

SUMMARY REPORT • FLUÉ GAS DESULFURIZATION SYSTEMS • MARCH - APRIL 1976

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Contract No. 68-02-1321  
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**Table 1**  
**SUMMARY LIST OF FGD SYSTEMS**

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SUMMARY LIST OF FGD SYSTEMS**

**FGD STATUS REPORT 05/76**

<b>I.D. NUMBER AND COMPANY NAME</b>	<b>UNIT NAME</b>	<b>LOCATION</b>	<b>START UP DATE</b>	<b>STATUS</b>	<b>REG CLASS</b>
1 ALABAMA ELECTRIC COOP	TOMBIGBEE NO. 2	JACKSON ALABAMA	3-78	3	A
2 ALABAMA ELECTRIC COOP	TOMBIGBEE NO. 3	JACKSON ALABAMA	3-79	3	A
3 ALLEGHENY POWER SYSTEM	PLEASANTS NO. 1	BELLMONT W VIRGINIA	3-79	3	A
4 ALLEGHENY POWER SYSTEM	PLEASANTS NO. 2	BELLMONT W VIRGINIA	3-80	3	A
5 ARIZONA ELECTRIC POWER COOP	APACHE NO 2	COCHISE ARIZONA	6-78	4	B
6 ARIZONA ELECTRIC POWER COOP	APACHE NO 3	COCHISE ARIZONA	6-79	4	B
7 ARIZONA PUBLIC SERVICE	CHOLLA NO 1	JOSEPH CITY ARIZONA	10-73	1	B
8 ARIZONA PUBLIC SERVICE	CHOLLA NO 2	JOSEPH CITY ARIZONA	6-77	2	B
9 ARIZONA PUBLIC SERVICE	FOUR CORNERS NO. 4	FARMINGTON NEW MEXICO	0- 0	6	B
10 ARIZONA PUBLIC SERVICE	FOUR CORNERS NO. 5A	FARMINGTON NEW MEXICO	2-76	1	B
11 ARIZONA PUBLIC SERVICE	FOUR CORNERS NO. 5B	FARMINGTON NEW MEXICO	0- 0	6	B
12 BASIN ELECTRIC POWER COOP	BEULAH NO. 1	BEULAH NORTH DAKOTA	0-81	6	B
13 BASIN ELECTRIC POWER COOP	BEULAH NO. 2	BEULAH NORTH DAKOTA	0-81	6	B
14 BASIN ELECTRIC POWER COOP	MISSOURI BASIN NO 1	WHEATLAND WYOMING	1-80	6	B
15 BASIN ELECTRIC POWER COOP	MISSOURI BASIN NO 2	WHEATLAND WYOMING	6-80	6	B
16 BASIN ELECTRIC POWER COOP	MISSOURI BASIN NO 3	WHEATLAND WYOMING	6-83	6	B
17 BRAZOS ELECTRIC POWER COOP	G & T COOPERATIVE PROJECT NO.1	SAN MIGUEL TEXAS	12-79	3	E
18 CENTRAL ILLINOIS LIGHT CO.	DUCK CREEK NO.1	CANTON ILLINOIS	6-76	2	A
19 CENTRAL ILLINOIS LIGHT CO.	DUCK CREEK NO.2	CANTON ILLINOIS	1-82	6	A
20 CENTRAL ILLINOIS LIGHT CO.	E.D.EDWARDS NO.3	BARTONVILLE ILLINOIS	7-79	6	C
21 CENTRAL ILLINOIS PUBLIC SERV	NEWTON NO.1	NEWTON ILLINOIS	12-77	5	A
22 CINCINNATI GAS & ELECTRIC CO.	EAST BEND NO 2	RABBIT HASH KENTUCKY	1-80	6	A
23 CINCINNATI GAS & ELECTRIC CO.	MIAMI FORT NO 8	NORTH BEND OHIO	1-78	5	D
24 COLUMBUS & SOUTHERN OHIO ELEC.	CONESVILLE NO 5	CONESVILLE OHIO	6-76	2	B
25 COLUMBUS & SOUTHERN OHIO ELEC.	CONESVILLE NO 6	CONESVILLE OHIO	1-78	3	B
26 COLUMBUS & SOUTHERN OHIO ELEC.	POSTON NO. 5	ATHENS OHIO	0-81	6	B
27 COLUMBUS & SOUTHERN OHIO ELEC.	POSTON NO. 6	ATHENS OHIO	0-83	6	B
28 COMMONWEALTH EDISON	POWERTON NO. 51	PEKIN ILLINOIS	12-79	3	C
29 COMMONWEALTH EDISON	WILL COUNTY NO 1	ROMEOVILLE ILLINOIS	2-72	1	C
30 DETROIT EDISON	ST.CLAIR NO 6	BELLE RIVER MICHIGAN	5-76	2	E
31 DUQUESNE LIGHT	ELRAMA	ELRAMA PENNSYLVANIA	10-75	1	B
32 DUQUESNE LIGHT	PHILLIPS	SOUTH HEIGHT PENNSYLVANIA	7-73	1	B
33 GENERAL MOTORS	CHEVROLET PARMA 1 2 3 & 4	PARMA OHIO	3-74	1	B
34 GULF POWER CO.	SCHOLZ NO. 1A	CHATTAHOOCHEE FLORIDA	2-75	1	C
35 GULF POWER CO.	SCHOLZ NO. 2A	CHATTAHOOCHEE FLORIDA	2-76	1	C

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|-------------------------------|---|
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- A. BOILER CONSTRUCTED SUBJECT TO FEDERAL NSPS  
 B. BOILER SUBJECT TO STATE STANDARD THAT IS MORE STRINGENT THAN THE FEDERAL NSPS  
 C. BOILER SUBJECT TO STATE STANDARD THAT IS EQUAL TO OR LESS STRINGENT THAN NSPS  
 D. OTHER  
 E. REGULATORY CLASS UNKNOWN

**PEDCO-ENVIRONMENTAL**

**TABLE 1  
SUMMARY LIST OF FGD SYSTEMS**

**FGD STATUS REPORT 05/76**

<b>I.D. NUMBER AND COMPANY NAME</b>	<b>UNIT NAME</b>	<b>LOCATION</b>	<b>START UP DATE</b>	<b>STATUS</b>	<b>REG CLASS</b>
36 GULF POWER CO.	SCHOLZ NOS. 18 & 28	CHATTAHOOCHEE FLORIDA	3-75	1	C
37 INDIANAPOLIS POWER & LIGHT CO.	PETERSBURG NO 3	PETERSBURG INDIANA	9-77	2	A
38 KANSAS CITY POWER & LIGHT	HAWTHORN NO 3	KANSAS CITY MISSOURI	11-72	1	B
39 KANSAS CITY POWER & LIGHT	HAWTHORN NO 4	KANSAS CITY MISSOURI	8-72	1	B
40 KANSAS CITY POWER & LIGHT	LA CYGNE NO 1	LA CYGNE KANSAS	2-73	1	C
41 KANSAS POWER & LIGHT	JEFFERY NO. 1	ST MARY KANSAS	6-78	3	B
42 KANSAS POWER & LIGHT	JEFFERY NO. 2	ST MARY KANSAS	6-79	3	B
43 KANSAS POWER & LIGHT	LAWRENCE NO 4	LAWRENCE KANSAS	12-68	1	D
44 KANSAS POWER & LIGHT	LAWRENCE NO 5	LAWRENCE KANSAS	11-71	1	D
45 KENTUCKY UTILITIES	GREEN RIVER UNITS 1 AND 2	CENTRAL CITY KENTUCKY	9-75	1	C
46 KEY WEST UTILITY BOARD	STOCK ISLAND PLANT	KEY WEST FLORIDA	10-72	1	C
47 LOUISVILLE GAS & ELECTRIC	CANE RUN NO 4	LOUISVILLE KENTUCKY	6-76	2	C
48 LOUISVILLE GAS & ELECTRIC	CANE RUN NO 5	LOUISVILLE KENTUCKY	12-77	2	C
49 LOUISVILLE GAS & ELECTRIC	CANE RUN NO 6	LOUISVILLE KENTUCKY	9-78	5	C
50 LOUISVILLE GAS & ELECTRIC	MILL CREEK NO 1	LOUISVILLE KENTUCKY	1-82	6	C
51 LOUISVILLE GAS & ELECTRIC	MILL CREEK NO 2	LOUISVILLE KENTUCKY	1-81	6	C
52 LOUISVILLE GAS & ELECTRIC	MILL CREEK NO 3	LOUISVILLE KENTUCKY	7-77	2	A
53 LOUISVILLE GAS & ELECTRIC	MILL CREEK NO 4	LOUISVILLE KENTUCKY	7-79	3	A
54 LOUISVILLE GAS & ELECTRIC	PADDYS RUN NO 6	LOUISVILLE KENTUCKY	4-73	1	C
55 MINNKOTA POWER COOPERATIVE	MILTON R. YOUNG NO. 2	CENTER NORTH DAKOTA	8-77	2	B
56 MONTANA POWER CO.	COLSTRIP NO 1	COLSTRIP MONTANA	10-75	1	C
57 MONTANA POWER CO.	COLSTRIP NO 2	COLSTRIP MONTANA	7-76	2	A
58 MONTANA POWER CO.	COLSTRIP NO.3	COLSTRIP MONTANA	7-80	6	A
59 MONTANA POWER CO.	COLSTRIP NO.4	COLSTRIP MONTANA	7-81	6	A
60 NEVADA POWER	HARRY ALLEN STATION NO. 1	N. E. LAS VEGAS	6-83	6	B
61 NEVADA POWER	HARRY ALLEN STATION NO. 2	N. E. LAS VEGAS	6-84	6	B
62 NEVADA POWER	HARRY ALLEN STATION NO. 3	N. E. LAS VEGAS	6-85	6	B
63 NEVADA POWER	HARRY ALLEN STATION NO. 4	N. E. LAS VEGAS	6-86	6	B
64 NEVADA POWER	REID GARDNER NO 1	MOAPA NEVADA	4-74	1	B
65 NEVADA POWER	REID GARDNER NO 2	MOAPA NEVADA	4-74	1	B
66 NEVADA POWER	REID GARDNER NO 3	MOAPA NEVADA	6-76	2	B
67 NEVADA POWER	REID GARDNER NO 4	MOAPA NEVADA	0- 0	4	B
68 NEVADA POWER	WARNER VALLEY STATION NO. 1	ST. GEORGE UTAH	6-82	6	B
69 NEVADA POWER	WARNER VALLEY STATION NO. 2	ST. GEORGE UTAH	6-83	6	B
70 NEW ENGLAND ELEC SYSTEM	BRAYTON POINT NO.3	SOMERSET MASSACHUSETTS	0- 0	6	C

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71 NORTHERN INDIANA PUB SERVICE	BAILLY NO. 7	CHESTERTON INDIANA	0- 0	6	C
72 NORTHERN INDIANA PUB SERVICE	BAILLY NO. 8	CHESTERTON INDIANA	0- 0	6	C
73 NORTHERN INDIANA PUB SERVICE	MITCHELL NO 11	GARY INDIANA	5-76	2	C
74 NORTHERN STATES POWER CO.	SHERBURNE NO 1	BECKER MINNESOTA	3-76	1	B
75 NORTHERN STATES POWER CO.	SHERBURNE NO 2	BECKER MINNESOTA	5-77	2	B
76 PENNSYLVANIA POWER CO.	BRUCE MANSFIELD NO. 1	SHIPPINGPORT PENNSYLVANIA	4-76	1	B
77 PENNSYLVANIA POWER CO.	BRUCE MANSFIELD NO. 2	SHIPPINGPORT PENNSYLVANIA	4-77	2	B
78 PENNSYLVANIA POWER CO.	BRUCE MANSFIELD NO. 3	SHIPPINGPORT PENNSYLVANIA	4-79	3	B
79 PHILADELPHIA ELECTRIC CO.	CROMBY	PHOENIXVILLE PENNSYLVANIA	10-78	6	C
80 PHILADELPHIA ELECTRIC CO.	EDDYSTONE NO 1A	EDDYSTONE PENNSYLVANIA	9-75	1	B
81 PHILADELPHIA ELECTRIC CO.	EDDYSTONE NO 1B	EDDYSTONE PENNSYLVANIA	10-78	4	B
82 PHILADELPHIA ELECTRIC CO.	EDDYSTONE NO 2	EDDYSTONE PENNSYLVANIA	10-78	6	C
83 PUBLIC SERVICE CO OF COLORADO	VALMONT NO. 5	VALMONT COLORADO	10-74	1	E
84 PUBLIC SERVICE CO OF NEW MEX.	SAN JUAN NO. 1	WATERFLOW NEW MEXICO	7-77	3	B
85 PUBLIC SERVICE CO OF NEW MEX.	SAN JUAN NO. 2	WATERFLOW NEW MEXICO	7-77	3	B
86 PUBLIC SERVICE CO OF NEW MEX.	SAN JUAN NO. 3	WATERFLOW NEW MEXICO	5-79	4	B
87 PUBLIC SERVICE CO OF NEW MEX.	SAN JUAN NO. 4	WATERFLOW NEW MEXICO	5-81	4	B
88 PUBLIC SERVICE INDIANA	GIBSON NO. 3	GIBSON COUNTY INDIANA	0-78	6	A
89 PUBLIC SERVICE INDIANA	GIBSON NO. 4	GIBSON COUNTY INDIANA	0-79	6	A
90 RICKENBACKER AFB	RICKENBACKER	COLUMBUS OHIO	3-76	1	E
91 S. CAROLINA PUB SERV AUTHORITY	WINYAH NO. 2	GEORGETOWN SOUTH CAROLINA	5-77	3	A
92 S. MISSISSIPPI ELEC PWR ASSOC	R.D. MORROW NO.1	HATTIESBURG MISSISSIPPI	11-77	3	A
93 S. MISSISSIPPI ELEC PWR ASSOC	R.D. MORROW NO.2	HATTIESBURG MISSISSIPPI	6-78	3	A
94 SOUTHERN CALIFORNIA EDISON	MOHAVE NO 1B	LAUGHLIN NEVADA	6-77	6	E
95 SOUTHERN CALIFORNIA EDISON	MOHAVE NO. 2	LAUGHLIN NEVADA	6-77	6	E
96 SOUTHERN ILLINOIS POWER COOP	SOUTHERN ILLINOIS POWER PT. 4	MARION ILLINOIS	1-78	3	A
97 SPRINGFIELD CITY UTILITIES	SOUTHWEST NO. 1	SPRINGFIELD MISSOURI	8-76	2	A
98 TENNESSEE VALLEY AUTHORITY	SHAWNEE NO.10A	PADUCAH KENTUCKY	4-72	1	C
99 TENNESSEE VALLEY AUTHORITY	SHAWNEE NO.10B	PADUCAH KENTUCKY	4-72	1	C
100 TENNESSEE VALLEY AUTHORITY	WIDOWS CREEK NO 8	BRIDGEPORT ALABAMA	2-77	2	C
101 TEXAS UTILITIES CO.	MARTIN LAKE NO. 1	TATUM TEXAS	1-77	2	A
102 TEXAS UTILITIES CO.	MARTIN LAKE NO. 2	TATUM TEXAS	10-77	2	A
103 TEXAS UTILITIES CO.	MARTIN LAKE NO. 3	TATUM TEXAS	12-78	4	A
104 TEXAS UTILITIES CO.	MARTIN LAKE NO. 4	TATUM TEXAS	12-79	4	A
105 UNITED POWER ASSOCIATION	COAL CREEK NO. 1	UNDERWOOD NORTH DAKOTA	11-78	5	A

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106 UNITED POWER ASSOCIATION	COAL CREEK NO. 2	UNDERWOOD NORTH DAKOTA	11-79	5	A
107 UTAH POWER & LIGHT CO.	EMERY NO.1	EMERY COUNTY UTAH	6-78	3	A
108 UTAH POWER & LIGHT CO.	HUNTINGTON NO.1	PRICE UTAH	6-77	2	A

- |                               |   |
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**PEDCo-ENVIRONMENTAL**

**Table 2**  
**STATUS OF FGD SYSTEMS**

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

COMPANY	CURRENT MONTH
POWER STATION	
I.D. NUMBER 1 ALABAMA ELECTRIC COOP TOMBIGBEE NO. 2 225 MW - NEW COAL 0.8- 1.5 PERCENT SULFUR PEABODY ENGINEERING LIMESTONE SCRUBBING STARTUP 3/78	PEABODY ENGINEERING WAS AWARDED CONTRACT TO INSTALL FGD SYSTEM ON TOMBIGBEE NO. 2. AT THE PRESENT TIME, WORK IS PROCEEDING ON THE FOUNDA- TION OF THIS LIMESTONE SCRUBBING SYSTEM.
I.D. NUMBER 2 ALABAMA ELECTRIC COOP TOMBIGBEE NO. 3 225 MW - NEW COAL 0.8- 1.5 PERCENT SULFUR PEABODY ENGINEERING LIMESTONE SCRUBBING STARTUP 3/79	PEABODY ENGINEERING WAS AWARDED CONTRACT TO INSTALL FGD SYSTEM ON TOMBIGBEE NO. 3. AT THE PRESENT TIME, WORK IS PROCEEDING ON THE FOUNDA- TION OF THIS LIMESTONE SCRUBBING SYSTEM.
I.D. NUMBER 3 ALLEGHENY POWER SYSTEM PLEASANTS NO. 1 625 MW - NEW COAL 2.0- 5.0 PERCENT SULFUR BABCOCK AND WILCOX LIME SCRUBBING STARTUP 3/79	THE THREE PRINCIPAL OPERATING UTILITY COMPANIES OF THE ALLEGHENY POWER SYSTEM HAVE CONCLUDED A LONG-TERM AGREEMENT WITH THE DRAVO LIME CO. TO SUPPLY THIOSORBIC LIME FOR THE PLANNED SO2 SCRUBBERS AT PLEASANTS NOS. 1 AND 2. THE CONTRACT FOR THIS LIME SCRUBBING PROCESS HAS BEEN AWARDED TO BABCOCK AND WILCOX. GUARANTEED SO2 AND PARTICULATE REMOVAL EFFICIENCIES FOR THIS EMISSION CONTROL SYSTEM ARE 90 AND 99.55 PERCENT RESPECTIVELY.
I.D. NUMBER 4 ALLEGHENY POWER SYSTEM PLEASANTS NO. 2 625 MW - NEW COAL 2.0- 5.0 PERCENT SULFUR BABCOCK AND WILCOX LIME SCRUBBING STARTUP 3/80	THE THREE PRINCIPAL OPERATING UTILITY COMPANIES OF THE ALLEGHENY POWER SYSTEM HAVE CONCLUDED A LONG-TERM AGREEMENT WITH THE DRAVO LIME CO. TO SUPPLY THIOSORBIC LIME FOR THE PLANNED SO2 SCRUBBERS AT PLEASANTS NOS. 1 AND 2. THE CONTRACT FOR THIS LIME SCRUBBING PROCESS HAS BEEN AWARDED TO BABCOCK AND WILCOX. GUARANTEED SO2 AND PARTICULATE REMOVAL EFFICIENCIES FOR THIS EMISSION CONTROL SYSTEM ARE 90 AND 99.55 PERCENT RESPECTIVELY.
I.D. NUMBER 5 ARIZONA ELECTRIC POWER COOP APACHE NO 2 200 MW - NEW COAL 0.5- 0.8 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 6/78	LETTER OF INTENT TO INSTALL AN FGD SYSTEM WAS ISSUED TO RESEARCH COTTRELL, ENGINEERING DESIGN WORK IS PROCEEDING. THE INITIAL SITE PREPARATION FOUNDATION WORK IS ALREADY UNDERWAY. THE CONCRETE FOR THE SCRUBBER TOWER HAS ALREADY BEEN POURED. GUARANTEED SO2 AND PARTICULATE REMOVAL EFFI- CIENCIES ARE 50 AND 99.4 PERCENT RESPECTIVELY.



**TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76**

<b>COMPANY</b>	<b>POWER STATION</b>	<b>CURRENT MONTH</b>
ARIZONA ELECTRIC POWER COOP APACHE NO 3 205 MW - NEW COAL 0.5- 0.8 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 6/79	I.D. NUMBER 6	LETTER OF INTENT TO INSTALL AN FGD SYSTEM WAS ISSUED TO RESEARCH COTTRELL. THE ENGINEERING DESIGN WORK IS PROCEEDING. THE INITIAL SITE PREPARATION WORK IS ALREADY UNDERWAY. THE CONCRETE FOR THE SCRUBBER TOWER FOUNDATION HAS ALREADY BEEN POURED. GUARANTEED SO <sub>2</sub> AND PARTICULATE REMOVAL EFFICIENCIES ARE 50 AND 99.4 PERCENT RESPECTIVELY.
ARIZONA PUBLIC SERVICE CHOLLA NO 1 115 MW - RETROFIT COAL 0.44-1 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 10/73	I.D. NUMBER 7	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1973. RELIABILITY FOR MODULES A AND B DURING THE MONTH OF APRIL WAS 99 AND 97.4 PERCENT RESPECTIVELY. RELIABILITY FOR BOTH MODULES HAS AVERAGED IN EXCESS OF 90 AND 83 PERCENT RESPECTIVELY DURING THE PERIOD OF APRIL 1975 TO JANUARY 1976.
ARIZONA PUBLIC SERVICE CHOLLA NO 2 250 MW - NEW COAL 0.44-1 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 6/77	I.D. NUMBER 8	RESEARCH COTTRELL WAS AWARDED A CONTRACT TO INSTALL FGD SYSTEM ON CHOLLA NO. 2, AND IS PRESENTLY WORKING ON THE DESIGN PHASE OF THIS PROJECT. ENGINEERING IS SUBSTANTIALLY COMPLETE. CONSTRUCTION IS UNDERWAY.
ARIZONA PUBLIC SERVICE FOUR CORNERS NO. 4 755 MW - RETROFIT COAL 0.7 - 0.75% SULFUR (AVG) NOT SELECTED NOT SELECTED STARTUP 0/ 0	I.D. NUMBER 9	THIS 755 MW UNIT WILL BE CONTROLLED PENDING THE OUTCOME OF TESTS TO BE MADE ON THE PROTOTYPE 160 MW FGD MODULE NOW BEING INSTALLED ON UNIT 5.
ARIZONA PUBLIC SERVICE FOUR CORNERS NO. 5A 160 MW - RETROFIT COAL 0.7 PERCENT SULFUR SCE LIME SCRUBBING STARTUP 2/76	I.D. NUMBER 10	THIS 160 MW SYSTEM HAS BEEN MOVED FROM THE MOHAVE STATION OF SOUTHERN CALIFORNIA EDISON WHERE THE SYSTEM WAS PREVIOUSLY TESTED. THE SYSTEM WILL TREAT APPROXIMATELY 20 PERCENT OF THE FLUE GAS FROM UNIT NO. 5, RATED AT 755 MW(NET). THE ENGINEERING AND CONSTRUCTION WORK HAS BEEN COMPLETED. THE SYSTEM BECAME OPERATIONAL ON FEBRUARY 17, 1976. THE EXPERIMENTAL SCRUBBER WAS TAKEN OUT OF SERVICE IN MID-APRIL FOR A SCHEDULED BOILER OVERHAUL.

## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION	CURRENT MONTH
I.D. NUMBER 11 ARIZONA PUBLIC SERVICE FOUR CORNERS NO. 5B 595 MW - RETROFIT COAL, 0.7 - 0.75% SULFUR (AVG) NOT SELECTED NOT SELECTED STARTUP 0/0	THE BALANCE OF THIS 755 MW UNIT WILL BE CONTROLLED PENDING THE OUTCOME OF TESTS TO BE MADE ON THE PROTOTYPE 160 MW FGD MODULE NOW BEING INSTALLED. NO START-UP DATE HAS BEEN SCHEDULED.
I.D. NUMBER 12 BASIN ELECTRIC POWER COOP BEULAH NO. 1 450 MW - NEW COAL 1.0 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 0/81	THE UTILITY IS NOW INVESTIGATING VARIOUS FGD PROCESSES. THIS NEW STATION, CURRENTLY KNOWN AS THE BEULAH PROJECT, WILL INCLUDE TWO NEW COAL-FIRED BOILERS WHICH WILL BE REQUIRED TO COMPLY WITH WITH AIR EMISSION STANDARDS VIA THE BEST AVAILABLE TECHNOLOGY.
I.D. NUMBER 13 BASIN ELECTRIC POWER COOP BEULAH NO. 2 450 MW - NEW COAL 1.0 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 0/81	THE UTILITY IS NOW INVESTIGATING VARIOUS FGD PROCESSES. THIS NEW STATION, CURRENTLY KNOWN AS THE BEULAH PROJECT, WILL INCLUDE TWO NEW COAL-FIRED BOILERS WHICH WILL BE REQUIRED TO COMPLY WITH WITH AIR EMISSION STANDARDS VIA THE BEST AVAILABLE TECHNOLOGY.
I.D. NUMBER 14 BASIN ELECTRIC POWER COOP MISSOURI BASIN NO 1 550 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 1/80	BECAUSE OF THE STRICT WYOMING EMISSION STANDARDS OF 0.2LBS PER MILLION BTU, LOW SULFUR COAL ALONE WILL NOT MEET STANDARDS. BASIN ELECTRIC IS NOW INVESTIGATING VARIOUS FGD PROCESSES.
I.D. NUMBER 15 BASIN ELECTRIC POWER COOP MISSOURI BASIN NO 2 550 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 6/80	BECAUSE OF THE STRICT WYOMING EMISSION STANDARDS OF 0.2LBS PER MILLION BTU, LOW SULFUR COAL ALONE WILL NOT MEET STANDARDS. BASIN ELECTRIC IS NOW INVESTIGATING VARIOUS FGD PROCESSES.

