRADE
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): BENTONITE CLAY LINING
EE SITE DIMENSIONS - AREA/DEPTH:
EE SITE CAPACITY - VOLUME/ACRE-FT/TONS:
SITE SERVICE LIFE - YEARS: 2-3 (IF NOT DREDGED)

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: RECIRCULATING SLURRY
FF CHEMICAL PARAMETERS (PH, ETC.): PH
FF PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY,
FLOW, ETC.): % SOLIDS; FLOW, PRESSURE
CONTROL LEVELS: PH 4.5 TO 5.5
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: RECIRCULATION TANK
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): MANUAL
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN AND ACTUAL
TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: 30
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: 0
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
GG MAKEUP WATER ADDITION - GPM: 290
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): ME WASH, LIME SLAKER, AND
SEAL WATER
MAKEUP WATER ADDITION POINTS & AMOUNTS: LIME SLAKER, MIST ELIMINATOR WASH
SYSTEM AND SEAL WATER SYSTEM

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MONTANA POWER
COLSTRIP 1

MAKEUP WATER PRE-TREATMENT TYPE: CLARIFIER, PLANT WATER SOFTENER, AND BRINE
EVAPORATOR

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT
NAME (LIMESTONE, ADIPIC ACID, ETC.): LIME/FLY ASH
PRINCIPAL CONSTITUENTS: 90% CaO/16-21% CaO AND 5% MgO
SOURCE/SUPPLIER: PETE LIENE
SUPPLIER LOCATION: RAPID CITY, SOUTH DAKOTA
HH CONSUMPTION (SPECIFY UNITS): 5 TPD (LIME)
UTILIZATION - %:
POINT OF ADDITION: SLAKER

II ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 96,400,000
CAPITAL COST - \$/KW: 134
OPERATING COST - MILLS/KWH: 3.20
MAINTENANCE COST: \$2,430,000/YR
LABOR COST: \$849,000/YR
UTILITIES COST: \$3,310,000/YR
CHEMICALS COST: \$2,090,000/YR
WASTE DISPOSAL COST: \$1,070,000/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: 20
ABSORBER - %: 20
MIST ELIMINATOR - %: 0
REHEATER - %: 50
FAN - %: 20
BALL MILL - %: N/A
SLAKER - %: 100
EFFLUENT HOLD TANK - %: 20
RECIRCULATION PUMP - %: 50
THICKENER - %: N/A
VACUUM FILTER - %: N/A
CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: 0.5
ABSORBER: 0.5
MIST ELIMINATOR: 0
REHEATER: 0
FAN: 0.5
BALL MILL: N/A
SLAKER: 1
EFFLUENT HOLD TANK: 0.5
RECIRCULATION PUMP: 1
THICKENER: N/A
VACUUM FILTER: N/A
CENTRIFUGE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA MONTANA POWER
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PILOT PLANT

UNIT NUMBER: J. E. CORETTE
PARTICIPANTS: BECHTEL, CEA, A. D. LITTLE, MONTANA POWER, PUGET SOUND
 POWER & LIGHT
PROCESS: LIME/ALKALINE FLY ASH
PLANT DESIGN: CEA/ADL
SUPPLIER: CEA/ADL
SERVICE DATE: 1/73
PERIOD OF OPERATION - MONTHS: 24
GAS FEED: SLIP STREAM UPSTREAM OF ESP
EQUIVALENT SCRUBBED CAPACITY - MW: 0.75 to 1 MW
JJ STATUS (ACTIVE/TERMINATED): TERMINATED

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ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): VENTURI/ABSORBER
RECYCLE

NUMBER OF TANKS: 3
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: TANK IS BOTTOM OF ABSORBER VESSEL
CONFIGURATION: CYLINDRICAL
DIMENSIONS - FT: 35 DIAMETER (BOTTOM PART OF MODULE)
CAPACITY - GAL: 113,600
RETENTION TIME - MIN: 8
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: BOTTOM ENTERING
AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS
STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850 AND PLASITE 4030

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY TRANSFER
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: SLAKER BUILDING
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 4 DIA X 4
CAPACITY - GAL: 90
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION: _____
AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS
STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY STORAGE
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED

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COLSTRIP 1

LOCATION: SLAKER BUILDING
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 12 DIA X 20.5
CAPACITY - GAL: 17,000
RETENTION TIME - MIN: 960
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION:
AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS
STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): EFFLUENT BLEED
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: IN SCRUBBER ALLEY
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 10.5 DIA X 18.5
CAPACITY - GAL: 12,000
RETENTION TIME - MIN: 4
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION:
AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS
STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): TRAY WASH WATER
RECYCLE
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: OPEN AREA BEHIND SCRUBBER VESSELS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 18 DIA X 18
CAPACITY - GAL: 34,000
RETENTION TIME - MIN: _____
NUMBER OF AGITATORS: 1

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COLSTRIP 1

AGITATOR CONFIGURATION: TOP ENTRY

AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL WITH TYPE 316 STAINLESS STEEL
HUB

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER

LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

UTILITY EMISSION CONTROL SYSTEM DATA . MONTANA POWER
DATE: 8/18/81 COLSTRIP 1

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): VENTURI
RECIRCULATION

NUMBER OF PUMPS: 6
KK NUMBER OF SPARES: 3
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: D65
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 6600
MOTOR BRAKE HP: 250
SPEED - RPM: _____
HEAD - FT: 90
SERVICE (PH, SOLIDS): PH 4-5, 12% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 6
KK NUMBER OF SPARES: 3
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: ALLEN-SHERMAN-HOFF
PUMP MODEL NUMBER: C65
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 7600
MOTOR BRAKE HP: 250
SPEED - RPM: _____
HEAD - FT: 90
SERVICE (PH, SOLIDS): PH 4-5, 12% SOLIDS
CASING MATERIAL GENERIC TYPE: RUBBER LINED
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: _____
IMPELLER MATERIAL GENERIC TYPE: RUBBER LINED
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): POND RETURN

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MONTANA POWER
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LL NUMBER OF PUMPS: 3
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER:
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
MM CAPACITY - GPM: 1900
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 40
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: ASTM A532 TYPE 3
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: ASTM A532 TYPE 3
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SYSTEM
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): EFFLUENT BLEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

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COLSTRIP 1

MANUFACTURER: A-S-H
PUMP MODEL NUMBER: C-6-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 1300
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 50
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE: GRAY CAST IRON
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): TRAY WASH WATER
RECYCLE

NUMBER OF PUMPS: 2
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: A-S-H
PUMP MODEL NUMBER: D-6-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 7600
MOTOR BRAKE HP: 300
SPEED - RPM: 555
HEAD - FT: 80
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE: GRAY CAST IRON
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