TABLE 2

STATUS OF FGD SYSTEMS DURING 05/76

COMPANY	
POWER STATION	CURRENT MONTH
I.D. NUMBER 16 BASIN ELECTRIC POWER COOP MISSOURI BASIN NO 3 550 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 6/83	BECAUSE OF THE STRICT WYOMING EMISSION STANDARDS OF 0.2LBS PER MILLION BTU, LOW SULFUR COAL ALONE WILL NOT MEET STANDARDS. BASIN ELECTRIC IS NOW INVESTIGATING VARIOUS FGD PROCESSES.
I.D. NUMBER 17 BRAZOS ELECTRIC POWER COOP G & T COOPERATIVE PROJECT NO.1 400 MW - NEW COAL 1.67 PERCENT SULFUR BABCOCK & WILCOX LIMESTONE SCRUBBING STARTUP 12/79	BABCOCK AND WILCOX HAS BEEN AWARDED THE CONTRACT FOR THE INSTALLATION OF THIS ENTIRE NEW SYSTEM. THE EMISSION CONTROL EQUIPMENT FOR THE COAL-FIRED RAUIANT BOILER WILL CONSIST OF ELECTROSTATIC PRECIPITATORS UPSTREAM OF THE LIMESTONE SCRUBBING MODULES. THE SCRUBBER FLUE GAS CAPACITY IS NOMINALLY DESIGNED TO EXCEED 1.5 MILLION ACFM. THE DESIGN SO2 REMOVAL EFFICIENCY IS 86 PERCENT FOR 4400 PPM SO2 INLET. LIGNITE COAL WILL BE FIRED IN THE BOILER. THE CONSULTING ENGINEERING FIRM IS TIPPETT AND GEE.
I.D. NUMBER 18 CENTRAL ILLINOIS LIGHT CO. DUCK CREEK NO.1 100 MW - NEW COAL 2.5-3.0 PERCENT SULFUR RILEY STOKER/ENVIRONEERING LIMESTONE SCRUBBING STARTUP 6/76	THE UNIT IS NOW UNDER CONSTRUCTION AND IS SCHEDULED FOR COMPLETION IN JUNE 1976. STATION CAPACITY IS 400MW, BUT FLUE GAS FROM ONLY 100 MW WILL BE TREATED INITIALLY.
I.D. NUMBER 19 CENTRAL ILLINOIS LIGHT CO. DUCK CREEK NO.2 400 MW - NEW COAL 2.5-3.0 PERCENT SULFUR NOT SELECTED LIMESTONE SCRUBBING STARTUP 1/82	THIS PROPOSED LIMESTONE UNIT IS SCHEDULED TO COMMENCE OPERATION IN JANUARY 1982. A SYSTEM SUPPLIER HAS NOT YET BEEN SELECTED.
I.D. NUMBER 20 CENTRAL ILLINOIS LIGHT CO. E.D.EDWARDS NO.3 357 MW - RETROFIT COAL 2.5 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 7/79	THE UTILITY PLANS TO USE LOW SULFUR COAL FROM 6/76 UNTIL SYSTEM STARTUP. THE PROCESS AND SYSTEM SUPPLIER HAVE NOT YET BEEN SELECTED.

## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

## POWER STATION

## CURRENT MONTH

I.D. NUMBER 21  
CENTRAL ILLINOIS PUBLIC SERV  
NEWTON NO.1  
600 MW - NEW  
COAL 2.8-3.2 PERCENT SULFUR  
NOT SELECTED  
NOT SELECTED  
STARTUP 12/77

THE UTILITY IS NOW IN THE PROCESS OF EVALUATING BIDS FOR LIME/LIMESTONE AND DOUBLE ALKALI SCRUBBING. A DECISION CONCERNING THE PARTICULAR PROCESS AND SYSTEM SUPPLIER WILL BE ANNOUNCED SHORTLY. THE DESIGN BASIS OF THE SCRUBBING SYSTEM CALLS FOR SO<sub>2</sub> REMOVAL EFFICIENCY TO MEET AIR QUALITY STANDARDS FOR 4 PERCENT SULFUR COAL.

I.D. NUMBER 22  
CINCINNATI GAS & ELECTRIC CO.  
EAST BEND NO 2  
600 MW - NEW  
COAL  
NOT SELECTED  
NOT SELECTED  
STARTUP 1/80

UTILITY WILL GO OUT FOR BIDS IN LATE 1976. THE COMPANY IS PRESENTLY OBTAINING CONSTRUCTION AND OPERATING PERMITS. STARTUP DATE HAS BEEN MOVED BACK TO JANUARY 1980. THE COAL SOURCE FOR THIS UNIT HAS NOT YET BEEN SELECTED.

I.D. NUMBER 23  
CINCINNATI GAS & ELECTRIC CO.  
MIAMI FORT NO 8  
500 MW - NEW  
COAL 1.3 PERCENT SULFUR  
NOT SELECTED  
NOT SELECTED  
STARTUP 1/78

THE UTILITY HAS SIGNED A CONTRACT FOR THE PURCHASE OF LOW SULFUR COAL (1.3 PERCENT SULFUR). THE COAL BED FOR UNIT NO.8 IS NOW IN THE PROCESS OF BEING REDESIGNED TO ACCEPT THE LOW SULFUR COAL. IN ADDITION TO LIME/LIMESTONE SCRUBBING, THE UTILITY IS ALSO INVESTIGATING THE POSSIBILITY OF BURNING LOW SULFUR COAL (0.7 PERCENT SULFUR) IN ORDER TO MEET NSPS. NO COMMITMENTS HAVE BEEN MADE.

I.D. NUMBER 24  
COLUMBUS & SOUTHERN OHIO ELEC.  
CONESVILLE NO 5  
400 MW - NEW  
COAL 4.5 - 4.9 PERCENT SULFUR  
UNIVERSAL OIL PRODUCTS  
LIME SCRUBBING  
STARTUP 6/76

THE UTILITY SIGNED LONG-TERM CONTRACTS WITH DRAVO FOR THE PURCHASE OF THIOSORBIC LIME AND WITH IUCS FOR THE PURCHASE OF SLUDGE FIXATIVES. THE BOILER AND FGD SYSTEM ARE STILL UNDER CONSTRUCTION. THIS MINE MOUTH PLANT PLANS TO BURN COAL WITH 17 PERCENT ASH CONTENT AND 4.5 TO 4.9 PERCENT SULFUR CONTENT. AN ELECTROSTATIC PRECIPITATOR WILL BE INSTALLED UPSTREAM OF THE FGD SYSTEM. PRESENT PLANS CALL FOR ONE MODULE OF THIS DUAL-MODULAR SYSTEM TO GO ON-LINE JUNE 23, 1976.

I.D. NUMBER 25  
COLUMBUS & SOUTHERN OHIO ELEC.  
CONESVILLE NO 6  
400 MW - NEW  
COAL 4.5 - 4.9 PERCENT SULFUR  
UNIVERSAL OIL PRODUCTS  
LIME SCRUBBING  
STARTUP 1/78

THE UTILITY SIGNED LONG-TERM CONTRACTS WITH DRAVO FOR THE PURCHASE OF THIOSORBIC LIME AND WITH IUCS FOR THE PURCHASE OF SLUDGE FIXATIVES. CONSTRUCTION ON THIS UNIT IS CURRENTLY SCHEDULED FOR 1977 WITH COMPLETION EXPECTED BY JANUARY 1978. SIMILAR TO CONESVILLE NO.5, THIS MINE MOUTH PLANT WILL BURN COAL WITH 17 PERCENT ASH CONTENT AND 4.5 TO 4.9 PERCENT SULFUR CONTENT. AN ELECTROSTATIC PRECIPITATOR WILL BE INSTALLED UPSTREAM OF THE FGD SYSTEM.

**TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76**

**COMPANY**

**CURRENT MONTH.**

<b>POWER STATION</b>	
<b>I.D. NUMBER 26</b> <b>COLUMBUS &amp; SOUTHERN OHIO ELEC.</b> <b>POSTON NO. 5</b> <b>375 MW - NEW</b> <b>COAL 2.5 PERCENT SULFUR</b> <b>NOT SELECTED</b> <b>NOT SELECTED</b> <b>STARTUP 0/81</b>	<b>UNIT WILL BURN 2.5 PERCENT SULFUR OHIO COAL.</b>
<b>I.D. NUMBER 27</b> <b>COLUMBUS &amp; SOUTHERN OHIO ELEC.</b> <b>POSTON NO. 6</b> <b>375 MW - NEW</b> <b>COAL 2.5 PERCENT SULFUR</b> <b>NOT SELECTED</b> <b>NOT SELECTED</b> <b>STARTUP 0/83</b>	<b>UNIT WILL BURN 2.5 PERCENT SULFUR OHIO COAL.</b>
<b>I.D. NUMBER 28</b> <b>COMMONWEALTH EDISON</b> <b>POWERTON NO. 51</b> <b>425 MW - RETROFIT</b> <b>COAL 3.6 PERCENT SULFUR</b> <b>UNIVERSAL OIL PRODUCTS</b> <b>LIMESTONE SCRUBBING</b> <b>STARTUP 12/79</b>	<b>THE CONTRACT FOR THIS FGD SYSTEM HAS BEEN AWARDED TO UNIVERSAL OIL PRODUCTS. THE PROCESS IS A CLOSED-LOOP WET LIMESTONE SCRUBBING SYSTEM WHICH WILL BE BACKFITTED TO BOILER 51, ONE OF TWO IDENTICAL BOILERS SUPPLYING STEAM TO AN 850 MW TURBINE-GENERATOR. THE FGD SYSTEM IS DESIGNED TO TREAT FLUE GAS RESULTING FROM THE COMBUSTION OF HIGH SULFUR COAL (3.6 PERCENT SULFUR* 8.3 PERCENT ASH* 17.3 PERCENT MOISTURE* 10,500 BTU/LB.) AND MEET SO2 EMISSION STANDARDS OF 1.8 LB. SO2/MM BTU.</b>
<b>I.D. NUMBER 29</b> <b>COMMONWEALTH EDISON</b> <b>WILL COUNTY NO 1</b> <b>167 MW - RETROFIT</b> <b>COAL - 9463 BTU, 2.1% SULFUR</b> <b>BABCOCK &amp; WILCOX</b> <b>LIMESTONE SCRUBBING</b> <b>STARTUP 2/72</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE FEBRUARY 1972. THE UNIT WAS RETURNED TO SERVICE IN MARCH FOLLOWING A MAJOR BOILER, TURBINE, AND SCRUBBER OVERHAUL. SYSTEM OPERABILITY FOR BOTH MODULES DURING THE REPORT PERIOD WAS 45 AND 20 PERCENT IN MARCH AND 20 AND 49 PERCENT IN APRIL FOR MODULES A AND B RESPECTIVELY. MODULES A AND B WERE IN SERVICE A TOTAL OF 3213 AND 2580 HOURS RESPECTIVELY, IN 1975, WHICH TRANSLATES INTO ANNUAL OPERABILITY FACTORS OF 52 AND 42 PERCENT RESPECTIVELY.</b>
<b>I.D. NUMBER 30</b> <b>DETROIT EDISON</b> <b>ST. CLAIR NO 6</b> <b>180 MW - RETROFIT</b> <b>COAL 3.7 PERCENT SULFUR</b> <b>PEABODY ENGINEERING</b> <b>LIMESTONE SCRUBBING</b> <b>STARTUP 5/76</b>	<b>NO INFORMATION WAS MADE AVAILABLE BY THE UTILITY DURING THE REPORT PERIOD. TO DATE, THE SYSTEM HAS OPERATED THROUGH FOUR HOT FLUE GAS RUNS, LOGGING IN EXCESS OF 637 HOURS OF SERVICE TIME. THE MAJORITY OF THE PROBLEMS ENCOUNTERED THUS FAR HAVE BEEN OF A MECHANICAL NATURE, SPECIFICALLY IN THE FORM OF PUMP FAILURES, EXCESSIVE FAN VIBRATION AND SPAY NOZZLE PLUGGING. A 30 DAY VENDOR QUALIFICATION RUN AND FINAL ACCEPTANCE TEST ARE NEXT ON THE AGENDA FOR THIS INSTALLATION.</b>

## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

## POWER STATION

## CURRENT MONTH

I.D. NUMBER 31

DUQUESNE LIGHT

ELRAMA

510 MW - RETROFIT

COAL 1.0 - 2.8 PERCENT SULFUR

CHEMICO

LIME SCRUBBING

STARTUP 10/75

THE FGD SYSTEM WAS PLACED IN SERVICE ON OCTOBER 26, 1975. INITIAL OPERATION PROCEEDED WITH FLUE GAS FROM ONE BOILER BEING TREATED BY THE SCRUBBING SYSTEM. A SECOND BOILER WAS TIED INTO THE SYSTEM ON FEBRUARY 4, 1976. DURING THE REPORT PERIOD MODIFICATIONS TO THE FIFTH SCRUBBING VESSEL WERE COMPLETED AND THE VESSEL IS NOW OPERATING WITH TWO RUBBER-LINED RECYCLE PUMPS.

I.D. NUMBER 32

DUQUESNE LIGHT

PHILLIPS

410 MW - RETROFIT

COAL 1.0- 2.8 PERCENT SULFUR

CHEMICO

LIME SCRUBBING

STARTUP 7/73

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE JULY 1973. THE UTILITY REPORTS THAT A TOTAL OF 4 BOILERS (NOS. 3,4,5,& 6) WERE COUPLED INTO THE SCRUBBING SYSTEM DURING THE REPORT PERIOD. THE SYSTEM IS NOW OPERATING ON HIGH CALCIUM LIME FOLLOWING THE COMPLETION OF THE THIOSORBIC LIME TEST PROGRAM. THE SCRUBBING SYSTEM AVAILABILITY DURING THE FIRST QUARTER OF 1976 WAS 72 PERCENT. THE SLUDGE STABILIZATION PRACTICES ARE STILL CONTINUING AT THIS FACILITY.

I.D. NUMBER 33

GENERAL MOTORS

CHEVROLET PARMA 1 2 3 &amp; 4

32 MW - RETROFIT

COAL 2.5 PERCENT SULFUR

KOCH

DOUBLE ALKALI

STARTUP 3/74

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE MARCH 1974. SYSTEM OPERABILITY DURING THE MONTHS OF MARCH AND APRIL WAS 17 AND 78 PERCENT RESPECTIVELY. SYSTEM OPERABILITY AVERAGED IN EXCESS OF 58 PERCENT DURING THE LAST EIGHT MONTHS. CURRENTLY, A SCRUBBING SYSTEM CHARACTERIZATION STUDY, SPONSORED BY THE EPA, IS BEING CONDUCTED BY A.D. LITTLE.

I.D. NUMBER 34

GULF POWER CO.

SCHOLZ NO. 1A

20 MW - RETROFIT

COAL 3.0 PERCENT SULFUR

ADL/COMBUSTION EQUIP ASSOCIATE

DOUBLE ALKALI

STARTUP 2/75

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE FEB. 1975. THE PROTOTYPE SYSTEM OPERATED A TOTAL OF 4744 HRS. DURING 1975, TRANSLATING INTO AN ANNUAL AVERAGE OPERABILITY OF 89 PERCENT. THE SYSTEM WAS PUT BACK IN SERVICE MARCH 12, 1976, FOLLOWING A SCHEDULED BOILER OVERHAUL. SYSTEM OPERABILITY WAS 94 PERCENT FOR THE DURATION OF THE MONTH.

I.D. NUMBER 35

GULF POWER CO.

SCHOLZ NO. 2A

20 MW - RETROFIT

COAL 3.0 PERCENT SULFUR

FOSTER WHEELER

ACTIVATED CARBON

STARTUP 2/76

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THE SYSTEM SUPPLIER AND TEST DIRECTOR (SOUTHERN SERVICES) REPORTED THREE OPERATIONAL RUNS DURING THE REPORT PERIOD. PERFORMANCE OF THE FRONT-END OF THE SYSTEM (ADSORPTION AND REGENERATION) WAS CONSIDERED ADEQUATE. THE RESOX SECTION OPERATED INTERMITTENTLY DURING THE REPORT PERIOD BECAUSE OF PLUGGING PROBLEMS IN THE SULFUR CONDENSER. TO DATE, THE SYSTEM SO<sub>2</sub> REMOVAL EFFICIENCY HAS EXCEEDED THE NOMINAL DESIGN VALUE (96 PERCENT).

## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

## POWER STATION

## CURRENT MONTH

<b>I.D. NUMBER 36</b> <b>GULF POWER CO.</b> <b>SCHOLZ NOS. 1R &amp; 2B</b> <b>23 MW - RETROFIT</b> <b>COAL 5.0 PERCENT SULFUR (MAX)</b> <b>CHIYODA INTERNATIONAL</b> <b>THOROUGHbred 101</b> <b>STARTUP 3/75</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE MARCH 1975. THE TOTAL SYSTEM OPERABILITY, INCLUDING SYSTEM COMMISSIONING, EXTENDING FROM FEB. 11, 1975, TO DECEMBER 31, 1975, WAS 60 PERCENT. SYSTEM OPERABILITY FOR THE MONTHS OF MARCH AND APRIL WAS 100 AND 14 PERCENT RESPECTIVELY. THE SYSTEM WAS TAKEN OUT OF SERVICE ON APRIL 5 FOR A SCHEDULED SYSTEM'S DESIGN MODIFICATION.</b>
<b>I.D. NUMBER 37</b> <b>INDIANAPOLIS POWER &amp; LIGHT CO.</b> <b>PETERSBURG NO 3</b> <b>530 MW - NEW</b> <b>COAL 3.0-3.5 PERCENT SULFUR</b> <b>UNIVERSAL OIL PRODUCTS</b> <b>LIMESTONE SCRUBBING</b> <b>STARTUP 9/77</b>	<b>UNIVERSAL OIL PRODUCTS HAS BEEN SELECTED TO BUILD THE LIMESTONE SCRUBBING SYSTEM. THE FLUE GAS FROM THE 530 MW UNIT WILL BE TREATED BY FOUR SCRUBBING MODULES. CONSTRUCTION ON THIS SYSTEM IS NOW IN PROGRESS. WORK IS PROCEEDING ACCORDING TO SCHEDULE. CURRENTLY, WORK ON THE FOUNDATION AND INSTALLATION OF THE RECYCLE TANKS IS BEING COMPLETED. THE SCRUBBING MODULES ARE NOW BEING FABRICATED. THE STARTUP DATE HAS BEEN MOVED BACK TO SEPTEMBER 1977.</b>
<b>I.D. NUMBER 38</b> <b>KANSAS CITY POWER &amp; LIGHT</b> <b>HAWTHORN NO 3</b> <b>140 MW - RETROFIT</b> <b>COAL 0.6- 3.0 PERCENT SULFUR</b> <b>COMBUSTION ENGINEERING</b> <b>LIMESTONE INJECTION &amp; WET SCRUB</b> <b>STARTUP 11/72</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1972. BOTH MODULES WERE DOWN THROUGHOUT THE REPORT PERIOD. THE UTILITY IS CURRENTLY ELIMINATING THE BY-PASS SEALS AND INSTALLING SLIDE-GATE DAMPERS. IN ADDITION, THE B-MODULE WAS RECONVERTED TO AN UNDERBED SPRAY ARRANGEMENT BECAUSE OF CONTINUING PLUGGING PROBLEMS.</b>
<b>I.D. NUMBER 39</b> <b>KANSAS CITY POWER &amp; LIGHT</b> <b>HAWTHORN NO 4</b> <b>100 MW - RETROFIT</b> <b>COAL 0.6- 3.0 PERCENT SULFUR</b> <b>COMBUSTION ENGINEERING</b> <b>LIMESTONE INJECTION &amp; WET SCRUB</b> <b>STARTUP 8/72</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE AUGUST 1972. OPERABILITY FOR MODULES A AND B WAS 0 AND 3 PERCENT RESPECTIVELY IN MARCH AND 42 AND 40 PERCENT RESPECTIVELY IN APRIL. DURING THE REPORT PERIOD THE UNIT'S BY-PASS SEALS WERE REPLACED WITH SLIDE-GATE DAMPERS.</b>
<b>I.D. NUMBER 40</b> <b>KANSAS CITY POWER &amp; LIGHT</b> <b>LA CYGNE NO 1</b> <b>820 MW - NEW</b> <b>COAL 5.0 PERCENT SULFUR</b> <b>BABCOCK &amp; WILCOX</b> <b>LIMESTONE SCRUBBING</b> <b>STARTUP 2/73</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE FEBRUARY 1973. DURING 1975 THE TOTAL AVAILABILITY OF THE FGD SYSTEM AVERAGED IN EXCESS OF 84 PERCENT (INCLUDING BOTH WORKING AND RESERVE HOURS). DURING THE FIRST QUARTER OF 1976 SYSTEM AVAILABILITY HAS AVERAGED 83.92, AND 91 PERCENT FOR THE MONTHS OF JANUARY, FEBRUARY, AND MARCH RESPECTIVELY. THE SYSTEM WAS BROUGHT DOWN ON APRIL 6 FOR A SCHEDULED BOILER AND AIR PREHEATER OVERHAUL.</b>

## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

## POWER STATION

## CURRENT MONTH

I.D. NUMBER 41  
KANSAS POWER & LIGHT  
JEFFERY NO. 1  
680 MW - NEW  
COAL 0.32 PERCENT SULFUR  
COMBUSTION ENGINEERING  
LIMESTONE SCRUBBING  
STARTUP 6/78

I.D. NUMBER 42  
KANSAS POWER & LIGHT  
JEFFERY NO. 2  
680 MW - NEW  
COAL 0.32 PERCENT SULFUR  
COMBUSTION ENGINEERING  
LIMESTONE SCRUBBING  
STARTUP 6/79

I.D. NUMBER 43  
KANSAS POWER & LIGHT  
LAWRENCE NO 4  
125 MW - RETROFIT  
COAL 0.5 PERCENT SULFUR  
COMBUSTION ENGINEERING  
LIMESTONE INJECTION & WET SCRUB  
STARTUP 12/68

I.D. NUMBER 44  
KANSAS POWER & LIGHT  
LAWRENCE NO 5  
400 MW - NEW  
COAL 0.5 PERCENT SULFUR  
COMBUSTION ENGINEERING  
LIMESTONE INJECTION & WET SCRUB  
STARTUP 11/71

I.D. NUMBER 45  
KENTUCKY UTILITIES  
GREEN RIVER UNITS 1 AND 2  
64 MW - RETROFIT  
COAL 3.8 PERCENT SULFUR  
AMERICAN AIR FILTER  
LIME SCRUBBING  
STARTUP 9/75

THE UTILITY HAS PURCHASED AN AIR QUALITY CONTROL SYSTEM FROM COMBUSTION ENGINEERING FOR PARTICULATE AND SO<sub>2</sub> REMOVAL. THE SYSTEM WILL CONSIST OF AN ESP DOWNSTREAM OF THE AIR HEATER PLUS ID FANS AND SPRAY TOWERS. AN OVERFIRE AIR SYSTEM AT THE TANGENTIAL FIRED PULVERIZED BURNERS WILL CONTROL THE NO<sub>x</sub> EMISSIONS. THE CLEANED GASES WILL BE VENTED TO A 600 FOOT STACK.

THE UTILITY HAS PURCHASED AN AIR QUALITY CONTROL SYSTEM FROM COMBUSTION ENGINEERING FOR PARTICULATE AND SO<sub>2</sub> REMOVAL. THE SYSTEM WILL CONSIST OF AN ESP DOWNSTREAM OF THE AIR HEATER PLUS ID FANS AND SPRAY TOWERS. AN OVERFIRE AIR SYSTEM AT THE TANGENTIAL FIRED PULVERIZED BURNERS WILL CONTROL THE NO<sub>x</sub> EMISSIONS. THE CLEANED GASES WILL BE VENTED TO A 600 FOOT STACK.

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE DECEMBER 1968. THIS UNIT IS CURRENTLY BURNING LOW SULFUR WYOMING COAL. THE OPERATION OF THE SCRUBBER HAS BEEN MORE EFFICIENT AND ECONOMICAL FOR THIS COAL TYPE BECAUSE A LESSER DEGREE OF SO<sub>2</sub> REMOVAL IS REQUIRED FOR COMPLIANCE. THE UTILITY PLANS TO REPLACE THIS SCRUBBING SYSTEM WITH A VENTRI-ROD AND SPRAY TOWER SCRUBBING SYSTEM.

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1971. THIS UNIT IS CURRENTLY BURNING LOW SULFUR WYOMING COAL. THE OPERATION OF THE SCRUBBER HAS BEEN MORE EFFICIENT AND ECONOMICAL FOR THIS COAL TYPE BECAUSE A LESSER DEGREE OF SO<sub>2</sub> REMOVAL IS REQUIRED FOR COMPLIANCE. THE UTILITY PLANS TO REPLACE THIS SCRUBBING SYSTEM WITH A VENTRI-ROD AND SPRAY TOWER SCRUBBING SYSTEM.

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS SYSTEM BECAME OPERATIONAL SEPTEMBER 13, 1975. THE OPERATIONAL DATA SUPPLIED BY THE UTILITY FOR THE REPORT PERIOD SHOWS THAT SYSTEM AVAILABILITY, RELIABILITY, OPERABILITY, AND UTILIZATION WAS 97, 95, 85, AND 52 PERCENT RESPECTIVELY FOR THE MONTH OF MARCH AND 90, 100, 100, AND 77 PERCENT RESPECTIVELY FOR THE MONTH OF APRIL.



COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION	CURRENT MONTH
I.D. NUMBER 46 KEY WEST UTILITY BOARD STOCK ISLAND PLANT 37 MW - NEW OIL 2.4 PERCENT SULFUR ZURN AIR SYSTEMS LIMESTONE SCRUBBING STARTUP 10/72	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE OCTOBER 1972. THE FGD SYSTEM HAS BEEN OUT OF SERVICE SINCE JANUARY 28, 1975. MODIFICATIONS AND REPAIRS ARE CURRENTLY IN PROGRESS. SYSTEM RESTART IS STILL INDEFINITE. A CHECKOUT OF ALL SYSTEM MOTORS AND PUMPS MUST BE COMPLETED BEFORE STARTUP CAN COMMENCE.
I.D. NUMBER 47 LOUISVILLE GAS & ELECTRIC CANE RUN NO 4 178 MW - RETROFIT COAL 3.5-4.05 PERCENT SULFUR AMERICAN AIR FILTER LIME SCRUBBING STARTUP 6/76	THE UTILITY HAS SIGNED A CONSENT AGREEMENT WITH THE EPA FOR THE INSTALLATION AND OPERATION OF FGD EQUIPMENT ON THIS UNIT BY JUNE 1, 1976. THE CONTRACT HAS BEEN AWARDED TO AMERICAN AIR FILTER. THE SYSTEM WILL OPERATE ON A CLOSED WATER LOOP AND THE SLUDGE WILL BE STABILIZED. THIS SYSTEM IS PRESENTLY UNDER CONSTRUCTION.
I.D. NUMBER 48 LOUISVILLE GAS & ELECTRIC CANE RUN NO 5 183 MW - RETROFIT COAL 3.5-4.05 PERCENT SULFUR COMBUSTION ENGINEERING LIME SCRUBBING STARTUP 12/77	THE UTILITY HAS SIGNED A CONSENT AGREEMENT WITH THE EPA FOR THE INSTALLATION AND OPERATION OF FGD EQUIPMENT ON THIS UNIT BY DECEMBER 1, 1977. THE CONTRACT FOR THIS LIME SCRUBBING SYSTEM HAS BEEN AWARDED TO COMBUSTION ENGINEERING. THE UNIT IS PRESENTLY UNDER CONSTRUCTION.
I.D. NUMBER 49 LOUISVILLE GAS & ELECTRIC CANE RUN NO 6 277 MW - RETROFIT COAL 3.5- 4.0 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 9/78	THE UTILITY HAS SIGNED A CONSENT AGREEMENT WITH THE EPA FOR THE INSTALLATION AND OPERATION OF FGD EQUIPMENT ON THIS UNIT BY SEPTEMBER 1, 1978. DURING THE REPORT PERIOD THE UTILITY ANNOUNCED THAT THEY HAVE BEEN SELECTED BY THE EPA TO NEGOTIATE A CONTRACT FOR THE INSTALLATION OF A DOUBLE ALKALI SYSTEM ON THIS UNIT. THE PROCESS BEING GIVEN PRIME CONSIDERATION IS THE CEA/ADL DUAL ALKALI FGD SYSTEM.
I.D. NUMBER 50 LOUISVILLE GAS & ELECTRIC MILL CREEK NO 1 330 MW - RETROFIT COAL 3.5- 4.0 PERCENT SULFUR NOT SELECTED LIME SCRUBBING STARTUP 1/82	A COMPLIANCE SCHEDULE HAS BEEN SUBMITTED TO THE JEFFERSON COUNTY AIR POLLUTION CONTROL DISTRICT WITH 1/82 ESTABLISHED AS THE STARTUP DATE FOR AN FGD SYSTEM.

PEDCo-ENVIRONMENTAL :

**TABLE 2**  
**STATUS OF FGD SYSTEMS DURING 05/76**

<b>COMPANY</b>	<b>POWER STATION</b>	<b>CURRENT MONTH*</b>
	I.D. NUMBER 51 LOUISVILLE GAS & ELECTRIC MILL CREEK NO 2 330 MW - RETROFIT COAL 3.5- 4.0 PERCENT SULFUR NOT SELECTED LIME SCRUBBING STARTUP 1/81	A COMPLIANCE SCHEDULE HAS BEEN SUBMITTED TO THE JEFFERSON COUNTY AIR POLLUTION CONTROL DISTRICT WITH 1/81 ESTABLISHED AS THE STARTUP DATE FOR AN FGD SYSTEM.
	I.D. NUMBER 52 LOUISVILLE GAS & ELECTRIC MILL CREEK NO 3 425 MW - NEW COAL 3.5- 4.0 PERCENT SULFUR AMERICAN AIR FILTER LIME SCRUBBING STARTUP 7/77	THE UTILITY HAS SIGNED A CONSENT AGREEMENT WITH THE EPA FOR THE INSTALLATION AND OPERATION OF FGD EQUIPMENT ON THIS POWER GENERATING UNIT BY JULY 1,1977. THIS NEW FACILITY WILL BE REQUIRED TO MEET FEDERAL NSPS FOR THE LIMITATION OF SO2 EMISSIONS. CONTRACT HAS BEEN AWARDED TO AMERICAN AIR FILTER. THE SYSTEM WILL OPERATE ON A CLOSED WATER LOOP AND THE SLUDGE WILL BE STABILIZED. CONSTRUCTION HAS BEGUN ON THE FGD SYSTEM.
	I.D. NUMBER 53 LOUISVILLE GAS & ELECTRIC MILL CREEK NO 4 425 MW - NEW COAL 3.5- 4.0 PERCENT SULFUR AMERICAN AIR FILTER LIME SCRUBBING STARTUP 7/79	THE UTILITY HAS SIGNED A CONSENT AGREEMENT WITH THE EPA FOR THE INSTALLATION AND OPERATION OF FGD EQUIPMENT ON THIS POWER GENERATING UNIT BY JULY 1,1979. THIS NEW FACILITY WILL BE REQUIRED TO MEET FEDERAL NSPS FOR THE LIMITATION OF SO2 EMISSIONS. THE CONTRACT HAS BEEN AWARDED TO AMERICAN AIR FILTER FOR A LIME SCRUBBING SYSTEM.
	I.D. NUMBER 54 LOUISVILLE GAS & ELECTRIC PADDYS RUN NO 6 65 MW - RETROFIT COAL 3.5-4.0 PERCENT SULFUR COMBUSTION ENGINEERING LIME SCRUBBING STARTUP 4/73	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1973. OPERABILITY WAS 100 PERCENT IN JANUARY. SO2 REMOVAL EFFICIENCY WAS 99 PERCENT DURING THIS OPERATING PERIOD. THE SYSTEM WAS SHUTDOWN IN EARLY FEBRUARY IN PREPARATION FOR THE EPA SCRUBBER AND SLUDGE STUDY WHICH MAY COMMENCE IN JUNE OR JULY OF 1976. THE SCRUBBER WILL NOT BE OPERATED UNTIL THIS TIME UNLESS THE NEED ARISES (PEAK LOAD DEMAND). CURRENTLY, THE UTILITY IS COMPLETING MODIFICATIONS ON THIS UNIT IN ANTICIPATION OF THE STUDY PROGRAM.
	I.D. NUMBER 55 MINNKOTA POWER COOPERATIVE MILTON R. YOUNG NO. 2 450 MW - NEW LIGNITE - 6,500 BTU, 0.7% S COMBUSTION EQUIP. ASSOCIATES LIME/ALKALINE FLYASH SCRUBBING STARTUP 8/77	THE CONTRACT FOR THIS FGD SYSTEM HAS BEEN AWARDED TO COMBUSTION EQUIPMENT ASSOCIATES. THE A/E FIRM IS SANDERSON AND PORTER. THE BOILER IS NOW UNDER CONSTRUCTION. THE TANKS FOR THE FGD SYSTEM HAVE BEEN FABRICATED AND ARE SCHEDULED FOR INSTALLATION IN JULY 1976. A PILOT PLANT (5000 ACFM) WAS PUT IN SERVICE ON OCTOBER 13,1975. THE PILOT PLANT RUNS ARE BEING CONDUCTED TO DETERMINE THE MAJOR CRITERIA FOR A FULL-SIZE INSTALLATION. SPECIFICALLY,THIS INCLUDES RELIABILITY TESTING, EVALUATION OFF VARIOUS PH CONTROL SYSTEMS AND ANALYSES OF VARIOUS TYPES OF FLYASH ABSORBENTS.

**PEDCo-ENVIRONMENTAL**

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

COMPANY POWER STATION	CURRENT MONTH
I.D. NUMBER 56 MONTANA POWER CO. COLSTRIP NO 1 360 MW - NEW COAL 0.8 PERCENT SULFUR COMBUSTION EQUIP. ASSOCIATES LIME/ALKALINE FLYASH SCRUBBING STARTUP 10/75	THE COLSTRIP PLANT IS A MINE MOUTH INSTALLATION. CONSTRUCTION ON THIS UNIT WAS COMPLETED BEHIND SCHEDULE. THE FGD SYSTEM STARTED UP IN LATE 1975 AND PROCEEDED THROUGH A SHAKEDOWN AND DEBUGGING OPERATION PHASE. THE UNIT IS NOW OPERATING AT FULL COMMERCIAL CAPACITY. OPERATING DATA ACCUMULATED TO-DATE IS IN THE PROCESS OF BEING EVALUATED BY THE UTILITY FOR PRESENTATION TO STATE REGULATORY AGENCIES.
I.D. NUMBER 57 MONTANA POWER CO. COLSTRIP NO 2 360 MW - RETROFIT COAL 0.8 PERCENT SULFUR COMBUSTION EQUIP. ASSOCIATES LIME/ALKALINE FLYASH SCRUBBING STARTUP 7/76	THE COLSTRIP PLANT IS A MINE MOUTH INSTALLATION. THIS FGD SYSTEM IS NOW UNDER CONSTRUCTION. TURBINE ROLL AND SYSTEM CHECKOUT IS SCHEDULED FOR MID-JUNE 1976. NO DELAYS FOR THE JULY STARTUP ARE ANTICIPATED. THE CONSULTING ENGINEERING FIRM IS BECHTEL.
I.D. NUMBER 58 MONTANA POWER CO. COLSTRIP NO.3 700 MW - NEW COAL 0.7 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 7/80	THE UTILITY IS CURRENTLY WAITING FOR APPROVAL OF A CERTIFICATE TO CONSTRUCT BOILERS 3 AND 4 BEFORE PROCEEDING WITH ORDERS TO INSTALL FGD SYSTEMS. THE FGD PROCESS BEING GIVEN PRIME CONSIDERATION FOR UNITS 3 AND 4 IS THE LIME/ALKALINE FLYASH SCRUBBING SYSTEM CURRENTLY OPERATING AND BEING INSTALLED ON COLSTRIP UNITS 1 AND 2 RESPECTIVELY
I.D. NUMBER 59 MONTANA POWER CO. COLSTRIP NO.4 700 MW - NEW COAL 0.7 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 7/81	THE UTILITY IS CURRENTLY WAITING FOR APPROVAL OF A CERTIFICATE TO CONSTRUCT BOILERS 3 AND 4 BEFORE PROCEEDING WITH ORDERS TO INSTALL FGD SYSTEMS. THE FGD PROCESS BEING GIVEN PRIME CONSIDERATION FOR UNITS 3 AND 4 IS THE LIME/ALKALINE FLYASH SCRUBBING SYSTEM CURRENTLY OPERATING AND BEING INSTALLED ON COLSTRIP UNITS 1 AND 2 RESPECTIVELY
I.D. NUMBER 60 NEVADA POWER HARRY ALLEN STATION NO. 1 500 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 6/83	CONSIDERING HOT SIDE ESP IN CONJUNCTION WITH AN FGD SYSTEM. SPECIFICATIONS HAVE NOT YET BEEN PREPARED.

COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION

CURRENT MONTH

I.D. NUMBER 61  
NEVADA POWER  
HARRY ALLEN STATION NO. 2  
500 MW - NEW  
COAL  
NOT SELECTED  
NOT SELECTED  
STARTUP 6/84

CONSIDERING HOT SIDE ESP IN CONJUNCTION WITH AN FGD SYSTEM. SPECIFICATIONS HAVE NOT YET BEEN PREPARED.

I.D. NUMBER 62  
NEVADA POWER  
HARRY ALLEN STATION NO. 3  
500 MW - NEW  
COAL  
NOT SELECTED  
NOT SELECTED  
STARTUP 6/85

CONSIDERING HOT SIDE ESP IN CONJUNCTION WITH AN FGD SYSTEM. SPECIFICATIONS HAVE NOT YET BEEN PREPARED.

I.D. NUMBER 63  
NEVADA POWER  
HARRY ALLEN STATION NO. 4  
500 MW - NEW  
COAL  
NOT SELECTED  
NOT SELECTED  
STARTUP 6/86

CONSIDERING HOT SIDE ESP IN CONJUNCTION WITH AN FGD SYSTEM. SPECIFICATIONS HAVE NOT YET BEEN PREPARED.

I.D. NUMBER 64  
NEVADA POWER  
REID GARDNER NO 1  
125 MW - RETROFIT  
COAL 0.5- 1.0 PERCENT SULFUR  
COMBUSTION EQUIP. ASSOCIATES  
SODIUM CARBONATE SCRUBBING  
STARTUP 4/74

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1974. SYSTEM OPERABILITY FOR THE MONTHS OF MARCH AND APRIL WAS 72 AND 91 PERCENT RESPECTIVELY. ONE FORCED SCRUBBER OUTAGE OCCURRED DURING THE REPORT PERIOD BECAUSE OF A VENTURI LEAK. THE BOILER WAS SHUTDOWN APRIL 5 FOR A VALVE AND COAL CONDUIT INSPECTION.

I.D. NUMBER 65  
NEVADA POWER  
REID GARDNER NO 2  
125 MW - RETROFIT  
COAL 0.5- 1.0 PERCENT SULFUR  
COMBUSTION EQUIP. ASSOCIATES  
SODIUM CARBONATE SCRUBBING  
STARTUP 4/74

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APR. 1974. SYSTEM OPERABILITY FOR THE MONTHS OF MARCH AND APRIL WAS 60 AND 77 PERCENT RESPECTIVELY. DURING THE REPORT PERIOD SEVERAL FORCED SCRUBBER OUTAGES WERE REPORTED, PRIMARILY CAUSED BY PLUGGED SENSING LINES, REHEATER REPAIRS, AND MALFUNCTIONS IN THE TRAY SYSTEM.

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

COMPANY	POWER STATION	CURRENT MONTH
I.D. NUMBER 66 NEVADA POWER REID GARDNER NO 3 125 MW - NEW COAL 0.5- 1.0 PERCENT SULFUR COMBUSTION EQUIP. ASSOCIATES SODIUM CARBONATE SCRUBBING STARTUP 6/76		FOR SPECIFIC INFORMATION ON THE TYPE OF SCRUBBING SYSTEM CURRENTLY UNDER CONSTRUCTION FOR THIS UNIT REFER TO THE BACKGROUND INFORMATION SECTIONS FOR REID GARDNER NOS 1 AND 2 IN TABLE 3 OF THIS REPORT. THE PRELIMINARY CHECKOUT AND OPERATION OF THE BOILER HAS ALREADY STARTED. THE FGD SYSTEM IS NOW SCHEDULED TO COMMENCE OPERATION ON JUNE 7, 1976. CONSTRUCTION IS STILL PROCEEDING.
I.D. NUMBER 67 NEVADA POWER REID GARDNER NO 4 125 MW - NEW COAL 0-5- 1.0 PERCENT SULFUR COMBUSTION EQUIP. ASSOCIATES SODIUM CARBONATE SCRUBBING STARTUP 0/ 0		NEVADA POWER COMPANY HAS SIGNED A LETTER OF INTENT WITH COMBUSTION EQUIPMENT ASSOCIATES FOR THE CONSTRUCTION OF AN FGD SYSTEM ON REID GARDNER NO. 4. HOWEVER, CONSTRUCTION OF THE BOILER HAS BEEN INDEFINITELY POSTPONED.
I.D. NUMBER 68 NEVADA POWER WARNER VALLEY STATION NO. 1 250 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 6/82		SPECIFICATIONS ARE BEING PREPARED FOR A SCRUBBING SYSTEM.
I.D. NUMBER 69 NEVADA POWER WARNER VALLEY STATION NO. 2 250 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 6/83		SPECIFICATIONS ARE BEING PREPARED FOR A SCRUBBING SYSTEM.
I.D. NUMBER 70 NEW ENGLAND ELEC SYSTEM BRAYTON POINT NO.3 650 MW - RETROFIT COAL 3.0 PERCENT SULFUR NOT SELECTED REGENERABLE NOT SELECTED STARTUP 0/ 0		INVESTIGATING THE POSSIBILITY OF AN ADVANCED REGENERABLE FGD SYSTEM HAVING ELEMENTAL SULFUR AS AN END PRODUCT WHICH HAS PROMISE OF A BREAKTHROUGH IN CAPITAL AND OPERATING COST.

COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION

CURRENT MONTH

I.D. NUMBER 71  
NORTHERN INDIANA PUB SERVICE  
BAILLY NO. 7  
190 MW - RETROFIT  
COAL 3 PERCENT SULFUR  
NOT SELECTED  
NOT SELECTED  
STARTUP 0/ 0

CONSIDERING A LIME OR LIMESTONE SCRUBBING UNIT. ALSO WAITING FOR PERFORMANCE OF WELLMAN LORD/ALLIED CHEMICAL UNIT UNDER CONSTRUCTION AT THEIR D.N.MITCHELL NO.11 UNIT. LOW SULFUR COAL MAY BE EMPLOYED TO COMPLY WITH SO2 EMISSION REGULATIONS.

I.D. NUMBER 72  
NORTHERN INDIANA PUB SERVICE  
BAILLY NO. 8  
400 MW - RETROFIT  
COAL 3 PERCENT SULFUR  
NOT SELECTED  
NOT SELECTED  
STARTUP 0/ 0

CONSIDERING A LIME OR LIMESTONE SCRUBBING UNIT. ALSO WAITING FOR PERFORMANCE OF WELLMAN LORD/ALLIED CHEMICAL UNIT UNDER CONSTRUCTION AT THEIR D. H. MITCHELL NO. 11 UNIT. LOW SULFUR COAL MAY BE BURNED TO COMPLY WITH SO2 EMISSION REGULATIONS.

I.D. NUMBER 73  
NORTHERN INDIANA PUB SERVICE  
MITCHELL NO 11  
115 MW - RETROFIT  
COAL 3.2- 3.5 PERCENT SULFUR  
DAVY POWERGAS/ALLIED CHEMICAL  
WELLMAN LORD/ALLIED CHEMICAL  
STARTUP 5/76

THIS FGD SYSTEM IS AN INTEGRATION OF THE WELLMAN-LORD SO2 RECOVERY PROCESS OF DAVY POWERGAS AND ALLIED CHEMICAL'S SO2 TO SULFUR REDUCTION PROCESS. DAVY POWERGAS IS THE ENGINEER AND CONSTRUCTOR OF THE FGD FACILITY AND ALLIED CHEMICAL IS THE SYSTEM OPERATOR AND PRODUCT MARKETER. THE STARTUP DATE FOR THE OPERATION OF THIS SYSTEM HAS BEEN DELAYED ONE MONTH BECAUSE OF A FIRE WHICH OCCURRED IN THE ABSORBER SECTION OF THE FGD SYSTEM. PRESENTLY, THE SYSTEM OPERATORS ARE CHECKING OUT THE VARIOUS SUB-SYSTEMS BY PASSING WATER AND GAS THROUGH THE EQUIPMENT.

I.D. NUMBER 74  
NORTHERN STATES POWER CO.  
SHERBURNE NO 1  
680 MW - NEW  
COAL 0.8 PERCENT SULFUR  
COMBUSTION ENGINEERING  
LIMESTONE SCRUBBING  
STARTUP 3/76

A PRELIMINARY SYSTEM CHECKOUT BY PASSING WATER AND AIR THROUGH THE EQUIPMENT WAS SUCCESSFULLY COMPLETED BY THE UTILITY. THE SYSTEM WAS PUT IN SERVICE ON MARCH 16, 1976, TREATING FLUE GAS FROM BOILER NO.1, WHICH FIRES A LOW SULFUR WESTERN COAL. FOLLOWING THE 3/16 STARTUP THE SYSTEM WAS TESTED ON VARIOUS LOAD CAPACITIES AND IS CURRENTLY OPERATING AT FULL COMMERCIAL LOAD. A 30-DAY VENDOR RELIABILITY TEST PROGRAM IS SCHEDULED TO COMMENCE IN MID-SUMMER 1976.

I.D. NUMBER 75  
NORTHERN STATES POWER CO.  
SHERBURNE NO 2  
680 MW - NEW  
COAL 0.8 PERCENT SULFUR  
COMBUSTION ENGINEERING  
LIMESTONE SCRUBBING  
STARTUP 5/77

THE FGD SYSTEM IS CURRENTLY UNDER CONSTRUCTION. RECENT SCRUBBER DESIGN CHANGES HAVE CAUSED EQUIPMENT DELIVERY DELAYS. IN ADDITION, SOME PROBLEMS HAVE ARISEN IN OBTAINING SOME ELECTRICAL CONTROLS. HOWEVER, THE OVERALL SCHEDULE HAS NOT BEEN UPSET AND CONSTRUCTION OF THE SYSTEM IS CONTINUING ON SCHEDULE.

**TABLE 2**  
**STATUS OF FGD SYSTEMS DURING 05/76**

<b>COMPANY</b>	<b>CURRENT MONTH</b>
<b>POWER STATION</b>	
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I.D. NUMBER 76 PENNSYLVANIA POWER CO. BRUCE MANSFIELD NO. 1 835 MW - NEW COAL 4.3 PERCENT SULFUR CHEMICO LIME SCRUBBING STARTUP 4/76	REFER TO THE BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS EMISSION CONTROL SYSTEM IS CAPABLE OF REMOVING FLYASH AND SO <sub>2</sub> FROM 3.35 MM ACFM OF FLUE GAS VIA WET LIME SCRUBBING. THE INITIAL SHUTDOWN AND DEBUGGING PHASE OF OPERATION BEGAN FOR PART OF THE SYSTEM IN DECEMBER 1975. FULL COMMERCIAL OPERATION COMMENCED IN APRIL 1976. TO DATE, ALL 6 OF THE SCRUBBER/ABSORBER TRAINS HAVE BEEN PUT INTO OPERATION.
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I.D. NUMBER 77 PENNSYLVANIA POWER CO. BRUCE MANSFIELD NO. 2 835 MW - NEW COAL 4.3 PERCENT SULFUR CHEMICO LIME SCRUBBING STARTUP 4/77	THE FGD SYSTEM FOR THIS INSTALLATION WILL BE A CHEMICO WET LIME SCRUBBING SYSTEM CAPABLE OF REMOVING PARTICULATE MATTER AND SO <sub>2</sub> FROM THE FLUE GAS. THIS SYSTEM IS CURRENTLY UNDER CONSTRUCTION. LONG DELAYS HAVE BEEN ENCOUNTERED IN MATERIAL DELIVERIES. THE FGD SYSTEM STARTUP DATE IS NOW SCHEDULED FOR APRIL 1977.
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I.D. NUMBER 78 PENNSYLVANIA POWER CO. BRUCE MANSFIELD NO. 3 835 MW - NEW COAL 4.3 PERCENT SULFUR PULLMAN KELLOGG LIMESTONE SCRUBBING STARTUP 4/79	PULLMAN INC., ANNOUNCED DURING THE REPORT PERIOD THAT ITS PULLMAN KELLOGG DIVISION HAS BEEN AWARDED A CONTRACT IN EXCESS OF \$50 MILLION FOR AN FGD SYSTEM TO BE INSTALLED ON THIS COAL-FIRED 835 MW UNIT. THE EMISSION CONTROL SYSTEM WILL CONSIST OF 5 WEIR HORIZONTAL CROSS-FLOW WET ABSORBER MODULES OPERATED IN CONJUNCTION WITH A PATENTED CATALYTIC CHEMISTRY PROCESS DEVELOPED BY KELLOGG. ESP'S WILL BE INSTALLED UPSTREAM OF THE SCRUBBING SYSTEM.
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I.D. NUMBER 79 PHILADELPHIA ELECTRIC CO. CROMBY 150 MW - RETROFIT COAL 2-4 PERCENT SULFUR UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING STARTUP 10/78	THE UTILITY PLANS TO RETROFIT ONE OF THE TWO BOILERS AT CROMBY WITH AN FGD SYSTEM. HOWEVER, A FINAL DECISION HAS NOT BEEN MADE. THE PROCESS BEING GIVEN PRIME CONSIDERATION IS MAGNESIUM OXIDE SCRUBBING DESIGNED JOINTLY BY UNITED ENGINEERS AND PHILADELPHIA ELECTRIC. ENGINEERING DESIGN WORK IS SCHEDULED FOR 1976. FGD SYSTEM STARTUP IS NOW SCHEDULED FOR OCTOBER 1978.
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I.D. NUMBER 80 PHILADELPHIA ELECTRIC CO. EDDYSTONE NO 1A 120 MW - RETROFIT COAL 2.5 PERCENT SULFUR UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING STARTUP 9/75	THE SO <sub>2</sub> SCRUBBER HAS BEEN TEMPORARILY SHUTDOWN BECAUSE THE ACID PLANT REGENERATION FACILITY AT THE OLIN CHEMICAL SULFURIC ACID PLANT IN PAULSBORO NEW JERSEY HAS PERMANENTLY CEASED OPERATIONS. CONSIDERATIONS ARE NOW BEING GIVEN TO THE RELOCATION OF THE REGENERATION FACILITY. ONCE THIS DECISION IS MADE A MINIMUM PERIOD OF SIX MONTHS WILL BE REQUIRED TO RELOCATE THE REGENERATION FACILITY. THE PARTICULATE SCRUBBERS ARE CONTINUING TO OPERATE. THE UTILITY IS STILL EXPERIENCING PROBLEMS WITH THE FANS, REHEAT BURNERS, DAMPERS, AND EXPANSION JOINTS.
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TABLE 2  
 COMPANY STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION	CURRENT MONTH
I.D. NUMBER 81 PHILADELPHIA ELECTRIC CO. EDDYSTONE NO 1B 240 MW - RETROFIT COAL 2.5 PERCENT SULFUR UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING STARTUP 10/78	THE RETROFITTING OF SECOND STAGE SCRUBBERS ON THE BALANCE OF THE FLUE GAS FROM EDDYSTONE 1 IS AWAITING PERFORMANCE OF THE EXISTING 2-STAGE UNIT WHICH IS TREATING ONE THIRD OF THE BOILER FLUE GAS. THIS UNIT CONSISTS OF A AND B PARTICULATE SCRUBBING TRAINS, EACH ARE 120 MW. CHECK VALVE FAILURE ON A TRAIN HAS BEEN CORRECTED. FAN ON B TRAIN IS STILL AT THE FACTORY FOR REPAIR.
I.D. NUMBER 82 PHILADELPHIA ELECTRIC CO. EDDYSTONE NO 2 336 MW - RETROFIT COAL 2.4 PERCENT SULFUR UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING STARTUP 10/78	COMPANY IS AWAITING PERFORMANCE OF FGD SYSTEM ON UNIT 1 BEFORE PROCEEDING WITH DESIGN OF FGD SYSTEM ON THIS BOILER. HOWEVER ENGINEERING PHASE IS TENTATIVELY PLANNED TO START IN JAN 76, AT WHICH TIME EVALUATION OF DATA FROM UNIT 1 SHOULD BE COMPLETE.
I.D. NUMBER 83 PUBLIC SERVICE CO OF COLORADO VALMONT NO. 5 50 MW - RETROFIT COAL 0.72 PERCENT SULFUR UOP / PUB SERVICE OF COLORADO LIMESTONE SCRUBBING STARTUP 10/74	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1974. THE FGD SYSTEM CURRENTLY OPERATIONAL AT THIS STATION IS AN EXPERIMENTAL UNIT, ORIGINALLY DESIGNED BY UNIVERSAL OIL PRODUCTS FOR PARTICULATE REMOVAL ONLY. ONE OF THE TWO PARALLEL SCRUBBING MODULES WAS CONVERTED TO LIMESTONE SCRUBBING FOR EXPERIMENTAL PURPOSES ONLY.
I.D. NUMBER 84 PUBLIC SERVICE CO OF NEW MEX. SAN JUAN NO. 1 375 MW - NEW COAL 0.8 PERCENT SULFUR DAVY POWERGAS/ALLIED CHEMICAL WELLMAN LORD/ALLIED CHEMICAL STARTUP 7/77	THIS FGD SYSTEM IS AN INTEGRATION OF THE WELLMAN-LORD SO2 RECOVERY PROCESS OF DAVY POWERGAS AND ALLIED CHEMICAL'S SO2 REDUCTION TO SULFUR PROCESS. DAVY POWERGAS IS THE ENGINEER AND CONSTRUCTOR OF THE FGD SYSTEM WHILE ALLIED CHEMICAL WILL BE THE SYSTEM OPERATOR AND PRODUCT MARKETER. CURRENTLY THE FGD PROJECT IS PROCEEDING ACCORDING TO PLAN WITH NO MAJOR PROBLEMS. EQUIPMENT IS NOW BEING PROCURED. CONSTRUCTION IS SCHEDULED TO BEGIN IN MARCH OR APRIL OF 1976.
I.D. NUMBER 85 PUBLIC SERVICE CO OF NEW MEX. SAN JUAN NO. 2 340 MW - RETROFIT COAL 0.8 PERCENT SULFUR DAVY POWERGAS/ALLIED CHEMICAL WELLMAN LORD/ALLIED CHEMICAL STARTUP 7/77	THIS FGD SYSTEM IS AN INTEGRATION OF THE WELLMAN-LORD SO2 RECOVERY PROCESS OF DAVY POWERGAS AND ALLIED CHEMICAL'S SO2 REDUCTION TO SULFUR PROCESS. DAVY POWERGAS IS THE ENGINEER AND CONSTRUCTOR OF THE FGD SYSTEM WHILE ALLIED CHEMICAL WILL BE THE SYSTEM OPERATOR AND PRODUCT MARKETER. CURRENTLY THE FGD PROJECT IS PROCEEDING ACCORDING TO PLAN WITH NO MAJOR PROBLEMS. EQUIPMENT IS NOW BEING PROCURED. CONSTRUCTION IS SCHEDULED TO BEGIN IN MARCH OR APRIL OF 1976.



## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

## POWER STATION

## CURRENT MONTH

I.D. NUMBER 86  
PUBLIC SERVICE CO OF NEW MEX.  
SAN JUAN NO. 3  
500 MW - NEW  
COAL 0.8 PERCENT SULFUR  
DAVY POWERGAS  
WELLMAN LORD  
STARTUP 5/79

A LETTER OF INTENT HAS BEEN SIGNED WITH DAVY POWERGAS FOR A WELLMAN LORD UNIT. THE PROJECTED STARTUP DATE OF THIS SYSTEM HAS BEEN DELAYED ONE YEAR TO MAY 1979.

I.D. NUMBER 87  
PUBLIC SERVICE CO OF NEW MEX.  
SAN JUAN NO. 4  
500 MW - NEW  
COAL 0.8 PERCENT SULFUR  
DAVY POWERGAS  
WELLMAN LORD  
STARTUP 5/81

A LETTER OF INTENT HAS BEEN SIGNED WITH DAVY POWERGAS FOR A WELLMAN LORD UNIT. THE PROJECTED STARTUP DATE OF THIS SYSTEM HAS BEEN DELAYED ONE YEAR TO MAY 1981.

I.D. NUMBER 88  
PUBLIC SERVICE INDIANA  
GIBSON NO. 3  
650 MW - NEW  
COAL 3.3 PERCENT SULFUR  
NOT SELECTED  
NOT SELECTED  
STARTUP 0/78

BID EVALUATION IS UNDERWAY.

I.D. NUMBER 89  
PUBLIC SERVICE INDIANA  
GIBSON NO. 4  
650 MW - NEW  
COAL 3.3 PERCENT SULFUR  
NOT SELECTED  
NOT SELECTED  
STARTUP 0/79

BID SPECIFICATIONS ARE BEING PREPARED.

I.D. NUMBER 90  
RICKENBACKER AFB  
RICKENBACKER  
20 MW - RETROFIT  
COAL 3.6 PERCENT SULFUR  
RESEARCH COTTRELL  
LIME SCRUBBING  
STARTUP 3/76

THE SYSTEM SUPPLIER REPORTED THAT THE FGD SYSTEM BECAME OPERATIONAL ON MARCH 11, 1976. SYSTEM OPERABILITY WAS REPORTED TO BE 97 PERCENT FOR THE DURATION OF THE MONTH. THE SYSTEM WAS BROUGHT DOWN ON APRIL 14 BECAUSE OF PUMP PROBLEMS. A 1.5 WEEK OUTAGE RESULTED BECAUSE OF A SPARE PART SHIPMENT. SO2 INLET CONCENTRATIONS HAVE BEEN AT THE 1800 PPM LEVEL. LIME UTILIZATION HAS BEEN GOOD. THE SO2 REMOVAL EFFICIENCY WAS REPORTED TO BE AS HIGH AS 96 PERCENT.

## COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

## POWER STATION

## CURRENT MONTH

I.D. NUMBER 91  
S. CAROLINA PUB SERV AUTHORITY  
WINYAH NO. 2  
140 MW - NEW  
COAL 1.0 PERCENT SULFUR  
BABCOCK & WILCOX  
LIMESTONE SCRUBBING  
STARTUP 5/77

THE CONTRACT HAS BEEN AWARDED TO B&W FOR CONSTRUCTION OF A LIMESTONE SYSTEM TREATING 50 PERCENT OF THE GAS FLOW FROM A 280 MW BOILER. THIS UNIT WILL FIRE 1 PERCENT SULFUR COAL AND THE GUARANTEED REMOVAL EFFICIENCY IS 69 PERCENT. DIFFERENT METHODS OF SLUDGE DISPOSAL ARE CURRENTLY BEING EXAMINED BY THE UTILITY.

I.D. NUMBER 92  
S. MISSISSIPPI ELEC PWR ASSOC  
R.D. MORROW NO.1  
180 MW - NEW  
COAL 1 PERCENT SULFUR  
RILEY STOKER/ENVIRONEERING  
LIMESTONE SCRUBBING  
STARTUP 11/77

THE CONTRACT FOR THIS LIMESTONE SYSTEM HAS BEEN AWARDED TO RILEY STOKER/ENVIRONEERING. GUARANTEED SO<sub>2</sub> REMOVAL EFFICIENCY IS 85 PERCENT. FABRICATION OF EQUIPMENT IS NOW IN PROGRESS. SYSTEM STARTUP IS SCHEDULED FOR NOVEMBER 1977.

I.D. NUMBER 93  
S. MISSISSIPPI ELEC PWR ASSOC  
R.D. MORROW NO.2  
180 MW - NEW  
COAL 1 PERCENT SULFUR  
RILEY STOKER/ENVIRONEERING  
LIMESTONE SCRUBBING  
STARTUP 6/78

THE CONTRACT FOR THIS LIMESTONE SYSTEM HAS BEEN AWARDED TO RILEY STOKER/ENVIRONEERING. GUARANTEED SO<sub>2</sub> REMOVAL EFFICIENCY IS 85 PERCENT. FABRICATION OF EQUIPMENT IS NOW IN PROGRESS. SYSTEM STARTUP IS SCHEDULED FOR JUNE 1978.

I.D. NUMBER 94  
SOUTHERN CALIFORNIA EDISON  
MOHAVE NO 1B  
620 MW - RETROFIT  
COAL 0.5- 0.8 PERCENT SULFUR  
NOT SELECTED  
LIME/LIMESTONE SCRUBBING  
STARTUP 6/77

THE TOTAL CAPACITY OF BOILER IS 790 MW. EXISTING EXPERIMENTAL FGD MODULE WILL TREAT ONLY 170 MW. FINAL SELECTION OF THE PROCESS HAS BEEN POSTPONED. SEE MOHAVE 1A.

I.D. NUMBER 95  
SOUTHERN CALIFORNIA EDISON  
MOHAVE NO. 2  
790 MW - RETROFIT  
COAL 0.5 TO 0.8 % SULFUR  
NOT SELECTED  
LIME/LIMESTONE SCRUBBING  
STARTUP 6/77

A PROTOTYPE 170 MW LIME SCRUBBING SYSTEM (HORIZONTAL MODULE) ON THIS UNIT WAS OPERATED FROM NOVEMBER 1973 UNTIL FEBRUARY 1975. AVAILABILITY FOR THE PERIOD 1/16/74 TO 2/9/75 AVERAGED 73.5%. THIS SYSTEM IS TO BE REINSTALLED AT THE FOUR CORNERS PLANT, OPERATED BY ARIZONA PUBLIC SERVICE.

**TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76**

<b>COMPANY</b>	<b>CURRENT MONTH</b>
<b>POWER STATION</b>	
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I.D. NUMBER 96 SOUTHERN ILLINOIS POWER COOP SOUTHERN ILLINOIS POWER PT. 4 184 MW - NEW COAL BARCOCK & WILCOX LIMESTONE SCRUBBING STARTUP 1/78	THE CONTRACT FOR THIS LIMESTONE SCRUBBING SYSTEM HAS BEEN AWARDED TO BARCOCK AND WILCOX. THE FGD SYSTEM WILL CONSIST OF 2 SCRUBBING MODULES, TREATING THE FLUE GAS FROM A COAL-FIRED BOILER, HAVING A NOMINAL DESIGN CAPACITY OF 691,500 ACFM AT 290F. THE DESIGN SO2 REMOVAL EFFICIENCY IS 89.4 PERCENT, BASED UPON AN INLET OF 3,326 PPM OF SO2. THE CONSULTING ENGINEERING FIRM FOR THE PROJECT IS BURNS-MCDONALD.
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I.D. NUMBER 97 SPRINGFIELD CITY UTILITIES SOUTHWEST NO. 1 200 MW - NEW COAL 3.5 PERCENT SULFUR UNIVERSAL OIL PRODUCTS LIMESTONE SCRUBBING STARTUP 8/76	THE CONSTRUCTION OF THE BOILER AND FGD SYSTEM AT THIS INSTALLATION IS STILL PROCEEDING BEHIND SCHEDULE. THE SCRUBBER, ESP, AND I.D.FANS ARE NOW BEING INSTALLED. COMPLETION IS SCHEDULED FOR MID-SUMMER 1976. SYSTEM STARTUP HAS BEEN DELAYED TO AUGUST 1, 1976.
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I.D. NUMBER 98 TENNESSEE VALLEY AUTHORITY SHAWNEE NO. 10A 10 MW - RETROFIT COAL 2.9 PERCENT SULFUR UNIVERSAL OIL PRODUCTS LIME/LIMESTONE SCRUBBING STARTUP 4/72	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS TURBULENT CONTACT ABSORBER (TCA) LIME/LIMESTONE SCRUBBING SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1972. THIS TEST PROGRAM IS FUNDED BY THE EPA. TVA IS THE CONSTRUCTOR AND FACILITY OPERATOR. THE BECHTEL CORP. OF SAN FRANCISCO IS THE MAJOR CONTRACTOR, TEST DIRECTOR, AND REPORT WRITER.
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I.D. NUMBER 99 TENNESSEE VALLEY AUTHORITY SHAWNEE NO. 10B 10 MW - RETROFIT COAL 2.9 PERCENT SULFUR CHEMICO LIME/LIMESTONE SCRUBBING STARTUP 4/72	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS VENTURI/SPRAY TOWER LIME/LIMESTONE SCRUBBING SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1972. THIS TEST PROGRAM IS FUNDED BY THE EPA. TVA IS THE CONSTRUCTOR AND FACILITY OPERATOR. THE BECHTEL CORP. OF SAN FRANCISCO IS THE MAJOR CONTRACTOR, TEST DIRECTOR, AND REPORT WRITER.
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I.D. NUMBER 100 TENNESSEE VALLEY AUTHORITY WIDOWS CREEK NO 8 550 MW - RETROFIT COAL 3.7 PERCENT SULFUR TENNESSEE VALLEY AUTHORITY LIMESTONE SCRUBBING STARTUP 2/77	CONTRACTS HAVE BEEN LET ON ALL MAJOR PROCESS EQUIPMENT INCLUDING THE SCRUBBER, MIST ELIMINATOR, PIPING, INSTRUMENTATION, HOT AIR INJECTION SYSTEM AND AIR HEATER FANS. THE ID FANS ARE NOW BEING INSTALLED AS IS THE LIMESTONE CRUSHER. ALL EQUIPMENT REQUISITIONS HAVE BEEN COMPLETED. THE SCHEDULED STARTUP DATE IS FEBRUARY 1977.
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TABLE 2  
 COMPANY STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION	CURRENT MONTH
I.D. NUMBER 101 TEXAS UTILITIES CO. MARTIN LAKE NO. 1 793 MW - NEW COAL 1.0 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 1/77	THE CONTRACT FOR THIS FGD SYSTEM WAS AWARDED TO RESEARCH-COTTRELL. THIS NEW FACILITY IS NOW UNDER CONSTRUCTION. THE FGD SYSTEM STARTUP DATE IS NOW SCHEDULED FOR JANUARY 1977.
I.D. NUMBER 102 TEXAS UTILITIES CO. MARTIN LAKE NO. 2 793 MW - NEW COAL 1.0 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 10/77	THE CONTRACT FOR THIS FGD SYSTEM WAS AWARDED TO RESEARCH-COTTRELL. THIS NEW FACILITY IS NOW UNDER CONSTRUCTION. THE FGD SYSTEM STARTUP DATE IS NOW SCHEDULED FOR OCTOBER 1977.
I.D. NUMBER 103 TEXAS UTILITIES CO. MARTIN LAKE NO. 3 793 MW - NEW COAL 1.0 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 12/78	UTILITY HAS SIGNED A LETTER OF INTENT WITH RESEARCH COTTRELL. THE BOILER IS CURRENTLY BEING ERECTED AT THIS NEW FACILITY.
I.D. NUMBER 104 TEXAS UTILITIES CO. MARTIN LAKE NO. 4 793 MW - NEW COAL 1.0 PERCENT SULFUR RESEARCH COTTRELL LIMESTONE SCRUBBING STARTUP 12/79	UTILITY HAS SIGNED A LETTER OF INTENT WITH RESEARCH COTTRELL. THE BOILER IS CURRENTLY BEING ERECTED AT THIS NEW FACILITY.
I.D. NUMBER 105 UNITED POWER ASSOCIATION COAL CREEK NO. 1 545 MW - NEW LIGNITE - 0.63 PERCENT SULFUR NOT SELECTED LIME/LIMESTONE STARTUP 11/78	THE UTILITY IS CURRENTLY IN THE PROCESS OF REQUESTING/EVALUATING BIDS FOR A NON-REGENERABLE LIME OR LIMESTONE SCRUBBING SYSTEM FOR SO2 REMOVAL. IN ADDITION, THE BIDDER CAN ALSO SPECIFY ALKALINE FLYASH SCRUBBING AS AN ALTERNATIVE SO2 REMOVAL PROCESS. INITIAL STARTUP OF THE INSTALLATION IS NOW PROJECTED FOR 8/78 WITH FULL COMMERCIAL OPERATION BY 11/78.

COMPANY

TABLE 2  
STATUS OF FGD SYSTEMS DURING 05/76

POWER STATION	CURRENT MONTH *
I.D. NUMBER 106 UNITED POWER ASSOCIATION COAL CREEK NO. 2 545 MW - NEW LIGNITE - 0.63 PERCENT SULFUR NOT SELECTED LIME/LIMESTONE STARTUP 11/79	THE UTILITY IS CURRENTLY IN THE PROCESS OF REQUESTING/EVALUATING BIDS FOR A NON-REGENERABLE LIME OR LIMESTONE SCRUBBING SYSTEM FOR SO <sub>2</sub> REMOVAL. IN ADDITION, THE BIDDER CAN ALSO SPECIFY ALKALINE FLYASH SCRUBBING AS AN ALTERNATIVE SO <sub>2</sub> REMOVAL PROCESS. INITIAL STARTUP OF THE INSTALLATION IS NOW PROJECTED FOR 8/79 WITH FULL COMMERCIAL OPERATION BY 11/79.
I.D. NUMBER 107 UTAH POWER & LIGHT CO. EMERY NO.1 400 MW - NEW COAL 0.5 PERCENT SULFUR CHEMICO LIME SCRUBBING STARTUP 6/78	THE CONTRACT FOR THIS FGD SYSTEM HAS BEEN AWARDED TO CHEMICO. THE PEBBLE LIME WET SCRUBBING SYSTEM IS DESIGNED TO OPERATE IN AN OPEN-LOOP MODE WITH AN SO <sub>2</sub> REMOVAL EFFICIENCY OF 80 PERCENT FOR LOW SULFUR UTAH COAL. PARTICULATE EMISSIONS WILL BE CONTROLLED BY AN UPSTREAM ESP. THE SLUDGE WILL BE STABILIZED WITH FLYASH AND DISPOSED ON THE PLANT SITE.
I.D. NUMBER 108 UTAH POWER & LIGHT CO. HUNTINGTON NO.1 415 MW - RETROFIT COAL 0.5 PERCENT SULFUR CHEMICO LIME SCRUBBING STARTUP 6/77	A LETTER OF INTENT HAS BEEN SIGNED WITH CHEMICO FOR THE INSTALLATION OF A LIME SCRUBBING SYSTEM ON THIS NEW UNIT. MATERIALS ARE NOW ARRIVING AT THE PLANT SITE. SITE PREPARATION AND CONSTRUCTION IS NOW UNDERWAY. THE STATE OF UTAH REGULATIONS REQUIRE THE BEST AVAILABLE AND MOST COST EFFECTIVE TECHNOLOGY FOR SO <sub>2</sub> REMOVAL.

**Table 3**

**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS**

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	7
UTILITY NAME	ARIZONA PUBLIC SERVICE
UNIT NAME	CHOLLA NO 1
UNIT LOCATION	JOSEPH CITY ARIZONA
UNIT RATING	115 MW
FUEL CHARACTERISTICS	COAL 0.44-1 PERCENT SULFUR
FGD VENDOR	RESEARCH COTTRELL
PROCESS	LIMESTONE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	10/73
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99.7 PERCENT
SO2	58.5 PERCENT
WATER MAKE UP	733 GAL/LB MOLE SO2 REMOVED
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$57/KW CAPITAL + 2.2 MILLS/KWH ANNUALIZED
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1973. RELIABILITY FOR MODULES A AND B DURING THE MONTH OF APRIL WAS 99 AND 97.4 PERCENT RESPECTIVELY. RELIABILITY FOR BOTH MODULES HAS AVERAGED IN EXCESS OF 90 AND 83 PERCENT RESPECTIVELY DURING THE PERIOD OF APRIL 1975 TO JANUARY 1976.

**PEDCo-ENVIRONMENTAL**

## BACKGROUND INFORMATION

ON

## THE CHOLLA POWER PLANT

THE CHOLLA POWER STATION, LOCATED NEAR JOSEPH CITY, ARIZONA, HAS ONE 115-MW COAL-FIRED BOILER IN SERVICE AND TWO 250 MW UNITS UNDER CONSTRUCTION. UNIT 1 IS A DRY-BOTTOM PULVERIZED-COAL-FIRED UNIT DESIGNED BY COMBUSTION ENGINEERING. THE COAL NOW BEING BURNED HAS AN AVERAGE HEATING VALUE (DRY BASIS) OF 12,146 BTU/LB AND ASH AND SULFUR CONTENTS OF 12.3 PERCENT AND 0.44 PERCENT, RESPECTIVELY.

THE FGD SYSTEM AT THE CHOLLA PLANT WAS MANUFACTURED BY RESEARCH-COTTRELL AND INSTALLATION WAS COMPLETED ON DECEMBER 3, 1973. THE COMBINED SO<sub>2</sub> REMOVAL EFFICIENCY (FOR BOTH MODULES A AND B) IS REPORTED TO BE 58.5 PERCENT. THE SYSTEM CONSISTS OF TWO SCRUBBING MODULES (A AND B). EACH MODULE IS DESIGNED FOR 240,000 ACFM THROUGHPUT AT 276°F, AND HANDLES 50 PERCENT OF THE BOILER'S FLUE GAS LOAD. MODULE A HAS A VARIABLE-THROAT FLOODED-DISC SCRUBBER (FDS) FOLLOWED BY A PACKED TOWER; MODULE B IS SIMILAR BUT THE TOWER IS NOT PACKED AND SLURRY IS NOT CIRCULATED THROUGH IT. EITHER ONE OR BOTH OF THE SCRUBBERS CAN BE BYPASSED. GAS LEAKAGE AROUND EACH TRAIN IS ESTIMATED TO BE ABOUT 4.5 PERCENT OF THE GAS BEING TREATED. THE TOWER PACKING, WHICH IS ABOUT 2 FEET THICK, IS MADE OF POLYPROPYLENE CORRUGATED SHEETS JOINED TOGETHER IN CRISS-CROSS PATTERNS SIMILAR TO HONEYCOMBS. THE TOWER DEMISTERS ARE MADE OF POLYPROPYLENE, AND THE REHEATERS ARE SHELL AND TUBE TYPE CONSISTING OF THREE TUBE BUNDLES.

LIMESTONE FOR THE FGD SYSTEM IS PURCHASED IN GROUND FORM SUITABLE FOR SLURRYING. THE MAIN SOURCE OF SUPPLY IS THE SUPERIOR CO., LOCATED NEAR PHOENIX, ARIZONA.

THE PLANT HAS NO SLUDGE TREATMENT OR FIXATION SYSTEMS. THE SLUDGE IS PUMPED TO THE FLY ASH POND ON AN INTERMITTENT BASIS THROUGH A COMMON PIPING SYSTEM WITH THE FLY ASH. NO POND WATER IS RECYCLED TO THE FGD SYSTEM.

### PROBLEMS AND SOLUTIONS

DECEMBER, 1973 TO APRIL 2, 1974 - BECAUSE OF A DIFFERENCE IN SIZE OF THE MAIN DUCT AND THE REHEATER TRANSITION DUCT, THE GAS FLOW PRODUCED HARMONIC VIBRATIONS IN THE REHEATER. THE VIBRATIONS WERE PARTIALLY DAMPED BY INSTALLATION OF BAFFLES. ONE OF THE REHEATER TUBE BUNDLES WAS BADLY CORRODED BY ACID THAT CONDENSED IN THE UNINSULATED DUCT UPSTREAM OF THE REHEATERS. THE TUBE BUNDLE WAS REPLACED, AND A BAFFLE WAS INSTALLED TO DIVERT CONDENSED ACID FROM REHEATER TUBES. ALSO, THE DUCT UPSTREAM OF THE REHEATER WAS INSULATED. THE ACID CONDENSATION OCCURRED ONLY IN THE MODULE WITH NO TOWER PACKING AND HENCE LOW SO<sub>2</sub> REMOVAL EFFICIENCY.

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**CHOLLA POWER PLANT (Continued)**

ANOTHER PROBLEM WAS DUE TO SOLIDS BUILDUP IN THE FDS STUFFING GLAND BOX AND ON TOP OF THE SPRAY DOME. ALSO, SOME LINES PLUGGED, PARTICULARLY WHEN THE SYSTEM OPERATED AT LOW FLOW RATES. SOLIDS SETTLED OUT IN STANDBY PUMPS, AND EXCESSIVE FAN VIBRATIONS OCCURRED BECAUSE OF ACCUMULATION OF SCALE BUILDUP WHEN THE UNIT WAS IDLE. TO SOLVE THESE PROBLEMS, PACKING GLAND POSITION WAS REVERSED (INSTALLED UPSIDE DOWN), THE FAN WAS SANDBLASTED, THE PIPING WAS MODIFIED TO ELIMINATE STAGNANT POCKETS, AND PUMPS WERE FLUSHED IMMEDIATELY AFTER REMOVAL FROM SERVICE.

MORE RECENT PROBLEMS INCLUDE: SIGNIFICANT CORROSION ATTACK IN THE VESSEL WALLS OF THE FLOODED-DISC PARTICULATE SCRUBBER OR MODULE; ACID CORROSION IN THE REHEATER HOUSING OF MODULE B; SCALE BUILDUP IN THE PIPE OUTLET AT THE SLUDGE/FLY ASH EVAPORATION POND; PLUGGING IN THE SCRUBBER TOWER PACKING AND MIST ELIMINATOR; EROSION IN THE PUMPS; CORROSION IN THE BOILER EXHAUST ELBOW OF THE DUCTWORK LEADING FROM THE SCRUBBERS TO THE STACK.

# FGD SYSTEM RELIABILITY

CHOLLA UNIT NO. 1

<u>Month</u>	<u>RELIABILITY (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Jan. 74	97	90	
Feb. 74	100	94	
Mar. 74	100	66	
Apr. 74	66	57	
May 74	98	99	
Jun. 74	100	100	
Jul. 74	97	92	
Aug. 74	97	97	
Sep. 74	95	99	
Oct. 74	83	68	Annual boiler and FGD System overhaul.
Nov. 74	100	98	
Dec. 74	100	100	
Jan. 75	98	99	
Feb. 75	96	99	
Mar. 75			
Apr. 75	88	65	
May 75	48	40	Modules were both off-line for most of month for scheduled repairs and cleaning.
Jun. 75	100	100	Substantial plugging of packing and mist eliminators was observed.
			No problems reported.
Jul. 75	97	98	Modules were shut down to clean flow restrictions in flooded-disc recirculation lines.
Aug. 75	95	100	Module A was down for inspection one time.

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**FGD SYSTEM RELIABILITY**  
**CHOLLA UNIT NO. 1 (continued)**

<u>Month</u>	<u>RELIABILITY (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Sep. 75	98	97	Minor outage due to flooded-disc lines.
Oct. 75	84	55	Outages resulted from scheduled equipment overhauls and recoating of vessels.
Nov. 75	100	80	No major outages or problems occurred during the report period. Minor problems
Dec. 75	100	100	during December included the rebuilding of a recycle pump and malfunctioning of the B-side reheater coil.
Jan. 76	99	99	Module A operated 715 hours during the report month, and Module B operated 654 hours. Module A experienced some minor valve and line plugging. Module B operating hours were lower because of reduced system requirements.
Feb. 76			
Mar. 76			
Apr. 76	99	98	The unit is currently experiencing coating failures in the elbow of the scrubber exhaust duct. Also, the utility performed some minor repairs to the housing of the B-side reheater.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	10
UTILITY NAME	ARIZONA PUBLIC SERVICE
UNIT NAME	FOUR CORNERS NO. 5A
UNIT LOCATION	FARMINGTON NEW MEXICO
UNIT RATING	160 MW
FUEL CHARACTERISTICS	COAL, 0.7 PERCENT SULFUR
FGD VENDOR	SCE
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	2/76
FGD STATUS	OPERATIONAL
EFFICIENCY, - PARTICULATES	

S02

WATER MAKE UP

SLUDGE DISPOSAL

UNIT COST

OPERATIONAL  
EXPERIENCE

THIS 160 MW SYSTEM HAS BEEN MOVED FROM THE MOHAVE STATION OF SOUTHERN CALIFORNIA EDISON WHERE THE SYSTEM WAS PREVIOUSLY TESTED. THE SYSTEM WILL TREAT APPROXIMATELY 20 PERCENT OF THE FLUE GAS FROM UNIT NO. 5, RATED AT 755 MW(NET). THE ENGINEERING AND CONSTRUCTION WORK HAS BEEN COMPLETED. THE SYSTEM BECAME OPERATIONAL ON FEBRUARY 17, 1976. THE EXPERIMENTAL SCRUBBER WAS TAKEN OUT OF SERVICE IN MID-APRIL FOR A SCHEDULED BOILER OVERHAUL.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

<b>IDENTIFICATION NO.</b>	<b>29</b>
<b>UTILITY NAME</b>	<b>COMMONWEALTH EDISON</b>
<b>UNIT NAME</b>	<b>WILL COUNTY NO 1</b>
<b>UNIT LOCATION</b>	<b>ROMEDEVILLE ILLINOIS</b>
<b>UNIT RATING</b>	<b>167 MW</b>
<b>FUEL CHARACTERISTICS</b>	<b>COAL - 9463 BTU, 2.1% SULFUR</b>
<b>FGD VENDOR</b>	<b>BABCOCK &amp; WILCOX</b>
<b>PROCESS</b>	<b>LIMESTONE SCRUBBING</b>
<b>NEW OR RETROFIT</b>	<b>RETROFIT</b>
<b>START UP DATE</b>	<b>2/72</b>
<b>FGD STATUS</b>	<b>OPERATIONAL</b>
<b>EFFICIENCY, PARTICULATES</b>	<b>98 PERCENT</b>
<b>S02</b>	<b>82 PERCENT</b>
<b>WATER MAKE UP</b>	<b>106 GAL/LB MOLE S02 REMOVED</b>
<b>SLUDGE DISPOSAL</b>	<b>STABILIZED SLUDGE DISPOSED IN CLAY LINED POND</b>
<b>UNIT COST</b>	<b>\$96/KW CAP. W/NO SLUDGE TREAT. 6.9 MILLS/KWH AT 65% BLR. CAP.</b>
<b>OPERATIONAL EXPERIENCE</b>	<p>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE FEBRUARY 1972. THE UNIT WAS RE-TURNED TO SERVICE IN MARCH FOLLOWING A MAJOR BOILER, TURBINE, AND SCRUBBER OVERHAUL. SYSTEM OPERABILITY FOR BOTH MODULES DURING THE REPORT PERIOD WAS 45 AND 20 PERCENT IN MARCH AND 20 AND 49 PERCENT IN APRIL FOR MODULES A AND B RESPECTIVELY. MODULES A AND B WERE IN SERVICE A TOTAL OF 3213 AND 2580 HOURS HOURS RESPECTIVELY. IN 1975, WHICH TRANLATES INTO ANNUAL OPERABILITY FACTORS OF 52 AND 42 PERCENT RESPECTIVELY.</p>

BACKGROUND INFORMATION  
ON  
THE WILL COUNTY POWER STATION

IN 1970, COMMONWEALTH EDISON CONTRACTED WITH BECHTEL CORPORATION TO INVESTIGATE THE SULFUR REMOVAL SYSTEMS THEN AVAILABLE HAVING A SUFFICIENT DEGREE OF DEVELOPMENT TO WARRANT LARGE-SCALE INSTALLATION ON WILL COUNTY STATION'S UNIT NO. 1. AFTER DECIDING ON A WET SCRUBBER SYSTEM USING LIME OR LIMESTONE, BECHTEL PREPARED A SPECIFICATION AND RELEASED IT FOR BID. FROM NINE BIDDERS THAT WERE SOLICITED, SEVEN PROPOSALS WERE RECEIVED. AFTER DETAILED STUDY AND BID EVALUATION WITH SPECIAL CONSIDERATION OF THE PROJECT SCHEDULE, BABCOCK AND WILCOX WAS AUTHORIZED IN SEPTEMBER 1970 TO BEGIN DETAILED ENGINEERING FOR A LIMESTONE SLURRY SYSTEM. COMPLETION DEADLINE FOR THE PROJECT WAS DECEMBER 31, 1971, A DEADLINE ESTABLISHED BY THE ILLINOIS COMMERCE COMMISSION AS PART OF A RATE CASE.

THE BABCOCK AND WILCOX PROCESS WAS GUARANTEED TO REMOVE .98 PERCENT OF THE FLY ASH AND 76 PERCENT OF THE SULFUR DIOXIDE. THESE EFFICIENCIES WERE BASED ON A DUST INLET LOADING OF 1.355 GRAINS PER STANDARD CUBIC FOOT AT 70°F AND ON BURNING OF ILLINOIS COAL CONTAINING 4 PERCENT SULFUR.

THE WILL COUNTY POWER STATION IS LOCATED NEAR ROMEOVILLE, ILLINOIS. THE PLANT HAS FOUR ELECTRIC POWER GENERATING UNITS WITH A TOTAL RATED CAPACITY OF 1147 MW. ONLY UNIT NO. 1 IS RETROFITTED WITH AN FGD SYSTEM.

UNIT NO. 1 IS A WET-BOTTOM COAL-FIRED BOILER PRODUCING 167 MW OF ELECTRICITY. THE BOILER WAS MANUFACTURED BY BABCOCK AND WILCOX AND WAS INSTALLED IN 1955. THE PLANT NOW BURNS A LOW-SULFUR (1.3 PERCENT) WESTERN COAL AND A HIGH-SULFUR ILLINOIS COAL.

THE WET LIMESTONE FGD SYSTEM AT WILL COUNTY WAS PLACED IN SERVICE ON FEBRUARY 23, 1972. THE SYSTEM CONSISTS OF TWO FGD MODULES (IDENTIFIED AS A AND B), LIMESTONE HANDLING AND MILLING FACILITIES, AND A SLUDGE TREATMENT AND STABILIZATION UNIT. SO<sub>2</sub> REMOVAL EFFICIENCY IS REPORTED TO BE 82 PERCENT. SHORTLY AFTER STARTUP AND DURING INITIAL SHAKEDOWN, NUMEROUS PROBLEMS WERE ENCOUNTERED. COMMONWEALTH EDISON SHUT DOWN MODULE B IN MAY 1973 TO CONCENTRATE ON SOLVING THE PROBLEMS OF MODULE A. MODULE B WAS NOT RESTARTED UNTIL MAY 1975.

THE LIMESTONE GRINDING FACILITIES CONSIST OF TWO WET BALL MILLS, EACH RATED AT 12 TONS PER HOUR OF LIMESTONE. THE LIMESTONE IS 97.5 PERCENT CALCIUM CARBONATE, AND CONTAINS 0.99 PERCENT MAGNESIUM CARBONATE AND 0.48 PERCENT SILICA. IT IS RECEIVED IN COARSE-GROUND FORM (ABOUT 1/2 INCH OR LESS) AND IS FINELY GROUND TO 95 PERCENT THROUGH 320 MESH.

## **WILL COUNTY (Continued)**

SLUDGE FROM THE SYSTEM IS SENT TO A CLARIFIER. THE OVERFLOW IS RETURNED TO THE PROCESS; THE UNDERFLOW IS STABILIZED BY MIXING IT WITH LIME AND FLY ASH. ABOUT 200 POUNDS OF LIME AND 400 POUNDS OF FLY ASH ARE USED PER TON OF DRY SOLIDS OF SLUDGE. THE FIXED SLUDGE IS TRANSPORTED BY CONCRETE MIXING TRUCKS TO AN ON-SITE HOLDING BASIN FOR SOLIDIFICATION. THE STABILIZED MATERIAL IS THEN HAULED AWAY APPROXIMATELY A WEEK LATER TO AN OFF-SITE DISPOSAL AREA.

### **PROBLEMS AND SOLUTIONS**

1972 - DEMISTER PLUGGING WAS A CONSTANT PROBLEM, MAINLY BECAUSE OF HEAVY LIMESTONE ACCUMULATIONS ON THE BOTTOM OF THE DEMISTER AND PARTLY BECAUSE OF LOW WASHWATER PRESSURE CAUSED BY LEAKS IN THE POND RETURN BYPASS. BECAUSE OF THESE PROBLEMS MODULES A AND B WERE OUT OF SERVICE FOR SEVERAL DAYS EACH MONTH DURING MARCH, APRIL, JUNE, AND JULY 1972. THE MODULES WERE ALSO OUT OF SERVICE FROM SEPTEMBER 26 TO NOVEMBER 21, 1972, BECAUSE THE BOILER WAS DOWN.

IN ORDER TO SOLVE THE DEMISTER PROBLEM, THE SLURRY NOZZLES WERE LOWERED AND THE SLURRY CIRCULATION SYSTEM WAS LEFT OUT OF SERVICE TO KEEP THE DEMISTER CLEAN. SINCE THE SITUATION DID NOT IMPROVE, THE DEMISTER ELEMENTS WERE HAND-WASHED. THIS SOLVED THE PROBLEM PARTIALLY, BUT CAUSED DIFFICULTY WITH THE VENTURI NOZZLES BECAUSE BROKEN ELEMENTS FROM THE DEMISTER GOT INTO THE SLURRY SYSTEM.

AT HIGH GAS FLOW RATES, THE REHEATER OF MODULE B VIBRATED EXCESSIVELY. THEREFORE, MODULE B WAS TAKEN OUT OF SERVICE IN APRIL TO ALLOW REHEATER MODIFICATIONS, WHICH INCLUDED REBRACING OF THE REHEATER TUBES AND INSTALLATION OF A BAFFLE PLATE TO REDUCE THE VIBRATIONS.

OTHER REASONS FOR OUTAGES WERE EROSION AND PLUGGING OF SPRAY NOZZLES, INTERNAL AND EXTERNAL BUILDUP OF DEPOSITS ON VENTURI NOZZLES, CORROSION, SULFITE BLINDING PROBLEMS, AND FAN VIBRATIONS.

1973 - DEMISTER PLUGGING CONTINUED. FURTHERMORE, THE DEMISTER ON MODULE B BROKE LOOSE FROM ITS MOUNTINGS AND THE RESULTANT CARRYOVER OF WASHWATER PLUGGED THE REHEATER. THIS REHEATER ALSO LEAKED BECAUSE OF CHLORIDE PITTING CORROSION. MODULE A WAS DOWN FROM APRIL 24 TO MAY 24, 1973, AND MODULE B WAS DOWN FROM APRIL TO DATE. THERE WAS NO SCRUBBER OPERATION FROM AUGUST 27 TO SEPTEMBER 26, 1973.

IN EFFORTS TO SOLVE THE DEMISTER AND REHEATER PROBLEMS, A CONSTANT UNDERSPRAY AND INTERMITTENT OVERSPRAY WERE USED TO WASH ALL THE DEMISTER COMPARTMENTS OF MODULE A. EXTRA NOZZLES WERE ADDED AND A CLEAN WATER SUPPLY WAS MAINTAINED. THE REHEATER UNIT WAS ALSO RETUBED.

1974 - ONLY MODULE A OPERATED DURING 1974. THE MAIN PROBLEMS WERE FREEZING OF THE VENTURI THROAT DRIVE MECHANISM, TANK SCREEN BLINDING, DUCT CORROSION, AND VIBRATIONS. LOSS OF BUILDING HEAT CAUSED EXTENSIVE DAMAGE AND KEPT THE SYSTEM DOWN FOR THE ENTIRE MONTH OF JANUARY 1974.

1975 - ENTERING 1975 MODULE A WAS OPERATIONAL AND MODULE B WAS STILL UNDERGOING MODIFICATION. IN THE FIRST QUARTER OF 1975 THERE WERE EIGHT A-MODULE OUTAGES; ONLY ONE WAS A FORCED OUTAGE, DUE TO THE SPLITTING OF A SLURRY VENTURI SUPPLY HOSE. MODULE B WAS RETURNED TO SERVICE ON MAY 20, 1975.

WILL COUNTY (continued)

THE UTILITY DECIDED TO OPERATE THE SCRUBBER ON ILLINOIS HIGH-SULFUR COAL. WHEN THIS OPERATION BEGAN, A MULTITUDE OF PROBLEMS OCCURRED: LOWER PARTICULATE REMOVAL EFFICIENCIES, HIGH SLURRY CARRYOVERS, DEMISTER PLUGGING, REHEATER COIL FOULING AND LEAKS. MODULE A WAS TAKEN OUT OF SERVICE IN MID-JUNE FOR THE REMAINDER OF 1975. BY MID-SEPTEMBER 1975 MODULE B WAS TAKEN OUT OF SERVICE OWING TO MASSIVE SCALING IN THE ABSORBER SYSTEM. FINALLY, UNIT NO. 1 WAS SHUT DOWN FOR OVERHAUL OF THE BOILER, TURBINE, AND SCRUBBER IN MID-OCTOBER; THIS OUTAGE LASTED MORE THAN 4 MONTHS.

OPERABILITY FACTORS FOR EACH MODULE AND THE CORRESPONDING COMMENTS FOR THE REPORT PERIOD ARE PRESENTED IN THE FOLLOWING TABLE.



FGD SYSTEM OPERABILITY  
WILL COUNTY UNIT NO. 1 \*

<u>PERIOD</u> Month/Year	<u>OPERABILITY (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Mar. 72	0	35	Module A down for repair and modification of demister wash piping assembly. Module B was removed from service every 2 or 3 days to hand-wash the demister. Other problems were vibration of reheater tube bundle, rapid erosion of scrubber spray nozzles, plugging of venturi nozzles.
Apr. 72	34	14	Module A out of service for 6 days because of near-rupture of a venturi pipe expansion joint. Heavy buildup of solids on demister. Module B out of service most of the time for similar repair of venturi pipe expansion joint, and for modification of reheater unit and demister wash system.
May 72	70	32	A two week outage of Module B to rebrace the reheater unit, to install underspray nozzles on demister, and to install heavier screens in the sump. Reheater plugging caused additional outages.
Jun. 72	8	31	Both Modules were out of service owing to high differential pressure across the demisters. Leakage of pond return bypass valve caused demister plugging. Also during this period, the rubber lining of scrubber A was repaired.
Jul. 72			
Aug. 72	79	21	Plugging of venturi nozzles and demister caused shutdown of Module A for 2 days for repairs. Module B was out of service for 22 days for cleaning of the demister and reheater unit, installation of overhead spray nozzles, and replacement of sections of the demister. The boiler was down for 2 days for repair of the generator.

WILL COUNTY UNIT NO. 1 (continued)

<u>PERIOD</u> Month/Year	<u>OPERABILITY (%)</u>		<u>Comments</u>
	Module A	Module B	
Sep. 72	0	30.	Boiler down Sept. 1-5 because of no demand. I.D. fan problem caused unstable operation of the boiler most of the month. Module A was down for modification of reheater unit and repair of recirculation tank screens.
Oct. 72	0	0	Boiler and scrubbers were down. Principal modifications included installation of reheater baffle plates to dampen vibrations and installation of an experimental demister wash system.
Nov. 72	0	0	Boiler problems causing unstable operation kept both modules down during this month.
Dec. 72	22	30	Modules operated intermittently because of electrostatic precipitator testing and miscellaneous instrument problems.
Jan. 73	0	0	Both modules were down for repairs and modifications.
Feb. 73	22	24	Modules were out of service because of cracks in the inlet ductwork of the booster fan. Improper installation of demister caused plugging of Module B reheater unit.
Mar. 73	65	11	Module A was out of service for 5 days because of demister plugging. Boiler was down for 4 days of inspection. Module B was down because of leaks from reheater tubes.
Apr. 73	6	13	Persisting problems with demister and deposits of calcium sulfate scale on reheater tubes of Module A.
May 73	0	0	Both modules were out of service during this month.
Jun. 73	16	0	Module B was kept down to allow concentration on the problems with Module A. Boiler-related problems were responsible for most of the outages of Module A.
Jul. 73	51	0	Module A problems: reheater tubes leaks and high fan vibrations.

WILL COUNTY UNIT NO. 1 (continued)

<u>PERIOD</u> Month/Year	<u>OPERABILITY (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Jul. 73	19	0	More reheater tube leaks on Module A attributed to chloride corrosion attack.
Sep. 73	0	0	Modules were down. During this month, Chicago Fly Ash Co. finished cleaning and treating the northeast half of the sludge pond.
Oct. 73	32	0	Module A tripped several times because of bad limit switches in the bypass and block dampers. Unit was also taken down to balance the booster I.D. fan.
Nov. 73	51	0	Routine inspection of Module A revealed some plugging. Module was kept down for cleaning and some modification. Poor gas distribution in module suspected to contribute to demister problems.
Dec. 73	0	0	Modules were down. The month was devoted to modification and maintenance, mostly of demister, venturi throats, pumps, and isolation valves.
Jan. 74	0	0	Modules were down owing to freezing in the 10-inch-diameter, 4400-ft. line between modules and pond. Some damage to sump pumps. Freezing also damaged some instruments.
Feb. 74	0	0	The frozen pipeline was thawed, reanchored, and returned to service. The instruments damaged by freezing were repaired. Module A kept down until arrival of second-stage demister.
Mar. 74	21	0	Module A was ready for service March 20 but was not returned to service till March 27 because boiler was down.
Apr. 74	72	0	Module A continued to operate until April 19 (except for two short inspection outages) for 23 consecutive days. Operation was on low-sulfur coal. Sump screen from Module B was substituted for damaged screen in Module A.
May 74	93	0	Module A operated for entire month except for short outages for inspection. Much of this operation was on high-sulfur coal.

WILL COUNTY UNIT NO. 1 (continued)

<u>PERIOD</u> Month/Year	<u>OPERABILITY (%)</u>		<u>Comments</u>
	Module A	Module B	
Jun. 74	55	0	Module A operated for about 300 hours. The system was off for 2 weeks for repair of venturi throat drive.
Jul. 74	96	0	Module A operated for the whole month except for one inspection outage and two boiler shutdowns. Module B remains down until satisfactory operation of Module A is achieved.
Aug. 74	91	0	Module A was down six times this month: three times because of no boiler demand, twice for repair of leaks in steam piping, and once for balancing of a fan.
Sep. 74	85	0	Module A was off three times; once for cleaning of deposits from the venturi throat, once for repair of a desuperheater leak, and once because boiler was down.
Oct. 74	94	0	Module A was down four times: once because of boiler outages, once for inspection, and twice for repair of reheater leaks.
Nov. 74	97	0	Module A was out of service three times: twice because of no demand and once for inspection.
Dec. 74	99	0	Module A was down twice: once for inspection and once for repair of valve in spent-liquor line to pond.
Jan. 75	99	0	Module A was down twice: once for inspection and once for no demand. Modification of module B is continuing.
Feb. 75	99	0	Module A was out of service twice: once for inspection and once for no demand. One small reheater leak in a stainless steel bundle was blanked-off on-line. During the inspection, demister underwash nozzles were cleaned and a small section of demister was replaced. Inspection showed that conditions inside the scrubber were about the same as before. Coal burned this month averaged less than 1% sulfur. Modification of Module B is continuing. Chicago Fly Ash is treating material from the scrubber with portland cement and fly ash and

WILL COUNTY UNIT NO. 1 (continued)

<u>PERIOD</u> <u>Month/Year</u>	<u>OPERABILITY (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Mar. 75	40	0	dumping the treated material into the north half of the holding basin. Module A was down four times: twice for no demand, once for a venturi hose leak, once for an accidental 50-minute trip.
Apr. 75	40	0	Sludge pond was overburdened by near-continuous operation of Module A. The FGD system was shut down to allow evaporation of water from the pond. During shut down, the following modifications were made. Pump gland water flows were reduced from 10 to 5 gpm. Filter backwash was routed out of system. Continuous demister underspray was changed to intermittent.
May 75	84	37	Module A remained out of service until May 5, when it was determined that there was enough freeboard in the pond to start operating. There were two more outages: one for 45 minutes, the result of a damper trip; the other for cleaning of underspray nozzles. Module B was placed in service 10:20 A.M., May 20, for the first time since noon on April 13, 1973. After brief start-up, which was routine, operation was delayed until the 20th because of two broken oil pumps on the recirculation tank mixers. Since the start-up, Module B has been out of service twice: once for a venturi pump trip, and once for a recirculation tank level trip. The total outage time was only 1 hour, 40 minutes.
Jun. 75	61	85	Module A sustained five outages during the month. Module is presently out of service to allow installation of new demisters and reheater. Module B was out of service 8 times. Longest outage was for 95 hours for cleaning of booster fan and demister. Booster fan vibrations caused a shutdown on June 30.
Jul. 75	0	79	Module A cannot be returned to service until the new reheater, ordered in April, is received and installed. Module B sustained four outages. Reheater failures at 1000 hours seem to be caused by vibration fatigue. One minor steam header leak also occurred.
Aug. 75	0	100	

WILL COUNTY UNIT NO. 1 (continued)

<u>PERIOD</u> Month/Year	<u>OPERABILITY (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Sep. 75	0	63	Module A remained out of service all month because of delay on the new reheater order. Module B was down three times because of massive absorber scale, demister and I.D. booster fan cleaning, balancing I.D. booster fan, and plugging of absorber pump screen. Total outage time was 238 hours, 40 minutes.
Oct. 75	0	100	On October 11, overhaul began on the Will County Unit No. 1 boiler, turbine, and scrubber. Module B experienced two minor outages during the 11-day period prior to the overhaul. Module A was down for delivery of the new reheater.
Nov. 75	0	0	The scheduled overhaul of the boiler, turbine, and scrubber modules continued. Major maintenance areas included module reheaters, pond return pump, venturi spray nozzles, venturi and absorber modules, pump valves, and sumps.
Dec. 75	0	0	Module B reheater was returned from manufacturer after repairs and revisions. Scrubber reheaters could be installed and operating by the end of January.
Jan. 76			The unit remained out of service for completion of the boiler, turbine, and scrubber over-
Feb. 76	0	0	haul that began on October 11, 1975. System restart is now scheduled for mid-March 1976.
Mar. 76	45	20	Unit No. 1 returned to service in March following an extended major boiler, turbine and scrubber overhaul. Module A was put into the gas path on March 22 and remained in service until March 29 because of delays in the installation of a repaired reheater.
Apr. 76	20	49	During the month of April Module A incurred pump liner failures when an isolation valve broke and fell into the venturi recycle pump. Module B outages during the month resulted from reheater tube bundle leaks; plugged absorber tank screens; and venturi pump liner failure. High sulfur coal (3.5 percent sulfur) was burned in the boiler throughout the month. In addition, the utility initiated a testing and evaluation program during the month. This program is designed to provide data and information concerning chemistry and related operating characteristics.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

<b>IDENTIFICATION NO.</b>	<b>31</b>
<b>UTILITY NAME</b>	<b>DUQUESNE LIGHT</b>
<b>UNIT NAME</b>	<b>ELRAMA</b>
<b>UNIT LOCATION</b>	<b>ELRAMA PENNSYLVANIA</b>
<b>UNIT RATING</b>	<b>510 MW</b>
<b>FUEL CHARACTERISTICS</b>	<b>COAL 1.0 - 2.8 PERCENT SULFUR</b>
<b>FGD VENDOR</b>	<b>CHEMICO</b>
<b>PROCESS</b>	<b>LIME SCRUBBING</b>
<b>NEW OR RETROFIT</b>	<b>RETROFIT</b>
<b>START UP DATE</b>	<b>10/75</b>
<b>FGD STATUS</b>	<b>OPERATIONAL</b>
<b>EFFICIENCY, PARTICULATES</b>	
<b>SO2</b>	<b>83 PERCENT FOR 2% SULFUR COAL</b>
<b>WATER MAKE UP</b>	
<b>SLUDGE DISPOSAL</b>	<b>STABILIZED SLUDGE DISPOSED IN UNLINED POND</b>
<b>UNIT COST</b>	<b>\$93/KW CAPITAL</b>
<b>OPERATIONAL EXPERIENCE</b>	<b>THE FGD SYSTEM WAS PLACED IN SERVICE ON OCTOBER 26, 1975. INITIAL OPERATION PROCEEDED WITH FLUE GAS FROM ONE BOILER BEING TREATED BY THE SCRUBBING SYSTEM. A SECOND BOILER WAS TIED INTO THE SYSTEM ON FEBRUARY 4, 1976. DURING THE REPORT PERIOD MODIFICATIONS TO THE FIFTH SCRUBBING VESSEL WERE COMPLETED AND THE VESSEL IS NOW OPERATING WITH TWO RUBBER-LINED RECYCLE PUMPS.</b>

## BACKGROUND INFORMATION

### ON

## ELRAMA POWER STATION

DUQUESNE LIGHT COMPANY, AN INVESTOR-OWNED ELECTRIC UTILITY, SERVES ABOUT ONE-HALF MILLION CUSTOMERS IN SOUTHWESTERN PENNSYLVANIA AND HAS A NET GENERATING CAPABILITY OF APPROXIMATELY 2500 MW. THIS CAPABILITY IS GENERATED BY COMBUSTION TURBINES IN SIMPLE AND COMBINED-CYCLE MODES, BY NUCLEAR PLANTS, AND BY COAL-FIRED POWER STATIONS. THE COMPANY IS SOLE OWNER AND OPERATOR OF THREE COAL-FIRED STATIONS, TWO OF WHICH HAVE BEEN RETROFITTED WITH WET SCRUBBERS USING LIME AS A REAGENT.