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MONTANA POWER
COLSTRIP 1

COMMENTS/FOOTNOTES

- A THE GAS TEMPERATURE AT THE REHEATER OUTLET IS ABOUT 175 F. THIS IS INCREASED BY COMPRESSION OF THE FAN TO 200 F.
- B SAME VESSEL AS ABSORBER.
- C IN THROAT AREA; TYPE 316L STAINLESS STEEL PLUMB BOB.
- D THERE ARE TWO SPRAY HEADERS, ONE FOR THE TANGENTIAL "RACETRACK" SPRAY AT THE THROAT AND ONE FOR THE 4 NOZZLES THAT SPRAY DOWN ON THE BARREL. BOTH GET THE SAME LIQUOR.
- E THE FLY ASH PROVIDES THE MAJORITY OF THE ALKALINE MATERIAL.
- F BASED ON THE COAL OUT OF THE PULVERIZERS AND FLUE GAS OUT OF THE STACK, THE SO₂ REMOVAL IS 83%. THIS INCLUDES THE SULFUR REMOVED WITH THE BOTTOM ASH. THE 60% FIGURE SHOWN HERE IS BASED ON THE EMISSION LIMITATION REQUIREMENT. 80% IS TYPICAL.
- G 3 OPERATORS/SHIFT, 3 SHIFTS/DAY FOR UNITS 1 AND 2 COMBINED. 1 CONTROL ROOM OPERATOR AND 2 FLOOR OPERATORS CHECKING NOZZLES, PH, LIME SYSTEM, PUMPS, ETC. - 7 DAYS/WEEK.
- H 30% OF THE 32-MAN STATION MAINTENANCE CREW IS DEDICATED TO THE SCRUBBERS. THERE ARE 10 INDIVIDUALS SCHEDULED TO PERFORM PREVENTIVE MAINTENANCE AND FAILURE REPAIRS DURING A 24-HOUR PERIOD (80 MAN-H/DAY). PM IS ON A SCHEDULED ROTATION. MAINTENANCE PERSONS ARE TAKEN ON AN AS-NEEDED BASIS FOR FAILURES.
- I ONLY DURING OVERHAUL OR MAJOR BREAKDOWN OF BOILER AND/OR SCRUBBER. USED REGULARLY ONCE/YEAR FOR 4 WEEKS PER UNIT.
- J THERE IS A 3-MONTH ROTATION FOR FLOOR OPERATORS. CONTROL BOARD OPERATORS ARE ROTATED AS DICTATED BY PROMOTION OR ATTRITION (6-8 MONTHS).
- K THERE ARE ONLY DEDICATED SUPERVISORS DURING UNIT OUTAGES. DURING NON-UNIT OUTAGES THE STATION MAINTENANCE SUPERVISORS OVERSEE SCRUBBER MAINTENANCE.
- L PRIMARY SO₂ REMOVAL OCCURS IN THE VARIABLE THROAT VENTURI WITHIN THE TOWER VESSEL.
- M ABSORBER WALLS WERE ORIGINALLY LINED WITH RIGIFLAK 4850. POOR ADHESION CAUSED THE LINING TO BE REPLACED WITH PLASITE 4030 AND PLASITE 4020 EXCEPT IN THE LOWER PORTION OF THE VESSEL.
- N 1109 IN. H₂O.
- O 17.5 (VENTURI), 3.5-5.2 (ME/WASH TRAY), 3.5 (REHEATER) - APPROXIMATELY 26 INCHES H₂O FROM SCRUBBER INLET TO REHEATER OUTLET.
- P RANGES FROM 5.8 TO 11. THE MIST ELIMINATORS ARE DESIGNED FOR 8.7. ACTUAL IS SLIGHTLY GREATER THAN 9.0.
- Q BASED ON WASH TRAY CONSTRAINTS.
- R ACTUAL IS BELOW 0.03 GR/SCF (OR LESS THAN 0.06 LB/MM BTU).
- S MIST ELIMINATOR UNDERSPRAY IS A BLEND OF 83% WASH TRAY RECYCLE WATER AND 17% RIVER WATER.
- T 2 BANKS; ONE IS INCONEL 625, THE OTHER IS HASTELLOY G AND THEY PROVIDE TEMPERATURE BOOSTS OF 20 AND 50 F, RESPECTIVELY.
- U LOCATED AT TOP OF BANKS WHERE FLUE GAS ENTERS AND BETWEEN BANKS.
- V UPPER INLET ROW IS INCONEL 625 AND LOWER OUTLET ROW IS HASTELLOY G.
- W COR-TEN STEEL CENTER PLATE. HOUSING LININGS ARE BEING REPLACED WITH CHLOROBUTYL RUBBER BECAUSE OF "CHECKING" (TEMPERATURE AND WEAR PROBLEMS).

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COLSTRIP 1

COMMENTS/FOOTNOTES (CONTINUED)

- X THE FAN INLET HAS A SPLIT DUCT. EACH HALF HAS A LOUVER DAMPER. THE SCRUBBER INLET IS JUST OFF THE COMMON PLENUM. THE SCRUBBER OUTLET IS RIGHT AT THE STACK. THERE ARE ALSO CONTROL LOUVERS AT THE FAN INLET.
- Y THERE ARE 7 EXPANSION JOINTS PER MODULE IN ADDITION TO THE EXPANSION JOINT AT THE COMMON PLENUM INLET.
- Z FORMERLY FIBER-REINFORCED RUBBER.
- AA JUST ABOVE WATER LINE.
- BB 3-MONTHS (LIME), 24 HOURS (SLAKED LIME). LIME IS DELIVERED BY 20-TON CAPACITY TRUCKS AND IS PNEUMATICALLY CONVEYED TO A 564-TON CAPACITY CARBON STEEL SILO FOR EACH UNIT.
- CC MAKEUP LINES AND TRAY POND RETURN FEED LINES WERE FRP (THESE ARE UNDERGROUND). THEY WERE REPLACED WITH RUBBER-LINED CARBON STEEL PIPING BECAUSE OF SHOCK DAMAGE DURING COLD WEATHER. ALL PIPING 4 INCHES DIAMETER OR LESS IS MADE OF TYPE 316 STAINLESS STEEL.
- DD DETAILS ARE NOT AVAILABLE; HOWEVER, THE MATERIAL IS PRIMARILY FLY ASH AND CALCIUM SULFATE - CaSO_4 (95% OXIDIZED).
- EE THERE ARE TWO 15-ACRE PONDS THAT VARY FROM 20 TO 30 FT DEEP. THESE ARE CONTINUALLY DREDGED 7 TO 8 MONTHS/YEAR. THE MATERIAL IS DISPOSED IN A 150-ACRE POND HAVING 10 YEARS OF DISPOSAL CAPACITY REMAINING (AS OF 8/81). THERE ARE PLANS FOR ANOTHER 150-ACRE POND. THE PONDS HAVE A NATURAL CLAY LINING EXCEPT AT THE DAMS WHERE CLAY WAS LAID TO SEAL THE POND. THERE IS ALSO A SEPARATE BENTONITE CLAY-LINED POND 355 FT BY 210 FT (1.7 ACRE) BY 20 FT FOR THE TRAY WATER RECYCLE SYSTEM. DECANTED WATER IS BROUGHT BACK TO THE WASH TRAY AND SCRUBBER RECYCLE LOOPS OF BOTH UNITS.
- FF AUTOMATIC MONITORS USUALLY DO NOT WORK. READINGS ARE TAKEN BY HAND SAMPLES.
- GG 97 PER MODULE.
- HH 2400 TPY FOR UNITS 1 AND 2 COMBINED.
- II UNITS 1 AND 2 COMBINED.
- JJ THE PLANT IS STILL ON SITE AND COULD BE USED AGAIN IF REQUIRED.
- KK THREE SPARE PUMPS SERVICE EITHER VENTURI OR ABSORBER SPRAY NOZZLES.
- LL 3 PUMPS SHARED BY 2 UNITS.
- MM CAPACITY IS NOT LARGE ENOUGH.

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MONTANA POWER
COLSTRIP 2

GENERAL PLANT INFORMATION

COMPANY NAME: MONTANA POWER COMPANY
ASSOCIATED UTILITIES: PUGET SOUND POWER & LIGHT
PLANT NAME: COLSTRIP
UNIT NUMBER: 2
PLANT ADDRESS: COLSTRIP POWER STATION
CITY: COLSTRIP
COUNTY: ROSEBUD
STATE: MONTANA
ZIP CODE: 59323
EPA REGION: 8
RIVER BASIN/LAKE REGION: YELLOWSTONE
REGULATORY CLASSIFICATION: NSPS (12/71)
PARTICLE EMISSION LIMITATION - LB/MM BTU: 0.1
SO2 EMISSION LIMITATION - LB/MM BTU: 1.2
NOX EMISSION LIMITATION - LB/MM BTU: 0.7
NET PLANT GENERATING CAPACITY - MW: 664
GROSS UNIT GENERATING CAPACITY - MW: 360
NET UNIT GENERATING CAPACITY WITH FGD - MW: 332
NET UNIT GENERATING CAPACITY W/O FGD - MW: 344
EQUIVALENT SCRUBBED CAPACITY - MW: 360

UNIT DATA (BOILER AND STACK)

BOILER SUPPLIER: COMBUSTION ENGINEERING
FURNACE TYPE (PULVERIZED COAL, CYCLONE, ETC.): PULVERIZED COAL
FURNACE FIRING METHOD: TANGENTIAL
WET BOTTOM/DRY BOTTOM: DRY BOTTOM
FURNACE DRAFT TYPE (FORCED, INDUCED, BALANCED): BALANCED
SERVICE LOAD (BASE, PEAK, STANDBY, ETC.): BASE
COMMERCIAL SERVICE DATE: 8/76
DESIGN BOILER FLUE GAS FLOW - ACFM: 1,430,000 (MAX. DESIGN)
FLUE GAS TEMPERATURE - F: 291
FLUE GAS OXYGEN - %: 5
HEAT RATE - BTU/KWH: 9400
DESIGN FIRING RATE - TPH: 180-198
EXCESS AIR - %: 21
CAPACITY FACTOR - %: 82 (1980); 72 (AVG. PLANNED FOR LIFE OF PLANT)
STACK HEIGHT - FT: 503
SHELL MATERIAL: CONCRETE
FLUE MATERIAL GENERIC TYPE: CARBON STEEL
FLUE MATERIAL SPECIFIC TYPE: AISI 1110
FLUE MATERIAL TRADE/COMMON NAME: N/A
FLUE LINER MATERIAL GENERIC TYPE: ORGANIC
FLUE LINER MATERIAL SPECIFIC TYPE: MICA FLAKE-FILLED POLYESTER
FLUE LINER MATERIAL TRADE/COMMON NAME: FLAKELINE 252
FLUE INNER DIAMETER - FT: 16.5
A STACK GAS INLET TEMPERATURE - F: 200
STACK GAS OUTLET VELOCITY - FT/SEC: 95