THE SCRUBBER FACILITY AT THE 494-MW ELRAMA STATION IS ALMOST IDENTICAL TO THE SYSTEM AT THE PHILLIPS STATION. GIBBS & HILL IS THE ARCHITECT-ENGINEER, AND CHEMICO SCRUBBERS HAVE BEEN INSTALLED WITHIN THE SAME DESIGNATED BATTERY AS AT PHILLIPS. MECHANICAL AND ELECTRICAL DUST-REMOVAL EQUIPMENT REMOVES MOST PARTICULATES FROM THE BOILER EMISSIONS, AND THE GAS TO AND FROM THE SCRUBBERS IS HEADERED IN THE SAME WAY. UNLIKE THE PHILLIPS SYSTEM, HOWEVER, THERE ARE FOUR BOILERS, EACH WITH ITS OWN TURBINE GENERATOR. FIVE SINGLE-STAGE SCRUBBERS WERE INSTALLED, WITH THE INTENTION THAT KNOWLEDGE GAINED FROM THE TEST PROGRAM AT PHILLIPS WOULD BE APPLIED TO ELRAMA TO ENABLE COMPLIANCE WITH EMISSION REGULATIONS.

THE FIRST ELRAMA SCRUBBER WAS PLACED IN SERVICE ON OCTOBER 26, 1975. IT HAD BEEN SCHEDULED FOR AN EARLIER STARTUP DATE, BUT BECAUSE OF THE SEVERITY AND NUMBER OF PROBLEMS ENCOUNTERED AT PHILLIPS, STARTUP WAS DELAYED UNTIL MANY OF THE PROBLEMS AT PHILLIPS WERE RESOLVED AND THE MODIFICATIONS COULD BE INCORPORATED AT BOTH STATIONS.

BOILER NO. 2 WAS INITIALLY CONNECTED TO THE FGD SYSTEM ON OCTOBER 26, 1975. THIS BOILER HAS AN EQUIVALENT CAPACITY OF APPROXIMATELY 100 MW, AND THE EMISSIONS ARE HANDLED BY ONE SCRUBBER. TO ENSURE RELIABILITY IN THE CASE OF A SCRUBBER MALFUNCTION, TWO SCRUBBERS ARE OPERATED AT PARTIAL LOAD TO PROTECT THE BOILER AND TURBINE GENERATOR AGAINST A TRIP-OFF.

THE BOILER OPERATED CONTINUOUSLY ON THE SCRUBBER SYSTEM THROUGH JANUARY 1976. TWO MINOR OUTAGES OCCURRED DURING THIS PERIOD, ONE CAUSED BY INOPERATIVE THROAT DAMPERS AND THE OTHER INVOLVING FAILURE OF A LIME FEEDER BELT.

UNTIL ADDITIONAL CONSTRUCTION IS COMPLETED, TWO BOILERS ARE THE MAXIMUM THAT CAN BE TIED INTO THE SCRUBBING SYSTEM. TO DATE THE UTILITY HAS ENCOUNTERED THE USUAL MINOR STARTUP PROBLEMS AND SOME MAJOR PROBLEMS AS WELL. THE MAJOR PROBLEMS HAVE ENTAILED FROZEN PIPES AND THICKENERS, THE LATTER INVOLVING HARDWARE AND DESIGN ASSOCIATED WITH RECIRCULATION OF THE SLUDGE WITHIN THE THICKENERS TO ATTAIN 30 TO 40 PERCENT SOLIDS CONCENTRATION.

THE SLUDGE BEING GENERATED AT THIS STATION IS TREATED BY THE IUCS METHOD, WHICH EMPLOYS A VACUUM FILTER THAT INCREASES THE SOLIDS IN THE UNDERFLOW TO 50 TO 60 PERCENT, SO THAT LESSER AMOUNTS OF DRY FLY ASH ARE REQUIRED FOR MIXING WITH THE SLUDGE.



# ELRAMA POWER STATION

Period	<u>Operating Hours</u>						<u>Comments</u>	
	<u>Boiler</u>		<u>Scrubber Vessels</u>					
	1	2	1	2	3	4		5
Oct. 75								One boiler was connected to the scrubber system on October 26, 1975. A second boiler was connected on February 4, 1976. Four of the scrubber vessels have been in service in various combinations. The service hours to January 31, 1974 are posted in the accompanying table. The fifth vessel has not been in service because it is being revised for trial installation of rubber-lined recycle pumps.  The system operated during the report period with 2 boilers coupled into the scrubbing system. Revisions to the fifth scrubbing vessel have been completed and operations are proceeding with two rubber-lined recycle pumps.
To								
Jan. 76			1169	1508	976	838		
Feb. 76								
Mar. 76								
Apr. 76								

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	32
UTILITY NAME	DUQUESNE LIGHT
UNIT NAME	PHILLIPS
UNIT LOCATION	SOUTH HEIGHT PENNSYLVANIA
UNIT RATING	410 MW
FUEL CHARACTERISTICS	COAL 1.0- 2.8 PERCENT SULFUR
FGD VENDOR	CHEMICO
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	7/73
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	
SO2	83 PERCENT FOR 2% SULFUR COAL
WATER MAKE UP	
SLUDGE DISPOSAL	STABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$103/KW CAPITAL * 5 MILLS/KWHRANNUALIZED COSTS
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE JULY 1973. THE UTILITY REPORTS THAT A TOTAL OF 4 BOILERS (NOS. 3,4,5,& 6) WERE COUPLED INTO THE SCRUBBING SYSTEM DURING THE REPORT PERIOD. THE SYSTEM IS NOW OPERATING ON HIGH CALCIUM LIME FOLLOWING THE COMPLETION OF THE THIOSORBIC LIME TEST PROGRAM. THE SCRUBBING SYSTEM AVAILABILITY DURING THE FIRST QUARTER OF 1976 WAS 72 PERCENT. THE SLUDGE STABILIZATION PRACTICES ARE STILL CONTINUING AT THIS FACILITY.

**BACKGROUND INFORMATION**  
**ON**  
**PHILLIPS POWER STATION**

THE PHILLIPS POWER STATION IS LOCATED ON THE OHIO RIVER ABOUT 20 MILES NORTHWEST OF PITTSBURGH. THE POWER STATION CONSISTS OF SIX COAL-FIRED BOILERS HAVING A NET GENERATING CAPABILITY OF 307 MW. THE RESULATANT FLUE GASES ARE DISCHARGED TO A COMMON HEADER, TO WHICH THE FGD MODULES ARE CONNECTED THROUGH ISOLATION VALVES. THE BOILERS ARE CURRENTLY BURNING COAL WITH A HEATING VALUE OF 11,350 BTU PER POUND AND SULFUR AND ASH CONTENTS OF 2.2 AND 18.2 PERCENT, RESPECTIVELY.

THE FGD SYSTEM, WHICH SUPPLEMENTS THE EXISTING MECHANICAL AND ELECTROSTATIC DUST COLLECTORS, CONSISTS OF FOUR TRAINS OF WET VENTURI-TYPE SCRUBBERS, INSTALLED AT A COST OF APPROXIMATELY \$103/KW. GIBBS & HILL, INC., WAS ENGAGED AS THE A-E FIRM FOR THE ENTIRE PROJECT; BATTERY LIMITS OF THE CHEMICO CORPORATION ARE CONFINED TO THE SCRUBBERS AND ASSOCIATED PUMPS AND CONTROLS BETWEEN THE INLET HOT GAS DUCT MANIFOLD AND THE EXIT WET GAS HEADER (INCLUDING THE REHEATER, EXCLUDING THE NEW ID FANS).

THE FOUR TRAINS ARE LOCATED DOWNSTREAM OF EXISTING MECHANICAL COLLECTORS AND ESP'S INSTALLED IN SERIES ON EACH OF THE SIX PULVERIZED-COAL-FIRED BOILERS. THREE OF THE TRAINS ARE SINGLE-STAGE VENTURI SCRUBBERS ORIGINALLY INTENDED FOR PARTICULATE REMOVAL. THE FOURTH TRAIN IS A DUAL-STAGE VENTURI SCRUBBER-ABSORBER AND IS THE PROTOTYPE FOR DETERMINING THE FEASIBILITY OF TWO-STAGE SCRUBBING FOR COMPLIANCE WITH SO<sub>2</sub> EMISSION LIMITS.

EACH TRAIN IS EQUIPPED WITH A NEW WET-TYPE ID FAN. A NEW COMMON DUCT DIRECTS GAS STREAMS FROM AIR BOILERS TO THE SCRUBBER SYSTEM, WHERE THEY CAN BE SENT TO ANY OR ALL OF THE TRAINS. THE SCRUBBED GAS IS EXHAUSTED THROUGH A COMMON DUCT AND AN OIL-FIRED REHEATER TO A NEW GROUND-SUPPORTED STACK, WHICH CONTAINS AN INNER ACID-RESISTANT BRICK STACK.

SLAKED QUICKLIME IS ADDED TO THE LOWER CONE OF EACH OF THE SCRUBBER VESSELS TO NEUTRALIZE THE RECIRCULATING LIQUOR, WHICH, IN SINGLE-STAGE SCRUBBING WITH HIGH-CALCIUM LIME, REACTS WITH APPROXIMATELY 50 PERCENT OF THE SO<sub>2</sub> IN THE FLUE GAS. A LIQUOR BLEED FLOW OF APPROXIMATELY 4 PERCENT IS SENT TO ONE OR BOTH OF THE THICKENERS FOR REMOVAL OF SOLIDS. THE OVERFLOW IS RETURNED TO THE SYSTEM, AND THE UNDERFLOW IS PIPED TO THE SLUDGE TREATMENT SYSTEM. THE UNDERFLOW IS STABILIZED BY THE ADDITION OF 200 POUNDS OF CALCILOX PER TON OF DRY SOLIDS IN THE SLUDGE. THE FIXED SLUDGE IS TRANSPORTED TO EXPERIMENTAL PLASTIC-LINED PONDS LOCATED ABOUT ONE MILE FROM THE STATION, WHERE THE MATERIAL SOLIDIFIES.

FLUE GASES FROM THE BOILERS ARE ACCELERATED TO A HIGH VELOCITY IN THE SCRUBBER. AT THE THROAT, THE GASES COLLIDE WITH THE SCRUBBING LIQUID, ATOMIZING IT INTO SMALL DROPLETS. THE FLY ASH AND THE SULFUR DIOXIDE IN THE GAS ARE PICKED UP BY THE SLURRY DROPLETS AND EXIT AT THE BASE OF THE TOWER. THE GAS THEN REVERSES DIRECTION AND FLOWS UP THROUGH THE MIST ELIMINATOR, WHERE FINE DROPLETS ARE REMOVED BEFORE THE GAS LEAVES THE SCRUBBER.

**PHILLIPS POWER STATION (continued)**

STARTUP OF A PORTION OF THE PHILLIPS SCRUBBER SYSTEM BEGAN JULY 1973. SEVERAL PROBLEMS THEN DEVELOPED IN THE FORM OF EROSION OF FANS AND THE LIME FEED SYSTEM, CAUSING OUTAGES OF THE SCRUBBER SYSTEM. AFTER AN EXTENDED OUTAGE, THE SCRUBBER SYSTEM WAS RETURNED TO SERVICE IN MARCH 1974. THE SYSTEM HAS BEEN OPERATING CONTINUOUSLY SINCE THAT TIME WITH VARIOUS NUMBERS OF BOILERS CONNECTED TO THE SCRUBBER SYSTEM AND SCRUBBER TRAINS IN SERVICE.

DETERMINATION OF THE AVAILABILITY OF THE PHILLIPS SYSTEM HAS BEEN DIFFICULT. UNTIL ALL BOILERS WERE CONNECTED TO THE SCRUBBERS, THERE WAS AT LEAST ONE SPARE TRAIN AND AS MUCH AS 100 PERCENT SPARE SCRUBBER CAPACITY. THEREFORE, HAVING A TRAIN OUT OF SERVICE FOR MAINTENANCE DID NOT REDUCE THE CAPABILITY OF THE SCRUBBER SYSTEM. UNTIL ALL SIX BOILERS WERE CONNECTED, MEANINGFUL AVAILABILITY FACTORS COULD NOT BE COMPUTED. ON MARCH 17, 1975, THE SIXTH BOILER WAS CONNECTED, AND ALL FOUR SCRUBBER TRAINS WERE REQUIRED TO BE IN SERVICE. OPERATION IN THAT MODE CONTINUED UNTIL AUGUST 4, 1975, WHEN THE NO. 6 BOILER WAS REMOVED FROM THE SCRUBBER SYSTEM BECAUSE THE pH LEVEL COULD NOT BE MAINTAINED AND DEPOSITS BECAME UNMANAGEABLE TO THE POINT THAT SCRUBBER OUTAGES WERE REDUCING GENERATING CAPABILITY OF THE STATION.

# PHILLIPS POWER STATION

Month	<u>Operating Hours</u>						<u>Scrubber-Absorber</u>				<u>Comments</u>
	1	2	Boiler 3	4	5	6	101	201	301	401	
Jul. 75	83	644	703	349	605	643	400	180	537	723	Fourth FGD train and sixth boiler were tied in on March 17, 1975. Particulate tests in May showed outlet loadings of 0.04 lb/million Btu. The two-stage train has been out of service from June 19 for general cleaning and repair of a leak in the first-stage scrubber.
Aug. 75	354	701	454	457	517	445	478	682	323	319	Scrubber unavailability forced returning Boiler No. 6 to the scrubber bypass gas path to prevent loss of boiler capacity. Plugging and maintenance problems have been encountered. Evaluation of various recycle pumps is continuing.
Sep. 75	463	287	669	503	672	525	57	561	685	536	In October 1975, Phillips initiated thiosorbic lime scrubbing in their single-stage modules on an experimental basis. The purpose is to study compliance feasibility. SO <sub>2</sub> removal efficiency, and quality of the sludge generated by the single-stage modules.
Oct. 75	547	575	620	604	681	687	607	207	505	487	
Nov. 75	16	720	688	70	720	593	626	720	0	75	The utility concluded the thiosorbic lime testing program in mid-December. Four boilers were coupled to the scrubbing system during the run. The utility is now analyzing the data generated during the test program. The scrubbers have been put back on regular lime. No unusual problems were encountered during the test run.
Dec. 75	172	660	709	0	689	547	360	661	182	386	
Jan. 76	222	722	639	0	662	661	277	536	101	707	The 2.5-month test program with thiosorbic lime included 1612 service hours on one train and 1309 hours on another train. Results indicate that the required degree of SO <sub>2</sub> removal (83 percent) can be obtained with an MgO content of 8-10 percent in the lime with single-stage scrubbing.

**PHILLIPS POWER STATION (Continued)**

<u>Month</u>	<u>Operating Hours</u>						<u>Scrubber-Absorber</u>			
	1	2	Boiler 3	4	5	6	101	201	301	401
Feb. 76	445	588	672	0	633	571	657	662	166	406
Mar. 76							695	353	659	461

Comments

Plant operation is proceeding with a total of 4 boilers coupled into the scrubbing system (equaling 336 MW, which is 87 percent of the total plant capacity). The FGD system operated on high calcium lime during the report period. The general operation mode at this facility has one of the four scrubbing trains out continually for repairs, cleaning, and preventative maintenance. The utility is still experiencing problems with solids deposition in the venturi throat of the scrubbing module, causing movement inhibition and greater pressure drops. The FGD system availability for the first quarter of 1976 was 72 percent. The sludge stabilization practices are still continuing at this facility.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	33
UTILITY NAME	GENERAL MOTORS
UNIT NAME	CHEVROLET PARMA 1 2 3 & 4
UNIT LOCATION	PARMA OHIO
UNIT RATING	32 MW
FUEL CHARACTERISTICS	COAL 2.5 PERCENT SULFUR
FGD VENDOR	KOCH
PROCESS	DOUBLE ALKALI
NEW OR RETROFIT	RETROFIT
START UP DATE	3/74
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	80 PERCENT
S02	90 PERCENT
WATER MAKE UP	CLOSED LOOP
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$3.2 MILLION CAPITAL + \$11.70 PER TON OF COAL ANNUALIZED
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE MARCH 1974. SYSTEM OPERABILITY DURING THE MONTHS OF MARCH AND APRIL WAS 17 AND 78 PERCENT RESPECTIVELY. SYSTEM OPERABILITY AVERAGED IN EXCESS OF 58 PERCENT DURING THE LAST EIGHT MONTHS. CURRENTLY, A SCRUBBING SYSTEM CHARACTERIZATION STUDY, SPONSORED BY THE EPA, IS BEING CONDUCTED BY A.D. LITTLE.

**BACKGROUND INFORMATION**  
**ON**  
**THE CHEVROLET PARMA STEAM PLANT**

THE CHEVROLET PARMA PLANT OF GENERAL MOTORS IS LOCATED NEAR CLEVELAND, OHIO. THE PLANT HAS FOUR SPREADER-STOKER BOILERS FIRED BY TRAVELING GRATES AND PRODUCES A TOTAL RATED CAPACITY OF 32 MW. THE BOILERS ARE RETROFITTED WITH A SOLUBLE ALKALI FGD SYSTEM. THE COAL BEING BURNED AT THE PLANT CONTAINS ABOUT 2.5 PERCENT SULFUR.

THE FGD SYSTEM SCRUBBING MODULES WERE SUPPLIED BY KOCK ENGINEERING. INSTALLATION WAS COMPLETED ON FEBRUARY 28, 1974. THE SYSTEM CONSISTS OF FOUR SCRUBBERS OPERATING IN PARALLEL. EACH SCRUBBER IS MADE OF THREE BUBBLE-CAP ABSORPTION TRAYS AND A MESH MIST ELIMINATOR.

THE  $\text{SO}_2$  CONTAINED IN THE FLUE GAS IS ABSORBED BY A REGENERATED CAUSTIC SOLUTION (0.1 MOLAR  $\text{NaOH}$ ), FORMING SOLUBLE SODIUM SALTS. THE SPENT CAUSTIC IS THEN REGENERATED BY REACTING THE SOLUTION WITH SLAKED LIME, RESULTING IN THE FORMATION OF CALCIUM SULFITE AND SULFATE SOLIDS, WHICH ARE SEPARATED OUT OF THE SOLUTION. NEXT, SODA ASH IS ADDED TO THE SOLUTION IN ORDER TO MAKE UP FOR SODIUM LOSSES AND MINIMIZE THE SCALE POTENTIAL FROM THE CALCIUM WHICH REMAINS IN SOLUTION. THE REGENERATED CAUSTIC FORMED IS THEN RECYCLED BACK TO THE SCRUBBER FOR ADDITIONAL  $\text{SO}_2$  REMOVAL, THE SLUDGE WHICH RESULTS IS DEWATERED AND HAULED AWAY BY TRUCK TO AN OFF-SITE LANDFILL.

**PROBLEMS AND SOLUTIONS**

THE SYSTEM WAS STARTED UP ON FEBRUARY 28, 1974 AND BY APRIL 31 IT HAD OPERATED FOR 624 HOURS. THERE WERE TWO SCHEDULED SHUTDOWNS DURING THIS PERIOD FOR EQUIPMENT INSPECTION. THE SECOND SHUTDOWN REVEALED THAT SOLIDS WERE NOT BEING DISCHARGED FROM THE PRIMARY CLARIFIER RAPIDLY ENOUGH. AS A RESULT, THE CLARIFIER RAKE JAMMED. A PIPING CHANGE WAS MADE TO BLEND THE CAUSTIC FEED IN WITH THE RECYCLE LIQUOR. THIS HAS IMPROVED PERFORMANCE BUT NOT COMPLETELY ELIMINATED THE PROBLEM. PREMATURE CAKE CRACKING IN THE VACUUM FILTERS REQUIRED THE PRESENCE OF AN OPERATOR DURING OPERATION. G.M. ANTICIPATES THAT THE CHANGE TO NYLON FROM POLYPROPYLENE WILL SOLVE THIS PROBLEM.

CAKE WASHING TO REDUCE SODIUM LOSSES WAS NOT INITIALLY SUCCESSFUL BECAUSE THE SPRAY WATER TENDED TO KNOCK THE CAKE OFF THE DRUM. ALTERATIONS IN SPRAY PATTERN AND OTHER MEASURES HAVE APPARENTLY SOLVED THIS PROBLEM. THERE HAS BEEN NO EVIDENCE OF CORROSION OR ABRASION IN THE PUMPS OR PIPING.

THE SYSTEM WAS SHUT DOWN FROM MAY 1 TO MAY 28, 1974, BECAUSE OF UNEXPECTED BUILDUP OF SOLIDS IN THE CLARIFIER, WITH SUBSEQUENT OVERFLOW INTO THE SCRUBBER. THE PROBLEM WAS SOLVED BY 1) USING A POLYMERIC FLOCCULATION AGENT TO ATTAIN BETTER SETTLING AND 2) WITHDRAWING SLUDGE FROM THE CLARIFIER



**CHEVROLET PARMA (continued)**

AT MORE FREQUENT INTERVALS. SYSTEM AVAILABILITY TO THE BOILER WAS 87 PERCENT IN APRIL 1974, LESS THAN 10 PERCENT IN MAY, AND 100 PERCENT IN JUNE, JULY, AND AUGUST AFTER THE SYSTEM WAS RESTARTED. PLUGGING BY  $\text{CaCO}_3$  DEPOSITS IN THE OVERFLOW LINE BETWEEN THE CLARIFIERS AND IN THE LINE FROM CLARIFIER NO. 2 TO THE MIX TANKS WAS CORRECTED BY RELOCATING A CHEMICAL FEED LINE AND REPLACING SOME PIPING. THE SYSTEM WAS DOWN THROUGHOUT JULY AND AUGUST FOR REPLACEMENT OF GRAVITY FLOW LINES WITH AN OPEN FLUME THAT CAN BE EASILY CLEANED.

CHEVROLET PARMA

Month .	<u>Operating Hours</u>				<u>FGD system</u>				<u>Operability (%)</u>				<u>Comments</u>
	<u>Boiler</u>												
	1	2	3	4	1	2	3	4	1	2	3	4	
Jun. 75													Recent operation has been intermittent. Tests have been conducted for analysis of particulate loading at the boiler outlet. The system was restarted in May but was shut down because of a plugged chemical feed line to clarifier. After restart about June 10, the system was shut down because of similar plugging in another part of the line. Unit ran for about 2 weeks in June.
Jul. 75					0	0	0	0	0	0	0	0	FGD system was down in July and August for replacement of gravity flow lines with an open flume.
Aug. 75					0	0	0	0	0	0	0	0	
Sep. 75													FGD system restarted September 8, and operated during this period at an availability factor of 80 percent.
Oct. 75		2331*				1848*				79			The FGD system operated during the report period except for a scheduled holiday shutdown from December 23 to January 4, 1976. Because of problems with solids and solids carryover, G.M. conducted stream tests during December to determine whether the solids carryover is due to a high solids recirculation rate. The FGD system was down most of December because of these tests, which caused the low operability factor.
Nov. 75													
Dec. 75		2135			1250				59				

\* Note: The figures given for September and October represent the operation hours from September 8 to November 9 inclusive.