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MONTANA POWER
COLSTRIP 2

FUEL DATA (ACTUAL)

FUEL GRADE (LIGNITE, SUBBITUMINOUS, ETC.): SUBBITUMINOUS
NAME OF SUPPLIER: WESTERN ENERGY COMPANY
MINE NAME/AREA: COLSTRIP
MINE LOCATION - COUNTY: ROSEBUD
MINE LOCATION - STATE: MONTANA
AVERAGE HEAT CONTENT - BTU/LB: 8843
RANGE HEAT CONTENT - BTU/LB: 8162-8897
AVERAGE ASH CONTENT - %: 8.6
RANGE ASH CONTENT - %: 6.1-12.6
AVERAGE MOISTURE CONTENT - %: 23.9
RANGE MOISTURE CONTENT - %: 21-25
AVERAGE SULFUR CONTENT - %: 0.78
RANGE SULFUR CONTENT - %: 0.4-1.0
AVERAGE CHLORIDE CONTENT - %: 0.01
RANGE CHLORIDE CONTENT - %:
FUEL ANALYSIS METHOD (AVERAGE, SPOT, TYPICAL): AVERAGE
FUEL ANALYSIS DATE: _____

PARTICLE CONTROL GENERAL DATA

CONFIGURATION (INTEGRATED/SEGREGATED): INTEGRATED
SPACE REQUIREMENTS - SQ FT: _____

MECHANICAL COLLECTOR

NUMBER OF MECHANICAL COLLECTORS: NONE
NUMBER OF SPARES:
TYPE:
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:

ELECTROSTATIC PRECIPITATOR

NUMBER OF ELECTROSTATIC PRECIPITATORS: NONE
NUMBER OF SPARES:
TYPE (HOT SIDE/COLD SIDE):
SUPPLIER:
INLET FLUE GAS CAPACITY - ACFM:
INLET FLUE GAS TEMPERATURE - F:
PRESSURE DROP - IN. H2O:
PARTICLE OUTLET LOAD - GR/SCF:
PARTICLE REMOVAL EFFICIENCY - %:
FLUE GAS CONDITIONING TYPE:

PARTICLE SCRUBBER

B NUMBER OF PARTICLE SCRUBBERS: 3
NUMBER OF SPARES: 0

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

GENERIC TYPE (VENTURI, PACKED TOWER, ETC.): VENTURI
SPECIFIC TYPE (FIXED THROAT, MOBILE BED, ETC.): VARIABLE-THROAT/TOP ENTRY
PLUMB BOB

TRADE/COMMON NAME: N/A

SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES

DIMENSIONS - FT: 15 DIA THROAT (TRAY OUTSIDE DIA - 35; INSIDE DIA - 15)

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

C LINER MATERIAL GENERIC TYPE: INORGANIC

LINER MATERIAL SPECIFIC TYPE: PREFIRED BRICK/SHAPES

LINER MATERIAL TRADE/COMMON NAME: ACID-RESISTANT BRICK (LOW H₂O
ABSORPTION)

BOILER LOAD PER SCRUBBER (DESIGN) - %: 40

GAS CONTACTING DEVICE TYPE (MOBILE BALLS, RODS, ETC.): NONE

NUMBER OF GAS CONTACTING ZONES: 1

DISTANCE BETWEEN CONTACTING ZONES - IN.: N/A

D NUMBER OF SPRAY HEADERS: 2

NOZZLE MATERIAL: TYPE 316L STAINLESS STEEL

NOZZLE PRESSURE DROP - PSI:

LIQUID RECIRCULATION RATE - GPM: 6600

L/G RATIO - GAL/1000 ACF: 15

PH CONTROL ADDITIVE: LIME/ALKALINE FLY ASH

GAS-SIDE PRESSURE DROP - IN. H₂O: 17 (15-21 RANGE)

SUPERFICIAL GAS VELOCITY - FT/SEC: 170-220

INLET GAS FLOW RATE - ACFM: 477,000

INLET GAS TEMPERATURE - F: 291

INLET SO₂ LEVEL - PPM: 600 (AVG.)

INLET SO₂ LEVEL - LB/MM BTU: 2.3

INLET PARTICLE LEVEL - GR/SCF: 1.9-3.6

INLET PARTICLE LEVEL - LB/MM BTU: 8.03

OUTLET GAS FLOW RATE - ACFM:

OUTLET GAS TEMPERATURE - F: 130

OUTLET SO₂ LEVEL - PPM:

OUTLET SO₂ LEVEL - LB/MM BTU:

OUTLET PARTICLE LEVEL - GR/SCF: 0.018

OUTLET PARTICLE LEVEL - LB/MM BTU: 0.06

SO₂ REMOVAL EFFICIENCY - %:

PARTICLE REMOVAL EFFICIENCY - %: 99.5

FGD SYSTEM GENERAL DATA

E PROCESS TYPE (LIME, LIMESTONE, ETC.): LIME/ALKALINE FLY ASH

PROCESS ADDITIVES (MG/ADIPIC ACID/ETC.): NONE

SYSTEM SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES

A-E FIRM: BECHTEL

CONSTRUCTION FIRM: BECHTEL

APPLICATION (NEW/RETROFIT): NEW

PARTICLE DESIGN REMOVAL EFFICIENCY - %: 99.5

F SO₂ DESIGN REMOVAL EFFICIENCY - %: 60

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

CURRENT STATUS: OPERATIONAL
TERMINATION DATE: N/A
COMMERCIAL START-UP: 10/76
INITIAL START-UP: 5/76
CONSTRUCTION COMPLETION: 8/75
CONSTRUCTION INITIATION: 6/73
CONTRACT AWARDED: 10/72
LETTER OF INTENT SIGNED: N/A
INITIATED BID REQUEST: 1972 (SUMMER)
INITIATED PRELIMINARY DESIGN: 10/72

FGD DESIGN AND OPERATING PARAMETERS

DESIGN COAL SULFUR CONTENT - %: 1.0
DESIGN COAL HEAT CONTENT - BTU/LB: 8162
DESIGN COAL ASH CONTENT - %: 12.6
DESIGN COAL MOISTURE CONTENT - %: 25.0
DESIGN COAL CHLORIDE CONTENT - %: 0.01

FGD SYSTEM SPACE REQUIREMENTS - SQ FT: _____

FGD SYSTEM TURNDOWN RATIO: 6:1

FGD SYSTEM TURNDOWN METHOD: TAKE TRAINS OFF LINE

FGD SYSTEM PRESSURE DROP - IN. H₂O: 38

FGD SYSTEM OXIDATION - %: >99

FGD SYSTEM SCRUBBER RECYCLE LIQUOR - % SOLIDS: 12

FGD SYSTEM ABSORBER RECYCLE LIQUOR - % SOLIDS: 12

FGD SYSTEM MAINTENANCE RESPONSIBILITY LEVEL (SAME AS BOILER, LOWER, OR HIGHER): SAME AS BOILER

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MANHOURS/DAY): 152 (UNITS 1 & 2 COMBINED)

G FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(OPERATORS/SHIFT): 3 (UNITS 1 & 2 COMBINED)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT

H (MAINTENANCE PERSONNEL/SHIFT): 3 (1 & 2 COMBINED)

FGD SYSTEM OPERATION & MAINTENANCE REQUIREMENT
(MAINTENANCE SHIFTS/DAY): 3 (AS NEEDED)

I FGD SYSTEM MAINTENANCE BY OUTSIDE CONTRACTORS
(MANHOURS/YEAR): 3456 (PER UNIT)

TYPE OF FGD SYSTEM MAINTENANCE CREW (DEDICATED, ETC.): NON-DEDICATED
SCHEDULE FOR BOILER MAINTENANCE PERSONNEL

J ROTATION TO FGD SYSTEM: N/A, THE ENTIRE STATION MAINTENANCE IS
QUALIFIED FOR SCRUBBER WORK.

K TYPE OF MAINTENANCE SUPERVISORS (DEDICATED, ETC.): NON-DEDICATED EXCEPT
DURING OUTAGES

FGD SYSTEM BYPASS CAPABILITY (YES/NO): NO

RESTRICTIONS TO USING BYPASS: N/A

TIME SCHEDULE FOR REDUCED BOILER LOAD: NIGHTLY

TIME SCHEDULE FOR BOILER SHUTDOWNS: ONCE/YEAR (4 WEEKS)

PLANNED MAINTENANCE DURING REDUCED

BOILER LOAD (TYPE AND FREQUENCY): GENERAL CLEANING, EVERY MODULE IS
CLEANED AND INSPECTED AT LEAST ONCE/12
WEEKS

UTILITY EMISSION CONTROL SYSTEM DATA
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MONTANA POWER
COLSTRIP 2

PLANNED MAINTENANCE DURING BOILER

SHUTDOWNS (TYPE AND FREQUENCY):

TYPE OF MAINTENANCE PERFORMED WHEN FAILURE OCCURS (OTHER THAN CORRECTING
CAUSE OF FAILURE): IF THERE IS A BACKLOG OF MAINTENANCE, ONLY HIGH
PRIORITY ITEMS WOULD BE ADDRESSED. ITEMS NOT LIMITING
STATION OPERATIONS WOULD BE ADDRESSED LATER.