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CHEVROLET PARMA (continued)

Month	<u>Operation hours</u>				<u>FDG system</u>				<u>Operability (%)</u>				<u>Comments</u>
	<u>Boiler</u>												
	1	2	3	4	1	2	3	4	1	2	3	4	
Jan. 76													G.M. has found solids concentration in the clarifier too high for efficient system operation. A.D. Little is scheduled to conduct tests on the system in April as part of an EPA evaluation.
Feb. 76			2997		1196				40				The low system operability during the month of March resulted from extensive modifications performed on the system by G.M. During this period the scrubber blowdown and scrubber flow indication system was revised.
Mar. 76			1379		240				17				From April 19 to the end of the month the system was operable 100%. During this period all system modifications were completed and all major problem areas corrected.
Apr.			1084		847				78				

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	34
UTILITY NAME	GULF POWER CO.
UNIT NAME	SCHOLZ NO. 1A
UNIT LOCATION	CHATTahooCHEE FLORIDA
UNIT RATING	20 MW
FUEL CHARACTERISTICS	COAL 3.0 PERCENT SULFUR
FGD VENDOR	ADL/COMBUSTION EQUIP ASSOCIATE
PROCESS	DOUBLE ALKALI
NEW OR RETROFIT	RETROFIT
START UP DATE	2/75
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99.7 PERCENT
S02	95 PERCENT
WATER MAKE UP	CLOSED LOOP
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN LINED POND
UNIT COST	
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE FEB. 1975. THE PROTOTYPE SYSTEM OPERATED A TOTAL OF 4744 HRS. DURING 1975, TRANSLATING INTO AN ANNUAL AVERAGE OPERABILITY OF 89 PERCENT. THE SYSTEM WAS PUT BACK IN SERVICE MARCH 12, 1976, FOLLOWING A SCHEDULED BOILER OVERHAUL. SYSTEM OPERABILITY WAS 94 PERCENT FOR THE DURATION OF THE MONTH.

**BACKGROUND INFORMATION**  
**ON**  
**SCHOLZ NO. 1A - DOUBLE ALKALI**

THE SCHOLZ STEAM POWER PLANT OF GULF POWER COMPANY IS LOCATED IN CHATTAHOOCHEE, FLORIDA. UNIT NO. 1 IS A COAL-FIRED BOILER DESIGNED FOR NOMINAL LOAD OPERATIONS OF 40 MW AND PEAK CAPACITY OPERATION OF 47.5 MW. THIS UNIT WAS SCHEDULED TO BURN VARIOUS TEST COALS WITH AN AVERAGE HEATING VALUE OF 12,400 BTU/LB, 14 PERCENT ASH, AND SULFUR CONTENTS RANGING AS HIGH AS 5 PERCENT.

A 20 MW PROTOTYPE DUAL ALKALI SYSTEM WAS JOINTLY DEVELOPED, DESIGNED, AND INSTALLED BY COMBUSTION EQUIPMENT ASSOCIATES AND ARUTHRU D. LITTLE. THE PROTOTYPE SYSTEM AT THE SCHOLZ STEAM PLANT IS INSTALLED ON BOILER NO. 1, A BABCOCK & WILCOX PULVERIZED-COAL-FIRED BOILER. THE SYSTEM IS DESIGNED TO HANDLE 50 PERCENT OF THE FLUE GAS FROM THE BOILER. THE BOILER HAS BEEN RETROFITTED WITH A SECTIONALIZED, HIGH-EFFICIENCY ESP CAPABLE OF 99.7 PERCENT PARTICULATE REMOVAL. THE ESP CAN BE SELECTIVELY DE-ENERGIZED FOR STUDY OF PARTICULATE IMPACT ON THE FGD OPERATION.

THE PROTOTYPE UNIT INCORPORATES A HIGH DEGREE OF FLEXIBILITY FOR GENERATION OF DESIGN AND OPERATING INFORMATION FOR A WIDE VARIETY OF APPLICATIONS. ALTHOUGH THE BASIC MODE OF SYSTEM OPERATION IS DUAL ALKALI WITH LIME REGENERATION, THE SYSTEM WAS DESIGNED TO ACCOMMODATE LIMESTONE REGENERATION AND LIME/LIMESTONE REGENERATION.

THE SYSTEM CONSISTS OF A VENTURI SCRUBBER AND AN ABSORPTION TOWER, WITH AN ADDITIONAL STORAGE SILO FOR LIMESTONE, A MIX TANK, AND OTHER ASSORTED TANKS, PUMPS, CONTROLLERS, AND PIPING.

THE PROTOTYPE SYSTEM WAS COMPLETED AND PUT IN OPERATION BY CEA/ADL IN EARLY FEBRUARY 1975. IN MID-MAY AN EPA DUAL ALKALI TEST PROGRAM WAS INITIATED BY SOUTHERN SERVICES, CEA, AND ADL. THE SYSTEM WAS OPERATIONAL THROUGH EARLY JANUARY 1976, WHEN THE BOILER WAS SHUT DOWN FOR A SCHEDULED OVERHAUL. THE BOILER AND PROTOTYPE SYSTEM ARE SCHEDULED TO BE BACK IN SERVICE IN EARLY MARCH 1976.

# SCHOLZ 1A - DOUBLE ALKALI

<u>Period</u>	<u>Operating hours</u>		<u>FGD system Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
Feb. 75 to Jul. 75		2,600	83	Unit was placed in operation February 8, 1975, and operated until July 18 when it was shut down for 2 months modifications, repairs, and replacement of parts. The system was unavailable to the boiler for a 491-hour period because of adjustments and modifications required for the formal EPA test program in mid-May.
Jul. 75 to Sep. 75				The system was shut down from mid-July to mid-September for mechanical overhaul involving replacement parts for valves that had failed.
Sep. 75 to Oct. 75			44 100	The system was put back in operation on September 16, 1975. From mid-September to mid-October the air preheater was repaired and boiler operation adjusted to reduce oxygen levels in the flue gas to the 5 to 6 percent range. The system operated approximately 800 hours during this period.
Nov. 75 to Dec. 75	620 732	560 732	90 100	The system ran continuously for the remainder of the test period through January 2, 1976. SO <sub>2</sub> levels during this period ranged from 800 to 1700 ppm. The system operated in the concentrated mode throughout the remainder of the test period. In the period from mid-September to January 2, 1976, the system operated about 2100 hours, with an operability factor of 97 percent.

SCHOLZ 1A - DOUBLE ALKALI (continued)

<u>Period</u>	<u>Operating hours</u>		<u>FGD system Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
Jan. 76				The FGD system and boiler underwent a scheduled overhaul during the report period. System restart is scheduled for mid-March 1976, to continue till June. During this operating period high-sulfur coal (3.5-4.0 percent) will be burned to allow evaluation of system performance on high-sulfur coal.
Feb. 76				
Mar. 76		445		The system was put back in service on March 12, 1976. The total number of operating hours for the month of March was 445 hours. This translates into a 94% operability factor since the March 12 restart.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	35
UTILITY NAME	GULF POWER CO.
UNIT NAME	SCHOLZ NO. 2A
UNIT LOCATION	CHATTAHOOCHEE FLORIDA
UNIT RATING	20 MW
FUEL CHARACTERISTICS	COAL 3.0 PERCENT SULFUR
FGD VENDOR	FOSTER WHEELER
PROCESS	ACTIVATED CARBON
NEW OR RETROFIT	RETROFIT
START UP DATE	2/76
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99.7 PERCENT
S02	74.5 PERCENT (DESIGN)
WATER MAKE UP	N/A DRY ADSORPTION SYSTEM
SLUDGE DISPOSAL	
UNIT COST	

**OPERATIONAL  
EXPERIENCE**

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THE SYSTEM SUPPLIER AND TEST DIRECTOR (SOUTHERN SERVICES) REPORTED THREE OPERATIONAL RUNS DURING THE REPORT PERIOD. PERFORMANCE OF THE FRONT-END OF THE SYSTEM (ADSORPTION AND REGENERATION) WAS CONSIDERED ADEQUATE. THE RESOX SECTION OPERATED INTERMITTENTLY DURING THE REPORT PERIOD BECAUSE OF PLUGGING PROBLEMS IN THE SULFUR CONDENSER. TO DATE, THE SYSTEM SO2 REMOVAL EFFICIENCY HAS EXCEEDED THE NOMINAL DESIGN VALUE (96 PERCENT).



BACKGROUND INFORMATION  
ON  
SCHOLZ NO. 2A - FWBF SYSTEM

IN JANUARY 1973, THE SOUTHERN SERVICES COMPANY OF GULF POWER AWARDED A CONTRACT TO THE FOSTER WHEELER CORPORATION TO BUILD A 20 MW PROTOTYPE DRY ADSORPTION SYSTEM FOR FLUE GAS DESULFURIZATION. CONSTRUCTION ON THE FOSTER WHEELER PROCESS STARTED FEBRUARY 15, 1974, AT THE SCHOLZ STEAM POWER PLANT IN CHATTACHOOCHEE, FLA. CONSTRUCTION WAS COMPLETED AND A TESTING PROGRAM WAS INITIATED IN MAY 1975.

THE SYSTEM AT THE SCHOLZ PLANT CONSISTS OF A 20-MW ADSORBER SECTION AND A 47.5-MW REGENERATION AND REDUCTION SECTION. THE 20 MW ADSORBER IS DESIGNED TO ACCEPT HALF OF THE MAXIMUM FLUE GAS FLOW FROM UNIT NO. 2. THE COAL-FIRED BOILER IS RATED AT 40 MW (NOMINAL); IT FIRES COAL WITH A HEATING VALUE OF 12,400 BTU/LB, ASH CONTENT IS 14 PERCENT, AND SULFUR CONTENT RANGING AS HIGH AS 5 PERCENT.

THE PURPOSE OF THE ADSORPTION SECTION IS TO REMOVE  $\text{SO}_2$ ,  $\text{NO}_x$ , AND PARTICULATE FROM THE FLUE GAS WITH ACTIVATED CHAR, CONVERTING THE CAPTURED POLLUTANTS TO SULFURIC ACID. THE REGENERATION SECTION PROVIDES CONTINUOUS ON-SITE REGENERATION OF THE CHAR, WHICH HAS BEEN LOADED WITH  $\text{SO}_2$  IN THE FORM OF  $\text{H}_2\text{SO}_4$ . THE CHAR IS REGENERATED AND A LOW-VOLUME,  $\text{SO}_2$ -RICH OFF-GAS STREAM IS FED FORWARD TO THE RESOX REACTOR, WHICH REDUCES THE  $\text{SO}_2$  STREAM TO GASEOUS ELEMENTAL SULFUR THAT IS COLLECTED AND STORED IN AN INSULATED TANK.

THE DEMONSTRATION UNIT HAS TWO ROWS OF MODULES, EACH ROW CONSISTING OF SIX MODULES. THE ADSORPTION SECTION IS A TWO-STAGE DESIGN CONSISTING OF VERTICAL COLUMNS OF PARALLEL LOUVER BEDS, WHICH SUPPORT AND CONTAIN THE ACTIVATED CHARCOAL.  $\text{SO}_2$  DIOXIDE, OXYGEN, WATER VAPOR, AND  $\text{NO}_x$  ARE ADSORBED BY THE CHAR PELLETS FROM THE CROSS-FLOWING FLUE GAS AT 250 TO 300°F. THE  $\text{SO}_2$  THEN REACTS WITH  $\text{O}_2$  AND  $\text{H}_2\text{O}$  TO FORM  $\text{H}_2\text{SO}_4$ , WHICH IS FIRMLY RETAINED IN THE INTERIOR PORE SYSTEM OF THE CHAR PELLETS. THE CHAR IS THEN REGENERATED IN THE REGENERATOR VESSEL BY HEATING TO 1200°F, DRIVING OFF THE ENTRAINED GASES, AND REDUCING SULFURIC ACID TO  $\text{SO}_2$ . THE  $\text{SO}_2$ -RICH GAS IS THEN PASSED THROUGH A VESSEL CONTAINING CRUSHED COAL, RESULTING IN REDUCTION TO GASEOUS ELEMENTAL SULFUR AND CARBON DIOXIDE. THIS LATTER PROCESS IS CARRIED OUT AT 1200° TO 1500°F.

THE INITIAL SHAKEDOWN ON FLUE GAS BEGAN AUGUST 11, 1975, AND PROCEEDED CONTINUOUSLY FOR 10 DAYS. THE REGENERATION SECTION WAS OPERATIONAL ABOUT 60 PERCENT OF THE TIME. HOWEVER, THE REDUCTION SECTION HAS NOT YET BEEN INTEGRATED INTO SYSTEM OPERATION.  $\text{SO}_2$  REMOVAL WAS WELL ABOVE EXPECTATIONS AND PRESSURE DROP ACROSS THE ADSORBER WAS WELL BELOW DESIGN LEVELS. THE SYSTEM WAS SHUT DOWN FOR CORRECTION OF SEVERAL OPERATING PROBLEMS, EQUIPMENT MODIFICATIONS, AND EVALUATION OF THE INITIAL OPERATING DATA. OPERATION WAS RESUMED IN OCTOBER 1975, WHEN TWO CONSECUTIVE RUNS WERE CONDUCTED WITH THE REDUCTION PORTION OF THE SYSTEM PROCESSING FRONT-END OFF-GAS AT FULL OPERATING TEMPERATURES. A PROGRAM OF MODIFICATION WAS COMPLETED ON THIS SYSTEM IN EARLY JANUARY 1976. REINTRODUCTION OF FLUE GAS INTO THE INTEGRATED SYSTEM COMMENCED IN FEBRUARY 1976. THE SYSTEM IS CURRENTLY OPERATING THROUGH 4-MONTH TEST PROGRAM SPONSORED BY SOUTHERN SERVICES AND FOSTER WHEELER.

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### FWBF SYSTEM OPERATING HISTORY

<u>Period</u>	<u>Comments</u>
May 75	Completion of construction was followed by a 3-month commissioning period which various pieces of equipment were operated individually and then in combinations to simulate subsystem operation. Subsystem operations were integrated into section operations and flue gas was passed through the adsorber and regenerator for a 10-day period beginning August.11. RESOX construction was incomplete at this time.
Jun. 75	
Jul. 75	
Aug. 75	
Sep. 75	
Oct. 75	Two consecutive runs were conducted on the RESOX portion of the system on front-end process off-gas at full operating temperatures. This operational period lasted 5 days.
Nov. 5	A program of modifications on the system began in late August 1975 and continued through January 1976, with the exception of the 5-day RESOX operation in October. Modifications were completed and pre-startup testing was conducted in late January and early February. A 3-day continuous dry run was successfully completed.
Dec. 75	
Jan. 76	
Feb. 76	All materials-handling loops and RESOX loops were operated at full operating temperatures and pressures. Reintroduction of flue gas into the system commenced, and a 4-month formal test program conducted by Southern Services and Foster Wheeler is now in progress.
Mar. 76	Three operational periods were logged by the prototype system during the report months. During these runs the adsorption and regeneration sections performed adequately. The RESOX section operated intermittently because of plugging problems in the sulfur condenser. Also, the front end of the system was taken down at one point due to frequent high temperature excursions. This problem was corrected by modifying system operating procedures. Currently, work is proceeding on the solution of the sulfur condenser problem.
Apr. 76	

**PEDCo-ENVIRONMENTAL**

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	36
UTILITY NAME	GULF POWER CO.
UNIT NAME	SCHOLZ NOS. 1B & 2B
UNIT LOCATION	CHATTAHOOCHEE FLORIDA
UNIT RATING	23 MW
FUEL CHARACTERISTICS	COAL 5.0 PERCENT SULFUR (MAX)
FGD VENDOR	CHIYODA INTERNATIONAL
PROCESS	THOROUGHbred 101
NEW OR RETROFIT	RETROFIT
START UP DATE	3/75
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99.7 PERCENT
SO2	90 PERCENT
WATER MAKE UP	
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN DRY GYPSUM POND
UNIT COST	
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE MARCH 1975. THE TOTAL SYSTEM OPERABILITY, INCLUDING SYSTEM COMMISSIONING, EXTENDING FROM FEB. 11, 1975, TO DECEMBER 31, 1975, WAS 60 PERCENT. SYSTEM OPERABILITY FOR THE MONTHS OF MARCH AND APRIL WAS 100 AND 14 PERCENT RESPECTIVELY. THE SYSTEM WAS TAKEN OUT OF SERVICE ON APRIL 5 FOR A SCHEDULED SYSTEM'S DESIGN MODIFICATION.

BACKGROUND INFORMATION  
ON  
SCHOLZ UNITS 1 AND 2 - CHIYODA

THE SCHOLZ POWER PLANT IS LOCATED IN CHATTAHOOCHEE, FLORIDA, ABOUT 50 MILES WEST OF TALLAHASSEE. THE FGD SYSTEM WAS DESIGNED BY CHIYODA INTERNATIONAL CORP. FOR TESTING AND PROCESS DEMONSTRATION ON A COAL-FIRED BOILER. THE PROCESS IS USED IN JAPAN ONLY ON OIL-FIRED AND GAS-FIRED BOILERS, AND TAIL GAS FROM CLAUS UNITS.

THE SYSTEM AT SCHOLZ CAN HANDLE ONE-HALF THE LOAD (53,000 SCFM) FROM EITHER OF THE 47 MW BOILERS. DESIGN ABSORBER INLET  $\text{SO}_2$  CONCENTRATION IS 2250 PPM. VARIOUS TEST COALS WITH SULFUR CONTENTS RANGING UP TO 5 PERCENT ARE SCHEDULED FOR BURNING.

THE PARTICULATE LOADS FROM NEWLY INSTALLED ELECTROSTATIC PRECIPITATORS ON THE TWO UNITS RANGE FROM 0.02 TO 0.1 GR/SCF. FLUE GAS FROM THE PRECIPITATORS IS QUENCHED WITH COOLING WATER TO REMOVE ADDITIONAL FLY ASH AND TO COOL THE GAS BEFORE IT ENTERS THE  $\text{SO}_2$  ABSORBER.

$\text{SO}_2$  IS ABSORBED IN WATER AND CATALYTICALLY OXIDIZED WITH AIR TO FORM SULFURIC ACID. THE DILUTE ACID IS RECIRCULATED THROUGH THE ABSORBER. A PORTION OF THE ACID IS NEUTRALIZED WITH LIMESTONE TO PRODUCE GYPSUM AS A BY-PRODUCT.

BREAK-IN TESTS WERE INITIATED IN FEBRUARY 1975. THE FIRST FEW MONTHS SHAKEDOWN PERIOD WAS CHARACTERIZED BY MANY SMALL PROBLEMS RESULTING IN A LOW OPERABILITY (30% FEBRUARY-MAY). MANY OF THESE PROBLEMS WERE RESOLVED BY JUNE, AND OPERABILITY DURING JUNE AND JULY WAS SOMEWHAT IMPROVED (84%). A SIX-WEEK OUTAGE STARTING IN AUGUST WAS THE RESULT OF UNBALANCING OF THE GYPSUM CENTRIFUGES. AFTER REPAIR OF THE CENTRIFUGES AND INSTALLATION ON SEPTEMBER 15, THE OPERABILITY THROUGH DECEMBER, 1975 AVERAGED ABOVE 97%.

SCHLOZ 1B AND 2B - CHIYODA

<u>Month</u>	<u>Operating hours</u>		<u>FGD system Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
				This is a pilot plant size demonstration unit. Engineering design began September 1973. Startup occurred in March 1975. After initial operation for break-in tests, unit will be shut down for internal inspection. Reliability tests will then follow, starting July 1975. Chemical performance was satisfactory. Emission tests have not been performed. Some pump and instrument failures have occurred.
Jun. 75			100	Unit has been out of service for minor repairs throughout July.
Jul. 75			0	
Aug. 75				
Sep. 75			45	Unit operated at a 95 percent SO <sub>2</sub> removal efficiency during this period.
Oct. 75			100	Gulf Power is attempting to upgrade this value to a higher efficiency level. Waste water discharge from this unit still a problem area.
Nov. 75			100	Outage time was less than one hour during November operation due to a broken flue gas blower inlet vane and repair of a pinhole in the prescrubber FRP lining.
Dec. 75			98	Scrubber outages during December resulted from continuing repairs to a pinhole in the prescrubber FRP lining.
Jan. 76		450	66	Outage time in January-February was primarily for repair and modification of the suction and discharge piping on the absorbent circulation pumps. These FRP lines broke in January at some weak field joints. SO <sub>2</sub> removal efficiency has been as high as 95%.
Feb. 76			11	
Mar. 76		741	100	
Apr. 76			14	Plant was stopped April 5 for a scheduled shut down to allow installation and

SCHOLZ 1B AND 2B - CHIYODA (Continued)

<u>Month</u>	<u>Operating hours</u> <u>Boiler</u> <u>FGD system</u>	<u>FGD system</u> <u>Operability (%)</u>	<u>Comments</u>
			modifications for reducing the quantity of liquid waste from the system. Start-up and testing of this modification was planned for the first week in May. A fire at the plant, however, necessitated a delay in system restart for an additional 3 to 4 week period.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

<b>IDENTIFICATION NO.</b>	<b>38</b>
<b>UTILITY NAME</b>	<b>KANSAS CITY POWER &amp; LIGHT</b>
<b>UNIT NAME</b>	<b>HAWTHORN NO 3</b>
<b>UNIT LOCATION</b>	<b>KANSAS CITY MISSOURI</b>
<b>UNIT RATING</b>	<b>140 MW</b>
<b>FUEL CHARACTERISTICS</b>	<b>COAL 0.6- 3.0 PERCENT SULFUR</b>
<b>FGD VENDOR</b>	<b>COMBUSTION ENGINEERING</b>
<b>PROCESS</b>	<b>LIMESTONE INJECTION &amp;WET SCRUB</b>
<b>NEW OR RETROFIT</b>	<b>RETROFIT</b>
<b>START UP DATE</b>	<b>11/72</b>
<b>FGD STATUS</b>	<b>OPERATIONAL</b>
<b>EFFICIENCY, PARTICULATES</b>	<b>99 PERCENT</b>
<b>S02</b>	<b>70 PERCENT</b>
<b>WATER MAKE UP</b>	
<b>SLUDGE DISPOSAL</b>	<b>UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND</b>
<b>UNIT COST</b>	<b>\$19/KW CAPITAL+2.5 MILS/KWH OP</b>
<b>OPERATIONAL EXPERIENCE</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1972. BOTH MODULES WERE DOWN THROUGHOUT THE REPORT PERIOD. THE UTILITY IS CURRENTLY ELIMINATING THE BY-PASS SEALS AND INSTALLING SLIDE-GATE DAMPERS. IN ADDITION, THE B-MODULE WAS RECONVERTED TO AN UNDERBED SPRAY ARRANGEMENT BECAUSE OF CONTINUING PLUGGING PROBLEMS.</b>

BACKGROUND INFORMATION  
ON  
THE HAWTHORN POWER STATION: UNIT NO. 3

THE HAWTHORN POWER STATION IS LOCATED ON THE NORTH BANK OF THE MISSOURI RIVER IN EAST KANSAS CITY, MISSOURI. THE PLANT HAS FIVE ELECTRIC GENERATING UNITS WITH A TOTAL RATED CAPACITY OF 980 MW. ONLY UNITS 3 AND 4 ARE RETROFITTED WITH FGD SYSTEMS.

BOILER 3 IS A DRY-BOTTOM PULVERIZED-COAL-FIRED UNIT, MANUFACTURED BY COMBUSTION ENGINEERING AND INSTALLED IN EARLY 1950. THE PLANT BURNS TWO GRADES OF COAL: THE COAL WITH HIGHER ASH CONTENT TYPICALLY CONTAINS 14 PERCENT ASH AND 3 PERCENT SULFUR, WITH A HEAT CONTENT OF 11,400 BTU/LB; THE LOWER ASH COAL HAS 11 PERCENT ASH, 0.6 PERCENT SULFUR, AND A HEAT CONTENT OF 9800 BUT/LB.

THE FGD SYSTEM OPERATES ON LIMESTONE FURNACE INJECTION FOLLOWED BY A FLUE GAS WET-SCRUBBING SYSTEM IN WHICH BOTH THE SO<sub>2</sub> AND THE FURNACE CALCINED LIMESTONE ARE SCRUBBED AND ALLOWED TO REACT IN A REACTION TANK.

THE FGD SYSTEM CONSISTS OF TWO IDENTICAL MODULES, EACH CAPABLE OF TREATING 500,000 ACFM OF FLUE GAS AT 300°F. BYPASSING OF THE MODULES IS POSSIBLE THROUGH A SYSTEM OF DUCTWORK AND DAMPERS AROUND EACH MODULE. EACH MODULE CONSISTS OF A GLASS MARBLE BED, A CHEVRON TYPE FIBERGLASS DEMISTER, AND A FINNED TUBE REHEATER. THE DEMISTER WASH SYSTEM USES A SET OF EIGHT WATER LANCES THAT TURN ON AUTOMATICALLY TO WASH MUD FROM THE DEMISTERS WHENEVER THE DAMPERS CLOSE.

THE SPENT LIMESTONE SLURRY FROM THE MODULES IS DISCHARGED INTO A CLARIFIER TANK, AND THE UNDERFLOW IS PUMPED, UNSTABILIZED, TO A 160-ACRE UNLINED POND, WHICH IS ALSO USED FOR DISPOSAL OF FLY ASH FROM THE OTHER BOILERS.