QUENCHER/PRESATURATOR

NUMBER OF QUENCHERS/PRESATURATORS: NONE

NUMBER OF SPARES:

TYPE:

LOCATION:

SUPPLIER:

SHELL MATERIAL GENERIC TYPE:

SHELL MATERIAL SPECIFIC TYPE:

SHELL MATERIAL TRADE/COMMON NAME:

LINER MATERIAL GENERIC TYPE:

LINER MATERIAL SPECIFIC TYPE:

LINER MATERIAL TRADE/COMMON NAME:

INLET GAS FLOW - ACFM:

INLET GAS TEMPERATURE - F:

PRESSURE DROP - IN. H2O:

LIQUID TYPE (MAKEUP WATER, RECLAIMED WATER, ABSORBER SLURRY, ETC.):

LIQUID RECIRCULATION RATE - GPM:

L/G RATIO - GAL/1000 ACF:

NUMBER OF SPRAY HEADERS:

NOZZLE MATERIAL:

NOZZLE PRESSURE DROP - PSI:

ABSORBER

NUMBER OF ABSORBERS: 3

NUMBER OF SPARES: 0

L GENERIC TYPE: COMBINATION

SPECIFIC TYPE: VENTURI SPRAY

TRADE/COMMON NAME: N/A

SUPPLIER: COMBUSTION EQUIPMENT ASSOCIATES

DIMENSIONS - FT: 35 DIA X 70.5 HIGH

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

M LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: INERT FLAKE/VINYL ESTER AND GLASS
FLAKE/POLYESTER

LINER MATERIAL TRADE/COMMON NAME: PLASITE 4030, PLASITE 4020, AND
RIGIFLAK 4850

BOILER LOAD PER ABSORBER - %: 40

GAS/LIQUID CONTACT DEVICE TYPE: VENTURI THROAT AND SPRAY ZONE

NUMBER OF GAS CONTACTING ZONES: 2

DISTANCE BETWEEN GAS CONTACTING ZONES - IN.: 240 BETWEEN VENTURI AND SPRAY
ZONE

UTILITY EMISSION CONTROL SYSTEM DATA
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MONTANA POWER
COLSTRIP 2

NUMBER OF SPRAY HEADERS: 10-14
NOZZLE MATERIAL: ALUMINUM OXIDE
N NOZZLE PRESSURE DROP - PSI: 40
LIQUID RECIRCULATION RATE - GPM: 7600
L/G RATIO - GAL/1000 ACF: 18
O GAS-SIDE PRESSURE DROP - IN. H2O: 17.5
P SUPERFICIAL GAS VELOCITY - FT/SEC: >9.0
Q ABSORBER TURNDOWN RATIO: 2:1
ABSORBER TURNDOWN METHOD: REDUCE GAS FLOW
INLET GAS FLOW RATE - ACFM: 426,600
INLET GAS TEMPERATURE - F: 120
INLET SO2 LEVEL - PPM: _____
INLET SO2 LEVEL - LB/MM BTU: _____
INLET PARTICLE LEVEL - GR/SCF: _____
INLET PARTICLE LEVEL - LB/MM BTU: _____
OUTLET GAS FLOW RATE - ACFM: _____
OUTLET GAS TEMPERATURE - F: 110-120
OUTLET SO2 LEVEL - PPM: 200
OUTLET SO2 LEVEL - LB/MM BTU: 0.6
R OUTLET PARTICLE LEVEL - GR/SCF: 0.03-0.13
OUTLET PARTICLE LEVEL - LB/MM BTU: 0.06
SO2 REMOVAL EFFICIENCY - %: 75-80
PARTICLE REMOVAL EFFICIENCY - %: 99.5

MIST ELIMINATOR

FUNCTION (PRE-MIST ELIMINATOR/MIST ELIMINATOR): (A) PRE-MIST ELIMINATOR
(B) MIST ELIMINATOR
(C) MIST ELIMINATOR

TOTAL NUMBER OF MIST ELIMINATORS: (A) 3 (B) 3 (C) 3

NUMBER OF SPARES: 0

NUMBER PER MODULE: (A) 1 (B) 1 (C) 1

GENERIC TYPE: (A) KNOCK-OUT (B) IMPINGEMENT (C) IMPINGEMENT

SPECIFIC TYPE: (A) WASH TRAY (B) BAFFLE (C) MESH

COMMON DESIGN: (A) IRRIGATION TRAY (B) CLOSED VANE
(C) KNITTED WIRE MESH PAD

MANUFACTURER: (A) KOCH (B) HEIL

CONFIGURATION (HORIZONTAL/VERTICAL): (A) HORIZONTAL (B) HORIZONTAL

SHAPE (Z-SHAPE/A-FRAME): (A) N/A (B) SINUSOIDAL

NUMBER OF STAGES: (A) 1 (B) 1 (C) 1

NUMBER OF PASSES/STAGE: (A) N/A (B) 4 (C) 1

FREEBOARD DISTANCE - FT: (B) 13

DISTANCE BETWEEN STAGES - IN.: N/A

DISTANCE BETWEEN VANES - IN.: (B) 1.0

VANE ANGLES - DEGREES: (B) 120

PRESSURE DROP - IN. H2O: (A) 2.5 (B) 0.2-0.4

P SUPERFICIAL GAS VELOCITY - FT/SEC: 5.8-11.9 (BOTH)

CONSTRUCTION MATERIAL GENERIC TYPE: (A) STAINLESS STEEL (B) ORGANIC
(C) STAINLESS STEEL

CONSTRUCTION MATERIAL SPECIFIC TYPE: (A) AUSTENITIC (B) POLYPHENYLENE
(C) AUSTENITIC

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MONTANA POWER
COLSTRIP 2

CONSTRUCTION MATERIAL TRADE/COMMON NAME: (A) TYPE 316L (B) NORYL® EN-265
(C) TYPE 316

S WASH WATER SOURCE (FRESH, BLENDED,
SUPERNATANT): (A) WASH TRAY RECYCLE (B) FRESH ABOVE AND BLENDED BELOW
POINT OF WATER COLLECTION: WASH TRAY
WASH DIRECTION (OVERSPRAY/UNDERSPRAY,
FRONTSpray/BACKSPRAY): (A) UNDERSPRAY (B) UNDERSPRAY AND OVERSPRAY
WASH FREQUENCY: (A) CONTINUOUS
(B) CONTINUOUS UNDERSPRAY AND ONCE/DAY OVERSPRAY
WASH DURATION: (A) N/A (B) 20 MINUTES OVERSPRAY (2 MIN/SECTION,
10 SECTIONS)
WASH RATE - GAL/MIN: (A) _____ (B) 360 UNDERSPRAY AND 450 OVERSPRAY
WASH COVERAGE - GAL/MIN/SQ FT: (A) _____ (B) _____

REHEATER

NUMBER OF REHEATERS: 3
NUMBER OF SPARES: 0
NUMBER PER MODULE: 1
GENERIC TYPE (IN-LINE, INDIRECT HOT AIR, IN-LINE BURNER, ETC.): IN-LINE
SPECIFIC TYPE (STEAM, HOT WATER, ETC.): STEAM (150 PSIG)
COMMON DESIGN (BARE OR FIN TUBES, GAS OR OIL, ETC.): PLATECOIL®
COMBUSTION FUEL SULFUR CONTENT - %: N/A

LOCATION: IN DUCT AFTER ABSORBER
AVERAGE PERCENT OF GAS BYPASSED FOR REHEAT: NONE
TEMPERATURE INCREASE - F: 70

INLET FLUE GAS FLOW RATE - ACFM: 426,600

INLET FLUE GAS TEMPERATURE - F: 120

OUTLET FLUE GAS FLOW RATE - ACFM: _____

OUTLET FLUE GAS TEMPERATURE - F: 170-180 (175 TYPICAL)

ENERGY REQUIREMENT - MM BTU/HR: _____

T NUMBER OF HEAT EXCHANGER BANKS: 6 PER ROW; 2 ROWS

NUMBER OF BUNDLES PER BANK: 11 PLATECOILS®

NUMBER OF TUBES PER BUNDLE: _____

STEAM OR WATER PRESSURE - PSIG: 150

STEAM OR WATER TEMPERATURE - F: 450

U SELF CLEANING DEVICE TYPE: STEAM SOOT BLOWERS (ONCE/HOUR)

V MATERIAL GENERIC TYPE: HIGH ALLOY; HIGH ALLOY

MATERIAL SPECIFIC TYPE: NICKEL BASE/CHROMIUM-IRON-MOLYBDENUM; NICKEL
BASE/CHROMIUM-IRON-COPPER-MOLYBDENUM

MATERIAL TRADE/COMMON NAME: INCONEL 625; HASTELLOY G

FANS

NUMBER OF FANS: 3

NUMBER OF SPARES: 0

DESIGN (CENTRIFUGAL, AXIAL, ETC.): CENTRIFUGAL

SUPPLIER: BUFFALO FORGE

FUNCTION (UNIT/BOOSTER): UNIT

APPLICATION (INDUCED DRAFT/FORCED DRAFT) - WRT ABSORBER: INDUCED DRAFT

SERVICE (WET/DRY): DRY

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MONTANA POWER
COLSTRIP 2

TYPE OF WASH: NONE
LOCATION WRT MAJOR COMPONENTS: BETWEEN REHEATER AND STACK
FLUE GAS FLOW RATE - ACFM: 473,000
FLUE GAS TEMPERATURE - F: 170-180
PRESSURE DROP - IN. H2O: 36
W MATERIAL GENERIC TYPE: CARBON STEEL; ORGANIC-LINED HOUSING
MATERIAL SPECIFIC TYPE: AISI 1110; SYNTHETIC RUBBER
MATERIAL TRADE/COMMON NAME: N/A; CHLOROBUTYL

DAMPERS

X LOCATION: (A) SCRUBBER INLET (B) SCRUBBER OUTLET (C) FAN INLET
NUMBER OF DAMPERS: (A) 3 (B) 3 (C) 6
FUNCTION (CONTROL/SHUT-OFF): (A) SHUT-OFF (B) SHUT-OFF (C) CONTROL
GENERIC TYPE (LOUVER, BUTTERFLY, ETC.): (A) BUTTERFLY (B) GUILLOTINE
(C) LOUVER
SPECIFIC TYPE (OPPOSED BLADE,
PARALLEL BLADE, ETC.): (A) N/A (B) SIDE-ENTRY GUILLOTINE
(C) PARALLEL BLADE MULTILOUVER
TRADE/COMMON DESIGN (SINGLE LOUVER/DOUBLE LOUVER): (A) N/A (B) N/A
(C) SINGLE LOUVER
MANUFACTURER: (A) ALLIS-CHALMERS (B) MOSSER (C) BUFFALO FORGE
MODULATION (OPEN/CLOSED, ETC.): (A) OPEN/CLOSED (B) OPEN/CLOSED
(C) VARIOUS

SEAL AIR - ACFM: N/A

SERVICE CONDITIONS (MAX GAS TEMP/TIME):

MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) STAINLESS STEEL
(C) CARBON STEEL (D) CARBON STEEL

MATERIAL SPECIFIC TYPE: (A) AISI 1110 (B) AUSTENITIC (C) AISI 1110

MATERIAL TRADE/COMMON NAME: (A) N/A (B) TYPE 316 (C) N/A

LINER MATERIAL GENERIC TYPE: NONE

LINER MATERIAL SPECIFIC TYPE: N/A

LINER MATERIAL TRADE/COMMON NAME: N/A

DUCTWORK

LOCATION: (A) INLET (B) OUTLET (C) REHEATER

CONFIGURATION (CIRCULAR, RECTANGULAR, ETC.): (A) CIRCULAR (B) RECTANGULAR
(C) RECTANGULAR

DIMENSIONS (DIAMETER, LENGTH, ETC.):

SHELL MATERIAL GENERIC TYPE: (A) CARBON STEEL (B) CARBON STEEL
(C) STAINLESS STEEL

SHELL MATERIAL SPECIFIC TYPE: (A) AISI 1110 (B) AISI 1110 (C) AUSTENITIC

SHELL MATERIAL TRADE/COMMON NAME: (A) N/A (B) N/A (C) TYPE 316L

LINER MATERIAL GENERIC TYPE: (A) NONE (B) ORGANIC (C) NONE

LINER MATERIAL SPECIFIC TYPE: (B) GLASS FLAKE-FILLED POLYESTER

LINER MATERIAL TRADE/COMMON NAME: (B) RIGIFLAK 4850

EXPANSION JOINTS

Y LOCATION: (A) PLENUM INLET (B) PLENUM OUTLET (C) SCRUBBER INLET
(D) SCRUBBER OUTLET (E) FAN INLET (F) FAN OUTLET
(G) STACK INLET

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MONTANA POWER
COLSTRIP 2

TYPE (METALLIC/ELASTOMERIC): ELASTOMERIC
FUNCTION (GAS CIRCUIT/LIQUID CIRCUIT): GAS CIRCUIT
PRESSURE (NEGATIVE/POSITIVE): NEGATIVE
OPERATING TEMPERATURE - F: (A) 291 (B) 291 (C) 291 (D) 130 (E) 175
(F) 200 (G) 200

DESIGN CONFIGURATION (V-SHAPED, ETC.): _____

MANUFACTURER: _____

Z MATERIAL: INCONEL MESH AND RUBBER (VITON®)

REAGENT PREPARATION EQUIPMENT

FUNCTION (LIMESTONE GRINDING, LIME SLAKING, ETC.): LIME SLAKING

PREPARATION DEVICE (BALL MILL, CRUSHER, ETC.): SLAKER

DEVICE TYPE (TUBE MILL, CONICAL MILL, ETC.): PASTE SLAKER

MANUFACTURER: BIF

MATERIALS: _____

NUMBER OF DEVICES: 2

NUMBER OF SPARES: 1

FULL LOAD DRY FEED CAPACITY - TPH: _____

PRODUCT QUALITY - % SOLIDS: 10

FULL LOAD PRODUCT QUANTITY EMPLOYED - GPM: _____

AA PREPARED REAGENT POINT OF ADDITION: RECYCLE TANK (BOTTOM OF ABSORBER)

BB ON-SITE STORAGE CAPABILITY - DAYS: 1

TANKS

*SEE ATTACHMENT A

PUMPS

*SEE ATTACHMENT B

MAJOR PIPING

FUNCTION (RECYCLE SLURRY, RECLAIMED

WATER, SLUDGE, ETC.): SLURRY RECYCLE, SLURRY TRANSFER, AND CLEAR WATER

DIMENSIONS - IN.: _____

MANUFACTURER: _____

CC MATERIAL: RUBBER-LINED CARBON STEEL; TYPE 316 STAINLESS STEEL

MAJOR VALVES

LOCATION: (A) VENTURI RETURN LINES (B) BEFORE AND AFTER RECYCLE PUMPS

(C) TRAY RECYCLE HEADER

FUNCTION (ISOLATION, CONTROL, ETC.): (A) CONTROL (B) ISOLATION

(C) ISOLATION

TYPE (BALL, GLOBE, PLUG, ETC.): (A) PINCH (B) PLUG (C) PLUG

CONTROL MODE (AUTOMATIC/MANUAL): AUTOMATIC/MANUAL

DIMENSIONS - IN.: (A) 3-4 (B) 12-18 (C) 12-18

MANUFACTURER: (A) R.K.L. (B) DEZURIK (C) DEZURIK

MATERIAL: (A) FIBER-REINFORCED RUBBER LINED (B) RUBBER LINED CARBON STEEL

(C) TYPE 316 STAINLESS STEEL (SOME ARE RUBBER LINED)

THICKENERS

NUMBER OF THICKENERS: NONE

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MONTANA POWER
COLSTRIP 2

NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY - GAL:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
RAKE MATERIAL:
FEED STREAM SOURCE:
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SOLIDS DEWATERING

DEVICE GENERIC TYPE (CENTRIFUGE, VACUUM FILTER, ETC.): NONE
DEVICE SPECIFIC TYPE (DRUM, HORIZONTAL BELT, ETC.):
DEVICE COMMON DESIGN (ROTARY, BELT FILTER, ETC.):
NUMBER OF DEVICES:
NUMBER OF SPARES:
CONFIGURATION:
DIMENSIONS - FT:
CAPACITY:
SHELL MATERIAL GENERIC TYPE:
SHELL MATERIAL SPECIFIC TYPE:
SHELL MATERIAL TRADE/COMMON NAME:
LINER MATERIAL GENERIC TYPE:
LINER MATERIAL SPECIFIC TYPE:
LINER MATERIAL TRADE/COMMON NAME:
BELT MATERIAL GENERIC TYPE:
BELT MATERIAL SPECIFIC TYPE:
BELT MATERIAL TRADE/COMMON NAME:
FEED STREAM SOURCE (ABSORBER BLEED, THICKENER UNDERFLOW, ETC.):
FEED STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OVERFLOW STREAM CHARACTERISTICS (VOLUME FLOW RATE, PERCENT SOLIDS):
OUTLET STREAM DISPOSITION:
OVERFLOW STREAM DISPOSITION:

SLUDGE

DD FULL LOAD QUANTITY - TPH/DRY: _____

MOISTURE CONTENT - % TOTAL FREE WATER: _____

PERCENT CASO3 - DRY: _____

PERCENT CASO4 - DRY: _____

PERCENT CAOH2 - DRY: _____

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MONTANA POWER
COLSTRIP 2

PERCENT CaCO₃ - DRY: _____
PERCENT ASH - DRY: _____
PERCENT OTHER COMPOUNDS - DRY: _____

SLUDGE TREATMENT

METHOD: NONE
COMMON DESIGN (RECYCLE STREAM, BLEED STREAM, ETC.):
DEVICE (OXIDATION TANK, PUG MILL, ETC.):
PROPRIETARY PROCESS (IUCS, DRAVO, ETC.):
INLET FLOW RATE - GPM:
INLET QUALITY - % SOLIDS:

SLUDGE DISPOSAL

NATURE (INTERIM/FINAL): FINAL
EE GENERIC TYPE (LANDFILL, POND, ETC.): POND
SPECIFIC TYPE (DIKED, SIDE HILL, ETC.): DIKED
COMMON DESIGN (ABANDONED SURFACE MINE, ETC.): BELOW GRADE
LOCATION (ON-SITE/OFF-SITE): ON-SITE
TRANSPORTATION METHOD (PIPELINE, TRUCK, ETC.): PIPELINE
SITE TREATMENT (CLAY LINING, SYNTHETIC LINING, ETC.): BENTONITE CLAY LINING
EE SITE DIMENSIONS - AREA/DEPTH: _____
EE SITE CAPACITY - VOLUME/ACRE-FT/TONS: _____
SITE SERVICE LIFE - YEARS: 2-3 (IF NOT DREDGED)

PROCESS CONTROL AND INSTRUMENTATION

PROCESS STREAM: RECIRCULATING SLURRY
FF CHEMICAL PARAMETERS (PH, ETC.): PH
FF PHYSICAL PARAMETERS (PERCENT SOLIDS, DENSITY,
FLOW, ETC.): % SOLIDS, FLOW, PRESSURE
CONTROL LEVELS: PH 4.5 TO 5.5
MONITOR TYPE (MANUFACTURER, ETC.): _____
MONITOR LOCATION: RECIRCULATION TANK
PROCESS CONTROL MANNER (AUTOMATIC/MANUAL): MANUAL
PROCESS CONTROL MODE (FEEDBACK/FEED FORWARD): FEEDBACK

WATER BALANCE

WATER BALANCE ENTRIES (DESIGN/ACTUAL): DESIGN AND ACTUAL
TYPE (OPEN/CLOSED): CLOSED
EVAPORATION WATER LOSS - GPM: 30
SLUDGE HYDRATION WATER LOSS - GPM: _____
SLUDGE INTERSTITIAL WATER LOSS - GPM: _____
POND SEEPAGE/RUNOFF WATER LOSS - GPM: 0
EFFLUENT WATER LOSS - GPM: _____
RECEIVING WATER STREAM NAME: _____
GG MAKEUP WATER ADDITION - GPM: 290
SOURCE OF MAKEUP WATER (RIVER WATER, ETC.): ME WASH, LIME SLAKER, AND
SEAL WATER
MAKEUP WATER ADDITION POINTS & AMOUNTS: LIME SLAKER, MIST ELIMINATOR WASH
SYSTEM AND SEAL WATER SYSTEM

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MONTANA POWER
COLSTRIP 2

MAKEUP WATER PRE-TREATMENT TYPE: CLARIFIER, PLANT WATER SOFTENER, AND BRINE
EVAPORATOR

CHEMICALS AND CONSUMPTION

FUNCTION (ABSORBENT, SOLIDS SETTLING, ETC.): ABSORBENT

NAME (LIMESTONE, ADIPIC ACID, ETC.): LIME/FLY ASH

PRINCIPAL CONSTITUENTS: 90% CaO/16-21% CaO AND 5% MgO

SOURCE/SUPPLIER: PETE LIENE

SUPPLIER LOCATION: RAPID CITY, SOUTH DAKOTA

HH CONSUMPTION (SPECIFY UNITS): 5 TPD (LIME)

UTILIZATION - %:

POINT OF ADDITION: SLAKER

II ECONOMICS (ADJUSTED FOR CONSISTENCY; MID-1980 TIME BASE; 65% CAPACITY FACTOR)

CAPITAL COST - \$: 96,400,000

CAPITAL COST - \$/KW: 134

OPERATING COST - MILLS/KWH: 3.20

MAINTENANCE COST: \$2,430,000/YR

LABOR COST: \$849,000/YR

UTILITIES COST: \$3,310,000/YR

CHEMICALS COST: \$2,090,000/YR

WASTE DISPOSAL COST: \$1,070,000/YR

FGD SPARE CAPACITY INDICES

SCRUBBER - %: 20

ABSORBER - %: 20

MIST ELIMINATOR - %: 0

REHEATER - %: 50

FAN - %: 20

BALL MILL - %: N/A

SLAKER - %: 100

EFFLUENT HOLD TANK - %: 20

RECIRCULATION PUMP - %: 50

THICKENER - %: N/A

VACUUM FILTER - %: N/A

CENTRIFUGE - %: N/A

FGD SPARE COMPONENT INDICES

SCRUBBER: 0.5

ABSORBER: 0.5

MIST ELIMINATOR: 0

REHEATER: 0

FAN: 0.5

BALL MILL: N/A

SLAKER: 1

EFFLUENT HOLD TANK: 0.5

RECIRCULATION PUMP: 1

THICKENER: N/A

VACUUM FILTER: N/A

CENTRIFUGE: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

PILOT PLANT

UNIT NUMBER: J. E. CORETTE

PARTICIPANTS: BECHTEL, CEA, A. D. LITTLE, MONTANA POWER, PUGET SOUND
POWER & LIGHT

PROCESS: LIME/ALKALINE FLY ASH

PLANT DESIGN: CEA/ADL

SUPPLIER: CEA/ADL

SERVICE DATE: 1/73

PERIOD OF OPERATION - MONTHS: 24

GAS FEED: SLIP STREAM UPSTREAM OF ESP

EQUIVALENT SCRUBBED CAPACITY - MW: 0.75 to 1 MW

JJ STATUS (ACTIVE/TERMINATED): TERMINATED

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

ATTACHMENT A

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): VENTURI/ABSORBER RECYCLE

NUMBER OF TANKS: 3

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): COVERED

LOCATION: TANK IS BOTTOM OF ABSORBER VESSEL

CONFIGURATION: CYLINDRICAL

DIMENSIONS - FT: 35 DIAMETER (BOTTOM PART OF MODULE)

CAPACITY - GAL: 113,600

RETENTION TIME - MIN: 8

NUMBER OF AGITATORS: 1

AGITATOR CONFIGURATION: BOTTOM ENTERING

AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS STEEL SHAFT

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER

LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850 AND PLASITE 4030

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY TRANSFER

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): COVERED

LOCATION: SLAKER BUILDING

CONFIGURATION: CIRCULAR

DIMENSIONS - FT: 4 DIA X 4

CAPACITY - GAL: 90

RETENTION TIME - MIN: _____

NUMBER OF AGITATORS: 1

AGITATOR CONFIGURATION: _____

AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS STEEL SHAFT

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER

LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): SLURRY STORAGE

NUMBER OF TANKS: 1

NUMBER OF SPARES: 0

TYPE (OPEN/COVERED): COVERED

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

LOCATION: SLAKER BUILDING
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 12 DIA X 20.5
CAPACITY - GAL: 17,000
RETENTION TIME - MIN: 960
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION:
AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS
STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): EFFLUENT BLEED
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): OPEN
LOCATION: IN SCRUBBER ALLEY
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 10.5 DIA X 18.5
CAPACITY - GAL: 12,000
RETENTION TIME - MIN: 4
NUMBER OF AGITATORS: 1
AGITATOR CONFIGURATION:
AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL BLADE AND TYPE 316 STAINLESS
STEEL SHAFT
SHELL MATERIAL GENERIC TYPE: CARBON STEEL
SHELL MATERIAL SPECIFIC TYPE: AISI 1110
SHELL MATERIAL TRADE/COMMON NAME: N/A
LINER MATERIAL GENERIC TYPE: ORGANIC
LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER
LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

TANKS

FUNCTION (ABSORBER EFFLUENT HOLD, SCRUBBER RECYCLE, ETC.): TRAY WASH WATER
RECYCLE
NUMBER OF TANKS: 1
NUMBER OF SPARES: 0
TYPE (OPEN/COVERED): COVERED
LOCATION: OPEN AREA BEHIND SCRUBBER VESSELS
CONFIGURATION: CIRCULAR
DIMENSIONS - FT: 18 DIA X 18
CAPACITY - GAL: 34,000
RETENTION TIME - MIN:
NUMBER OF AGITATORS: 1

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

AGITATOR CONFIGURATION: TOP ENTRY

AGITATOR MATERIALS: RUBBER-CLAD MILD STEEL WITH TYPE 316 STAINLESS STEEL
HUB

SHELL MATERIAL GENERIC TYPE: CARBON STEEL

SHELL MATERIAL SPECIFIC TYPE: AISI 1110

SHELL MATERIAL TRADE/COMMON NAME: N/A

LINER MATERIAL GENERIC TYPE: ORGANIC

LINER MATERIAL SPECIFIC TYPE: GLASS FLAKE-FILLED POLYESTER

LINER MATERIAL TRADE/COMMON NAME: RIGIFLAK 4850

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

ATTACHMENT B

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): VENTURI
RECIRCULATION

NUMBER OF PUMPS: 6

KK NUMBER OF SPARES: 3

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER: D65

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 6600

MOTOR BRAKE HP: 250

SPEED - RPM: _____

HEAD - FT: 90

SERVICE (PH, SOLIDS): PH 4-5, 12% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON

CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON

CASING MATERIAL TRADE/COMMON NAME: N/A

IMPELLER MATERIAL GENERIC TYPE: RUBBER LINED

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): ABSORBER
RECIRCULATION

NUMBER OF PUMPS: 6

KK NUMBER OF SPARES: 3

GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT

SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL

COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

MANUFACTURER: ALLEN-SHERMAN-HOFF

PUMP MODEL NUMBER: C65

PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT

CAPACITY - GPM: 7600

MOTOR BRAKE HP: 250

SPEED - RPM: _____

HEAD - FT: 90

SERVICE (PH, SOLIDS): PH 4-5, 12% SOLIDS

CASING MATERIAL GENERIC TYPE: RUBBER LINED

CASING MATERIAL SPECIFIC TYPE: _____

CASING MATERIAL TRADE/COMMON NAME: _____

IMPELLER MATERIAL GENERIC TYPE: RUBBER LINED

IMPELLER MATERIAL SPECIFIC TYPE: _____

IMPELLER MATERIAL TRADE/COMMON NAME: _____

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): POND RETURN

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

LL NUMBER OF PUMPS: 3
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: INGERSOLL-RAND
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
MM CAPACITY - GPM: 1900
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 40
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: ASTM A532 TYPE 3
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: ASTM A532 TYPE 3
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): LIME SYSTEM
NUMBER OF PUMPS: _____
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): _____
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): _____
COMMON DESIGN (V-BELT, ETC.): _____
MANUFACTURER: WORTHINGTON
PUMP MODEL NUMBER: _____
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): _____
CAPACITY - GPM: _____
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: _____
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: CARBON STEEL
CASING MATERIAL SPECIFIC TYPE: _____
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: CARBON STEEL
IMPELLER MATERIAL SPECIFIC TYPE: _____
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): EFFLUENT BLEED
NUMBER OF PUMPS: 2
NUMBER OF SPARES: 1
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

MANUFACTURER: A-S-H
PUMP MODEL NUMBER: C-6-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 1300
MOTOR BRAKE HP: _____
SPEED - RPM: _____
HEAD - FT: 50
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE: GRAY CAST IRON
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

PUMPS

FUNCTION (ADDITIVE FEED, ABSORBER RECIRCULATION, ETC.): TRAY WASH WATER
RECYCLE

NUMBER OF PUMPS: 2
NUMBER OF SPARES: _____
GENERIC TYPE (CENTRIFUGAL, DIAPHRAGM, ETC.): NONDISPLACEMENT
SPECIFIC TYPE (BELT DRIVE, DIRECT DRIVE, ETC.): CENTRIFUGAL
COMMON DESIGN (V-BELT, ETC.): SINGLE-ADMISSION INTAKE
MANUFACTURER: A-S-H
PUMP MODEL NUMBER: D-6-5
PUMP DRIVE (BELT, VARIABLE, DIRECT, ETC.): BELT
CAPACITY - GPM: 7600
MOTOR BRAKE HP: 300
SPEED - RPM: 555
HEAD - FT: 80
SERVICE (PH, SOLIDS): _____
CASING MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
CASING MATERIAL SPECIFIC TYPE: GRAY CAST IRON
CASING MATERIAL TRADE/COMMON NAME: N/A
IMPELLER MATERIAL GENERIC TYPE: RUBBER-LINED CAST IRON
IMPELLER MATERIAL SPECIFIC TYPE: GRAY CAST IRON
IMPELLER MATERIAL TRADE/COMMON NAME: N/A

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

COMMENTS/FOOTNOTES

- A THE GAS TEMPERATURE AT THE REHEATER OUTLET IS ABOUT 175 F. THIS IS INCREASED BY COMPRESSION OF THE FAN TO 200 F.
- B SAME VESSEL AS ABSORBER.
- C IN THROAT AREA; TYPE 316L STAINLESS STEEL PLUMB BOB.
- D THERE ARE TWO SPRAY HEADERS, ONE FOR THE TANGENTIAL "RACETRACK" SPRAY AT THE THROAT AND ONE FOR THE 4 NOZZLES THAT SPRAY DOWN ON THE BARREL. BOTH GET THE SAME LIQUOR.
- E THE FLY ASH PROVIDES THE MAJORITY OF THE ALKALINE MATERIAL.
- F BASED ON THE COAL OUT OF THE PULVERIZERS AND FLUE GAS OUT OF THE STACK, THE SO₂ REMOVAL IS 83%. THIS INCLUDES THE SULFUR REMOVED WITH THE BOTTOM ASH. THE 60% FIGURE SHOWN HERE IS BASED ON THE EMISSION LIMITATION REQUIREMENT. 80% IS TYPICAL.
- G 3 OPERATORS/SHIFT, 3 SHIFTS/DAY FOR UNITS 1 AND 2 COMBINED. 1 CONTROL ROOM OPERATOR AND 2 FLOOR OPERATORS CHECKING NOZZLES, PH, LIME SYSTEM, PUMPS, ETC. - 7 DAYS/WEEK.
- H 30% OF THE 32-MAN STATION MAINTENANCE CREW IS DEDICATED TO THE SCRUBBERS. THERE ARE 10 INDIVIDUALS SCHEDULED TO PERFORM PREVENTIVE MAINTENANCE AND FAILURE REPAIRS DURING A 24-HOUR PERIOD (80 MAN-H/DAY). PM IS ON A SCHEDULED ROTATION. MAINTENANCE PERSONS ARE TAKEN ON AN AS-NEEDED BASIS FOR FAILURES.
- I ONLY DURING OVERHAUL OR MAJOR BREAKDOWN OF BOILER AND/OR SCRUBBER. USED REGULARLY ONCE/YEAR FOR 4 WEEKS PER UNIT.
- J THERE IS A 3-MONTH ROTATION FOR FLOOR OPERATORS. CONTROL BOARD OPERATORS ARE ROTATED AS DICTATED BY PROMOTION OR ATTRITION (6-8 MONTHS).
- K THERE ARE ONLY DEDICATED SUPERVISORS DURING UNIT OUTAGES. DURING NON-UNIT OUTAGES THE STATION MAINTENANCE SUPERVISORS OVERSEE SCRUBBER MAINTENANCE.
- L PRIMARY SO₂ REMOVAL OCCURS IN THE VARIABLE THROAT VENTURI WITHIN THE TOWER VESSEL.
- M ABSORBER WALLS WERE ORIGINALLY LINED WITH RIGIFLAK 4850. POOR ADHESION CAUSED THE LINING TO BE REPLACED WITH PLASITE 4030 AND PLASITE 4020 EXCEPT IN THE LOWER PORTION OF THE VESSEL.
- N 1109 IN. H₂O.
- O 17.5 (VENTURI), 3.5-5.2 (ME/WASH TRAY), 3.5 (REHEATER) - APPROXIMATELY 26 INCHES H₂O FROM SCRUBBER INLET TO REHEATER OUTLET.
- P RANGES FROM 5.8 TO 11. THE MIST ELIMINATORS ARE DESIGNED FOR 8.7. ACTUAL IS SLIGHTLY GREATER THAN 9.0.
- Q BASED ON WASH TRAY CONSTRAINTS.
- R ACTUAL IS BELOW 0.03 GR/SCF (OR LESS THAN 0.06 LB/MM BTU).
- S MIST ELIMINATOR UNDERSPRAY IS A BLEND OF 83% WASH TRAY RECYCLE WATER AND 17% RIVER WATER.
- T 2 BANKS, ONE IS INCONEL 625, THE OTHER IS HASTELLOY G AND THEY PROVIDE TEMPERATURE BOOSTS OF 20 AND 50 F, RESPECTIVELY.
- U LOCATED AT TOP OF BANKS WHERE FLUE GAS ENTERS AND BETWEEN BANKS.
- V UPPER INLET ROW IS INCONEL 625 AND LOWER OUTLET ROW IS HASTELLOY G.
- W COR-TEN STEEL CENTER PLATE. HOUSING LININGS ARE BEING REPLACED WITH CHLOROBUTYL RUBBER BECAUSE OF "CHECKING" (TEMPERATURE AND WEAR PROBLEMS).

UTILITY EMISSION CONTROL SYSTEM DATA
DATE: 8/18/81

MONTANA POWER
COLSTRIP 2

COMMENTS/FOOTNOTES (CONTINUED)

- X THE FAN INLET HAS A SPLIT DUCT. EACH HALF HAS A LOUVER DAMPER. THE SCRUBBER INLET IS JUST OFF THE COMMON PLENUM. THE SCRUBBER OUTLET IS RIGHT AT THE STACK. THERE ARE ALSO CONTROL LOUVERS AT THE FAN INLET.
- Y THERE ARE 7 EXPANSION JOINTS PER MODULE IN ADDITION TO THE EXPANSION JOINT AT THE COMMON PLENUM INLET.
- Z FORMERLY FIBER-REINFORCED RUBBER.
- AA JUST ABOVE WATER LINE.
- BB 3-MONTHS (LIME), 24 HOURS (SLAKED LIME). LIME IS DELIVERED BY 20-TON CAPACITY TRUCKS AND IS PNEUMATICALLY CONVEYED TO A 564-TON CAPACITY CARBON STEEL SILO FOR EACH UNIT.
- CC MAKEUP LINES AND TRAY POND RETURN FEED LINES WERE FRP (THESE ARE UNDERGROUND). THEY WERE REPLACED WITH RUBBER-LINED CARBON STEEL PIPING BECAUSE OF SHOCK DAMAGE DURING COLD WEATHER. ALL PIPING 4 INCHES DIAMETER OR LESS IS MADE OF TYPE 316 STAINLESS STEEL.
- DD DETAILS ARE NOT AVAILABLE; HOWEVER, THE MATERIAL IS PRIMARILY FLY ASH AND CALCIUM SULFATE - CaSO_4 (95% OXIDIZED).
- EE THERE ARE TWO 15-ACRE PONDS THAT VARY FROM 20 TO 30 FT DEEP. THESE ARE CONTINUALLY DREDGED 7 TO 8 MONTHS/YEAR. THE MATERIAL IS DISPOSED IN A 150-ACRE POND HAVING 10 YEARS OF DISPOSAL CAPACITY REMAINING (AS OF 8/81). THERE ARE PLANS FOR ANOTHER 150-ACRE POND. THE PONDS HAVE A NATURAL CLAY LINING EXCEPT AT THE DAMS WHERE CLAY WAS LAID TO SEAL THE POND. THERE IS ALSO A SEPARATE BENTONITE CLAY-LINED POND 355 FT BY 210 FT (1.7 ACRE) BY 20 FT FOR THE TRAY WATER RECYCLE SYSTEM. DECANTED WATER IS BROUGHT BACK TO THE WASH TRAY AND SCRUBBER RECYCLE LOOPS OF BOTH UNITS.
- FF AUTOMATIC MONITORS USUALLY DO NOT WORK. READINGS ARE TAKEN BY HAND SAMPLES.
- GG 97 PER MODULE.
- HH 2400 TPY FOR UNITS 1 AND 2 COMBINED.
- II UNITS 1 AND 2 COMBINED.
- JJ THE PLANT IS STILL ON SITE AND COULD BE USED AGAIN IF REQUIRED.
- KK THREE SPARE PUMPS SERVICE EITHER VENTURI OR ABSORBER SPRAY NOZZLES.
- LL 3 PUMPS SHARED BY 2 UNITS.
- MM CAPACITY IS NOT LARGE ENOUGH.

SECTION 4
PERFORMANCE DATA

Utility/unit	Date	Period Hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Montana Power Colstrip 1	9/75	720	72	System		0		Initial startup/shakedown operations commenced
	10/75	744	456	System		0		
Commercial start-up	11/75	720	576	System		0		
	12/75	744	720	System		0		
	1/76	744	672	System		90		
	2/76	696	624	System		98		
	3/76	744	576	System		98		
	4/76	720	672	System		74		
	5/76	744	336	System		97		
	6/76	720	0	System	0	0		
	7/76	744	480	System		93		
	8/76	744	552	System		95		
	9/76	720	720	System		89		
	10/76	744	720	System		80		Temperature excursion resulted in damage (mist eliminators and linings) to system components (emergency scrubber quench water supply system failed to operate)
	11/76	720	720	System		63	ID fan	Fan motor failed
	12/76	744	744	System		74		
	1/77	744	744	System		93		
	2/77	672	48	System		95		
	3/77	744	0	System	0	0		

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Colstrip 1 (continued)								
	4/77	720	600	System		83		
	5/77	744	624	System		85		
	6/77	720	672	System		87		
	7/77	744	696	System		85		
	8/77	744		System		93		
	9/77	720		System		93		
	10/77	744		System		96		
	11/77	720		System		96		
	12/77	744		System		98		
	1/78	744		System		96		
	2/78	672		System		100		
	3/78	744		System		92		
	4/78	720		System		100		
	5/78	744		System	10	66	ID fan	Motor repairs continued on Module 1A ID fan
	6/78	720		System		76		
	7/78	744		System		96		
	8/78	744		System		97		
	9/78	720		System		96		
	10/78	744		System		95		
	11/78	720		System		91		

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Colstrip 1 (continued)	12/78	744		System		97		
	1/79	744		System		98		
	2/79	672		System		90		
	3/79	744		System		97		
	4/79	720		System	597	99		
	5/79	744		System		90		
	6/79	720		System		95	System	During May and June the unit was shut down for a system overhaul (availability for these periods was based on operations before and after overhaul)
	7/79	744		System		98		
	8/79	744		System		97		
	9/79	720		System		95		
	10/79	744		System		93		
	11/79	720		System		98	System	Routine maintenance performed
	12/79	744		System		96		
	1/80	744		System		97		
	2/80	696		System		97		
	3/80	744		System		95		
	4/80	720		System		100		
	5/80	744		System			System	Unit down for a scheduled boiler/FGD system outage for routine maintenance

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Colstrip 1 (continued)	6/80	720		System		78		
	7/80	744		System		99		
	8/80	744		System		99		
	9/80	720		System		98		
	10/80	744		System				Information for the fourth quarter 1980 was not available
	11/80	720		System				
	12/80	744		System				

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail- ability	Problem equipment area	Problem description/comments
Montana Power Colstrip 2	5/76	744	72	System		100		Initial startup/shakedown operations commenced
	6/76	720	384	System		100		
	7/76	744	312	System		99		
	3/76	744	240	System		96		
	3/76	720	720	System		98		
Commercial start-up	10/76	744	744	System		90		
	11/76	720	720	System		94		
	12/76	744	744	System		93		
	1/77	744	720	System		83		
	2/77	572	648	System		94		
	3/77	744	672	System		97		
	4/77	720	696	System		85		
	5/77	744	312	System		63		
	6/77	720	672	System		88		
	7/77	744	672	System		91		
	8/77	744		System		81		
	9/77	720		System		90		
	10/77	744		System		77	System	Boiler/FGD system maintenance outage (98 percent availability when boiler outage is excluded)

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Availability	Problem equipment area	Problem description/comments
Colstrip 2 (continued)	11/77	720		System		98		
	12/77	744		System		98		
	1/78	744		System		97		
	2/78	672		System		95		
	3/78	744		System		89		Boiler scheduled maintenance outage
	4/78	720		System		87		
	5/78	744		System		99		
	6/78	720		System		97		
	7/78	744		System		96		
	8/78	744	0	System	0	99		
	9/78	720	0	System	0	94		
	10/78	744	0	System	0	99		
	11/78	720	0	System	0	99		
	12/78			System		91		
	1/79	744		System		94		
	2/79	672		System		98		
	3/79	744		System		94		
	4/79	720		System		100		Unit overhauled (availability figures are based upon operations before and after the overhaul)
	5/79	744		System		94		

(continued)

Utility/unit	Date	Period hours	Boiler hours	Module	FGD hours	Avail-ability	Problem equipment area	Problem description/comments
Colstrip 2 (continued)	6/79	720		System		98		
	7/79	744		System		96		
	8/79	744		System		99		
	9/79	720		System		92		
	10/79	744		System		93		
	11/79	720		System		98		High availabilities are due to the ability to perform routine maintenance while modules are on line
	12/79	744		System		96		
	1/80	744		System		93		
	2/80	696		System		98		
	3/80	744		System		98		
	4/80	720		System			System	Boiler/FGD system scheduled maintenance outage
	5/80	744		System		94		
	6/80	720		System		96		
	7/80	744		System		100		
	8/80	744		System		96		
	9/80	720		System		91		
	10/80	744		System				Information for the fourth quarter 1980 was not available
	11/80	720		System				
	12/80	744		System				