PROBLEMS AND SOLUTIONS

THE MAJOR PROBLEMS ENCOUNTERED WITH THE TWO FGD SYSTEMS ON UNITS 3 AND 4 AT THE HAWTHORN POWER STATION HAVE BEEN IDENTICAL.

BECAUSE MAINTAINING THE SOLIDS IN THE REACTION TANKS IN SUSPENSION WAS DIFFICULT, BUILDUP OF MUD OCCURRED IN THE CORNERS OF THE TANK. THE PROBLEM WAS SOLVED BY ROUNDING THE BOTTOM CORNERS, INSTALLING FRESH WATER FLUSHING NOZZLES ON EACH WALL, AND INCREASING THE HORSEPOWER OF THE TANK MIXERS.

SEDIMENT BUILDUP OCCURRED IN THE DRAIN POTS HORIZONTAL HEADERS. ALSO, FREQUENT DISLOCATION OF THE MARBLE BED DRAIN POT COVERS AND CONSEQUENT LOSS OF MARBLES WAS SOLVED BY INSTALLING NEW STAINLESS STEEL DRAIN POTS WITH EXPANDED METAL COVERS AND MODIFYING THE DRAIN PIPING. OTHER MODIFICATIONS INCLUDED INSTALLING A NEW WASH SYSTEM TO CONTROL DEMISTER PLUGGING, CHANGING THE FLUSHING SEQUENCE WITHIN THE WATER SEAL TO ELIMINATE BYPASS SEAL PLUGGING, AND REPLACING SPRAY NOZZLES. THESE MODIFICATIONS WERE COMPLETED BY FEBRUARY 1974. ADDITIONAL MODIFICATIONS AND SYSTEM DESIGN CHANGES ARE CONTAINED IN THE COMMENTS SECTION OF THE OPERATING HISTORY SUMMARY FOR THIS INSTALLATION.



# HAWTHORN NO. 3

<u>Month</u>	<u>Boiler</u>	<u>Operating Hours</u>		<u>FGD Operability (%)</u>		<u>Comments</u>
		<u>Module 3A</u>	<u>Module 3B</u>	<u>Module A</u>	<u>Module B</u>	
Jul. 75	584	0		0		Problems with Module 3A included a leak in city water line, a plugged duct to the I.D. fan, and a malfunctioning outlet damper from the scrubber.
			247		42	Marbles were lost from the bed and a spray header was broken.
Aug. 75	0	0	0	0	0	Lost I.D. fan for half of the boiler. Carryover of July problems.
Sep. 75	358	247	81	69	23	Outage due to cleaning and mechanical repairs. Pots, covers, and marbles in the marble bed of module 3B were replaced.
Oct. 75	180	117	145	65	81	Module 3A outage was due largely to replacement of a recycle pump motor. A scheduled boiler overhaul reduced boiler operation hours.
Nov. 75	0	0	0	0	0	Boiler and scrubbers were shut down for a scheduled turbine overhaul.
Dec. 75	0	0	0	0	0	The system is scheduled to go back on-line in January 1976.
Jan. 76	0	0	0	0	0	System was down all month because of frozen equipment and lines and a manpower shortage due to a boiler and turbine overhaul on another unit at this station.
Feb. 76	503	148	7	37	1	Scrubber outages resulted from plugging in the scrubber bed, caused by conversion from an under-bed to over-bed spray system.
Mar. 76	0	0	0	0	0	Reconversion of Module 3B's spray system arrangement has been completed.
Apr. 76	0	0	0	0	0	Also, the bypass system has been modified and changed to a slide-gate damper arrangement.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

<b>IDENTIFICATION NO.</b>	<b>39</b>
<b>UTILITY NAME</b>	<b>KANSAS CITY POWER &amp; LIGHT</b>
<b>UNIT NAME</b>	<b>HAWTHORN NO 4</b>
<b>UNIT LOCATION</b>	<b>KANSAS CITY MISSOURI</b>
<b>UNIT RATING</b>	<b>100 MW</b>
<b>FUEL CHARACTERISTICS</b>	<b>COAL 0.6- 3.0 PERCENT SULFUR</b>
<b>FGD VENDOR</b>	<b>COMBUSTION ENGINEERING</b>
<b>PROCESS</b>	<b>LIMESTONE INJECTION WET SCRUB</b>
<b>NEW OR RETROFIT</b>	<b>RETROFIT</b>
<b>START UP DATE</b>	<b>8/72</b>
<b>FGD STATUS</b>	<b>OPERATIONAL</b>
<b>EFFICIENCY, PARTICULATES</b>	<b>99 PERCENT</b>
<b>SO2</b>	<b>70 PERCENT</b>
<b>WATER MAKE UP</b>	
<b>SLUDGE DISPOSAL</b>	<b>UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND</b>
<b>UNIT COST</b>	<b>\$19/KW CAPITAL*2.2 MILS/KWH OP</b>
<b>OPERATIONAL EXPERIENCE</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE AUGUST 1972. OPERABILITY FOR MODULES A AND B WAS 0 AND 3 PERCENT RESPECTIVELY IN MARCH AND 42 AND 40 PERCENT RESPECTIVELY IN APRIL. DURING THE REPORT PERIOD THE UNIT'S BY-PASS SEALS WERE REPLACED WITH SLIDE-GATE DAMPERS.</b>

**BACKGROUND INFORMATION**  
**ON**  
**THE HAWTHORN POWER STATION: UNIT NO. 4**

THE HAWTHORN POWER STATION IS LOCATED ON THE NORTH BANK OF THE MISSOURI RIVER IN EAST KANSAS CITY, MISSOURI. THE PLANT HAS FIVE ELECTRIC GENERATING UNITS WITH A TOTAL RATED CAPACITY OF 980 MW. ONLY UNITS 3 AND 4 ARE RETROFITTED WITH FGD SYSTEMS.

BOILER 4 IS A BOTTOM PULVERIZED-COAL-FIRED UNIT MANUFACTURED BY COMBUSTION ENGINEERING AND INSTALLED IN EARLY 1950. THE PLANT BURNS TWO GRADES OF COAL: THE COAL WITH HIGHER ASH CONTENT TYPICALLY CONTAINS 14 PERCENT ASH AND 3 PERCENT SULFUR, WITH A HEAT CONTENT OF 11,400 BTU/LB; THE LOWER-ASH COAL HAS 11 PERCENT ASH, 0.6 PERCENT SULFUR, AND A HEAT CONTENT OF 9800 BTU/LB.

ORIGINALLY THE FGD SYSTEM OPERATED ON FURNACE INJECTION OF LIMESTONE FOLLOWED BY FLUE GAS WET-SCRUBBING SYSTEM IN WHICH BOTH THE SO<sub>2</sub> AND THE FURNACE CALCINED LIMESTONE ARE SCRUBBED AND ALLOWED TO REACT IN A REACTION TANK. BECAUSE OF FURNACE TUBES PLUGGING, WHICH WAS ATTRIBUTED TO LIMESTONE INJECTION, THE SYSTEM WAS CONVERTED IN 1972 TO TAILEND INJECTION, IN WHICH LIMESTONE IS INJECTED INTO THE GAS DUCT BETWEEN THE AIR HEATER AND THE SCRUBBER VESSEL.

THE FGD SYSTEM CONSISTS OF TWO IDENTICAL MODULES, EACH CAPABLE OF TREATING 500,000 ACFM OF FLUE GAS AT 300°F. BYPASSING OF THE MODULES IS POSSIBLE THROUGH A SYSTEM OF DUCTWORK AND DAMPERS AROUND EACH MODULE. EACH MODULE CONSISTS OF A GLASS MARBLE BED, A CHEVRON TYPE FIBERGLASS DEMISTER, AND A FINNED TUBE REHEATER.

THE DEMISTER WASH SYSTEM USES A SET OF EIGHT WATER LANCES THAT TURN ON AUTOMATICALLY TO WASH MUD FROM THE DEMISTERS WHENEVER THE DAMPERS CLOSE.

THE SPENT LIMESTONE SLURRY FROM ALL MODULES IS DISCHARGED INTO A CLARIFIER TANK, AND THE UNDERFLOW IS PUMPED, UNSTABILIZED, TO A 160-ACRE UNLINED POND, WHICH IS ALSO USED FOR DISPOSAL OF FLY ASH FROM THE OTHER BOILERS.

BECAUSE OF CONTINUED OPERATIONAL PROBLEMS SINCE START-UP, THE AVAILABILITY FACTOR FOR THE SYSTEMS HAS BEEN LOW, (IN THE RANGE OF 30 PERCENT TO 40 PERCENT). AVAILABILITY OF THE FGD SYSTEM HAS BEEN HAMPERED BY MANY PROBLEMS ATTRIBUTED TO DRY LIMESTONE INJECTION.

**OPERATING HISTORY**

APART FROM THOSE ENTAILLED IN SWITCHING OF UNIT 4 FROM FURNACE INJECTION TO TAIL GAS INJECTION, THE MAJOR PROBLEMS ENCOUNTERED WITH THE FGD SYSTEM ON BOILERS 3 AND 4 AT THE HAWTHORN POWER STATION HAVE BEEN IDENTICAL.

DIFFICULTY IN MAINTAINING SOLIDS IN THE REACTION TANKS IN SUSPENSION CAUSED BUILDUP OF MUD IN THE CORNERS OF THE REACTION TANK. THE PROBLEM WAS SOLVED BY ROUNDING THE BOTTOM CORNERS, INSTALLING FRESH WATER FLUSING NOZZLES ON EACH WALL, AND INCREASING THE HORSEPOWER OF THE TANK MIXERS.

IN LATE 1972, BECAUSE OF BOILER TUBE PLUGGING, WHICH WAS ATTRIBUTED TO FURNACE-LIMESTONE INJECTION, THE UNIT WAS CONVERTED TO A TAILEND LIMESTONE INJECTION SYSTEM. SEDIMENT BUILDUP OCCURRED IN THE DRAIN POTS HORIZONTAL HEADERS. ALSO, FREQUENT DISLOCATION OF THE MARBLE BED DRAIN POT

**HAWTHORN UNIT NO. 4 (Continued)**

COVERS AND CONSEQUENT LOSS OF MARBLES WAS SOLVED BY INSTALLING NEW STAINLESS STEEL DRAIN POTS WITH EXPANDED METAL COVERS AND MODIFYING THE POTS DRAIN PIPING. OTHER MODIFICATIONS INCLUDED INSTALLING A NEW DEMISTER WASH SYSTEM TO CONTROL DEMISTER PLUGGING, CHANGING THE FLUSHING SEQUENCE WITHIN THE WATER SEAL TO ELIMINATE BYPASS SEAL PLUGGING, AND REPLACING SPRAY NOZZLES. THESE MODIFICATIONS WERE COMPLETED BY APRIL 1974. ADDITIONAL MODIFICATIONS AND SYSTEM DESIGN CHANGES ARE CONTAINED IN THE COMMENTS SECTION OF THE OPERATING HISTORY SUMMARY FOR THIS INSTALLATION.

HAWTHORN NO. 4

<u>Month</u>	<u>Operating Hours</u>		<u>Module 4B</u>	<u>FGD Operability (%)</u>		<u>Comments</u>
	<u>Boiler</u>	<u>Module 4A</u>		<u>Module A</u>	<u>Module B</u>	
Jul. 75	518	41	128	8	25	Marble bed plugging and strainer problems on both modules.
Aug. 75		168	212			Lost half of boiler due to No. 4B I.D. fan outage. Both FGD modules were shut down to ensure against the loss of the entire unit. New chemistry - attempting to run at 100% blowdown and near 0 percent solids. Emphasis on particulate control. Maintaining pH at 5 without limestone injection.
Sep.	395	206	210	52	53	Scrubber modules were returned to service on Sept. 21 after replacement of the original I.D. fan on module 4B side. New process design - marbles removed from scrubber bed of Module A and replaced with a stainless steel perforated bed. The marbles were removed because of continuing operational difficulties. Very good performance resulted in increased availability and continuation of high particulate removal efficiency (97 percent).
Oct. 75	721	429	656	60	91	Minor boiler restriction on the Module 4A side between the economizer and the inlet draft ductwork caused reduction of gas velocity. New chemistry process modification of running at 100 percent blowdown and zero percent solids is still in progress. SO <sub>2</sub> removal efficiency in the 50 to 60 percent range. KCP&L is concentrating heavily on particulate emission control.
Nov. 75	720	0	713	0	99	Module 4A was shut down during the report period because of loss of draft through the ductwork from the economizer to the air preheater.

HAWTHORN NO. 4 (Continued)

<u>Month</u>	<u>Operating Hours</u>		<u>Module 4B</u>	<u>FGD Operability (%)</u>		<u>Comments</u>
	<u>Boiler</u>	<u>Module 4A</u>		<u>Module A</u>	<u>Module B</u>	
						The reheater plugged frequently until the system was shut down.
Dec. 75	640	0	103	0	16	Boiler outage of 5 days was due to a scheduled overhaul.
Jan. 76	0	0	0	0	0	The system was down all month because of frozen equipment and lines; manpower was assigned to a boiler and turbine overhaul on another unit.
Feb. 76	579	0	450	0	78	Module 4A was shut down the entire month because of continuing loss of draft through the ductwork from the economizer to the air preheater. Marble bed plugging and loss of a recycle pump occurred on Module 4B.
Mar. 76	706	0	24	0	3.4	During the report period the unit's bypass seals were replaced with slide-gate dampers.
Apr. 76	550	231	220	42	40	

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	40
UTILITY NAME	KANSAS CITY POWER & LIGHT
UNIT NAME	LA CYGNE NO 1
UNIT LOCATION	LA CYGNE KANSAS
UNIT RATING	820 MW
FUEL CHARACTERISTICS	COAL 5.0 PERCENT SULFUR
FGD VENDOR	BABCOCK & WILCOX
PROCESS	LIMESTONE SCRUBBING
NEW OR RETROFIT	NEW
START UP DATE	2/73
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	98 PERCENT
S02	76 PERCENT
WATER MAKE UP	CLOSED LOOP
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$52/KW CAPITAL * 1.26 MILLS/ KWH
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE FEBRUARY 1973. DURING 1975 THE TOTAL AVAILABILITY OF THE FGD SYSTEM AVERAGED IN EXCESS OF 84 PERCENT (INCLUDING BOTH WORKING AND RESERVE HOURS). DURING THE FIRST QUARTER OF 1976 SYSTEM AVAILABILITY HAS AVERAGED 83.92, AND 91 PERCENT FOR THE MONTHS OF JANUARY, FEBRUARY, AND MARCH RESPECTIVELY. THE SYSTEM WAS BROUGHT DOWN ON APRIL 6 FOR A SCHEDULED BOILER AND AIR PREHEATER OVERHAUL.

## BACKGROUND INFORMATION

ON

### LA CYGNE UNIT NO. 1

THE LA CYGNE POWER STATION OF KANSAS CITY POWER AND LIGHT COMPANY BEGAN COMMERCIAL OPERATION ON JUNE 1, 1973, AS A JOINT PROJECT OF KANSAS "GAS" AND ELECTRIC COMPANY AND KANSAS CITY POWER & LIGHT COMPANY. THE STATION IS LOCATED ABOUT 55 MILES SOUTH OF KANSAS CITY, IN LINN COUNTY, KANSAS.

ELECTRIC POWER GENERATING FACILITIES CONSIST OF ONE 820 MW COAL-FIRED BASE-LOAD BOILER WITH ASSOCIATED STEAM TURBINES AND ELECTRIC GENERATORS. THE PLANT HAS THREE OIL-FIRED BOILERS, USED PRIMARILY FOR STARTUP OF THE LARGE UNIT. THEIR COMBINED CAPACITY IS EQUIVALENT TO 28 MW.

THE BOILER AT LA CYGNE, DESIGNED BY BABCOCK AND WILCOX, IS A DRY-BOTTOM, PULVERIZED-COAL-FIRED CYCLONE UNIT. THE COAL BURNED IS LOW-GRADE, SUBBITUMINOUS, WITH AN AS-FIRED HEATING VALUE OF 9000 TO 9700 BTU/LB AND ASH AND SULFUR CONTENTS OF 25 PERCENT AND 5 PERCENT, RESPECTIVELY. POLLUTION CONTROL EQUIPMENT ON THIS BOILER CONSISTS OF SEVEN FGD MODULES, BUILT BY BABCOCK AND WILCOX AS AN INTEGRAL PART OF THE POWER GENERATING FACILITIES. BYPASSING OF THE BOILER'S FLUE GAS AROUND THE FGD SYSTEM IS NOT POSSIBLE.

#### PROBLEMS AND SOLUTIONS

THE FGD INSTALLATION HAS BEEN PLAGUED WITH NUMEROUS PROBLEMS SINCE THE FIRST TRIAL OPERATION ON DECEMBER 26, 1972. SOME OF THESE PROBLEMS, SUCH AS VIBRATIONS OF THE INDUCED-DRAFT FANS AND THEIR SENSITIVITY TO IMBALANCE, OCCURRED EVEN BEFORE THE BOILER WAS FIRED.

AS THESE FABRICATION PROBLEMS WERE CORRECTED AND THE FGD SYSTEM WENT INTO OPERATION, TWO OTHER TYPES OF PROBLEMS APPEARED. THE FIRST TYPE, ASSOCIATED WITH THE WET LIMESTONE PROCESS, INCLUDES PLUGGING OF THE DEMISTER AND STRAINERS, WEARING OF SPRAY NOZZLES, AND CORROSION OF REHEATER TUBES. PROBLEMS OF THE SECOND TYPE MAY BE UNIQUE TO THE LACYGNE INSTALLATION; THEY CONCERN THE EFFECT OF THE SCRUBBED FLY ASH ON VISCOSITY AND FLOW CHARACTERISTICS OF THE RECIRCULATED SLURRY, WHICH RESTRICTS MOBILITY OF THE BALLS IN THE TCA TOWER.

FLY ASH CONTENT OF THE FLUE GAS (DUE TO LACK OF PRIMARY PARTICULATE CONTROLS) IS LARGELY RESPONSIBLE FOR BOTH TYPES OF PROBLEMS. SEVERAL MODIFICATIONS HAVE BEEN MADE: THE ORIGINAL TURBULENT CONTACT ABSORBER'S FLOATING BED WAS REPLACED WITH SIEVE TRAYS; ALSO TO REDUCE THE EROSION EFFECT OF FLY ASH AND LARGE-SCALE PARTICLES, AND TO EXTEND THE LIFE OF THE LIMESTONE SLURRY SPRAY NOZZLES ON THE VENTURI SCRUBBERS, A HYDROCLONE WAS INSTALLED IN THE SLURRY RECIRCULATION LINE OF EACH MODULE TO CENTRIFUGALLY SEPARATE AND REMOVE THESE PARTICLES FROM THE SYSTEM.

THE CORROSION ASSOCIATED WITH CONDENSATION OF ACID VAPORS FROM THE GAS ON THE REHEATER TUBE BUNDLES WAS CONTROLLED BY INJECTION OF SLIP STREAMS OF HOT AIR FROM THE BOILER'S COMBUSTION AIR HEATER INTO THE SCRUBBED FLUE GASES AT THE INLET TO THE REHEATER UNITS. THIS PRACTICE HAS REDUCED THE MAXIMUM GENERATING CAPACITY OF THE BOILER BY LIMITING THE AIR AVAILABLE FOR COAL COMBUSTION.



LA CYGNE UNIT NO. 1 (Continued)

BECAUSE THE FGD SYSTEM INCLUDES NO SPARE MODULES AND IT CANNOT BE BYPASSED, OUTPUT OF THE BOILER IS TOTALLY CONTROLLED BY PERFORMANCE AND AVAILABILITY OF THE FGD MODULES. PRESENT PROCEDURES CALL FOR CLEANING ONE MODULE EACH NIGHT ON A ROTATIONAL SCHEDULE AND KEEPING ALL MODULES AVAILABLE DURING THE DAYTIME PEAK PERIODS. CLEANOUTS REQUIRE THREE MEN FOR A PERIOD OF 10 TO 12 HOURS. RECENT MODIFICATIONS BY THE UTILITY ON THE SCRUBBER INSTALLATION HAVE RESULTED IN PLANS FOR PROLONGED OPERATIONAL PERIODS, WITH MODULES STAYING ON-LINE CONTINUOUSLY FOR PERIODS UP TO 3 WEEKS.

# FGD SYSTEM AVAILABILITY

LA CYGNE UNIT NO. 1

Month	Boiler Hours	Percent Availability-by Module							Average	Comments
		A	B	C	D	E	F	G		
Jan. 74		49	32	44	87	23	37	81	50	
Feb. 74		66	68	59	76	52	100	65	69	
Mar. 74		Boiler Shutdown								
Apr.		67	70	75	88	74	100	88	80	
May 74		69	83	78	85	78	84	80	80	
Jun. 74		92	84	83	90	82	83	87	86	
Jul. 74		75	80	80	81	85	79	77	80	
Aug. 74		90	90	73	81	81	78	99	85	
Sep. 74		69	88	73	76	83	89	86	81	
Oct. 74		90	71	60	61	84	85	84	76	
Nov. 74		90	71	60	61	84	85	84	76	
Dec. 74		Boiler Shutdown								
Jan. 75		Boiler Shutdown								
Feb. 75		Boiler Shutdown								
Mar. 75	694	82	96	90	76	93	92	96	90	
Apr. 75		5 Days of Operation								
May 75	683	95	85	94	90	90	89	83	89	
Jun. 75	667	88	85	84	85	84	86	89	86	
Jul. 75	590	78	90	90	84	85	87	85	86	Modules A and D are used for research tests.
Aug. 75	630	75	88	87	78	92	85	83	84	One module is shut down each evening for cleaning.
Sep. 75	610	78	84	84	85	79	78	74	80	System shutdown Oct. 16, 1975 owing to problems with

# FGD SYSTEM AVAILABILITY (continued)

## LA CYGNE UNIT NO. 1

Month	Boiler Hours	Percent Availability-by Module							Average
		A	B	C	D	E	F	G	
Oct. 75	231	66	77	46	74	72	73	65	68
Nov. 75	346	93	90	80	93	96	89	94	91
Dec. 75	597	91	87	81	85	87	89	84	86
Jan. 76									83
Feb. 76									92
Mar. 76									91
Apr. 76									

Comments

generator and I.D. air fan. System remained inoperative throughout the month.

Availability figures for October and November do not include the outage time from October 16 to November 13. Boiler outages of 80, 50, and 11 hours, totaling 141 hours, occurred during December.

The system was shot down on April 6 for a scheduled boiler and air preheater overhaul. During this outage some maintenance is being performed on the scrubber ductwork because of corrosion problems.

Note: The 1974 figures are based on actual operating hours of each module divided by hours of boiler operation.

During reduced boiler load operation, some of these modules were not needed and were shut down, although they were available. Availability was therefore higher than some of these figures indicate. The 1975 figures are based on the hours the module was in service or available for service divided by the total hours in the month.

**PEDCo-ENVIRONMENTAL**

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	43
UTILITY NAME	KANSAS POWER & LIGHT
UNIT NAME	LAWRENCE NO 4
UNIT LOCATION	LAWRENCE KANSAS
UNIT RATING	125 MW
FUEL CHARACTERISTICS	COAL 0.5 PERCENT SULFUR
FGD VENDOR	COMBUSTION ENGINEERING
PROCESS	LIMESTONE INJECTION WET SCRUB
NEW OR RETROFIT	RETROFIT
START UP DATE	12/68
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT
SO2	75 PERCENT
WATER MAKE UP	
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE DECEMBER 1968. THIS UNIT IS CURRENTLY BURNING LOW SULFUR WYOMING COAL. THE OPERATION OF THE SCRUBBER HAS BEEN MORE EFFICIENT AND ECONOMICAL FOR THIS COAL TYPE BECAUSE A LESSER DEGREE OF SO2 REMOVAL IS REQUIRED FOR COMPLIANCE. THE UTILITY PLANS TO REPLACE THIS SCRUBBING SYSTEM WITH A VENTRI-ROD AND SPRAY TOWER SCRUBBING SYSTEM.

**BACKGROUND INFORMATION**  
**ON**  
**THE LAWRENCE POWER STATION: UNIT NO. 4**

LAWRENCE POWER STATION'S UNIT NO. 4 IS A CYCLIC LOAD STEAM BOILER EQUIPPED TO BURN COAL, NATURAL GAS SUPPLEMENTED WITH OIL, OR COMBINATIONS OF THESE THREE FUELS. THE BOILER WAS BUILT BY COMBUSTION ENGINEERING AND PLACED IN SERVICE IN 1959. GENERATING CAPACITY VARIES FROM 125 MW TO 143 MW WITH THE TYPE OF FUEL BEING BURNED. RETROFITTING WITH AN FGD SYSTEM IN NOVEMBER 1968 INTRODUCED ADDITIONAL PRESSURE DROP IN THE FLUE GAS SYSTEM AND REDUCED BOILER CAPACITY TO 115 MW.

THE COAL NOW BURNED AT THE LAWRENCE POWER PLANT IS A LOW-SULFUR SOUTHEAST WYOMING COAL, HAVING AN AVERAGE HEATING VALUE OF 10,000 BTU/LB AND SULFUR AND ASH CONTENTS OF 0.5 AND 11 PERCENT RESPECTIVELY.

THE BOILER HAS TWO MODULES, EACH DESIGNED TO HANDLE ROUGHLY 150,000 SCFM OF FLUE GAS. EACH MODULE CONSISTS OF A SINGLE-STAGE MARBLE BED SCRUBBER FOLLOWED BY A CHEVRON-TYPE DEMISTER AND AN INDIRECT C.S. REHEATER. ORIGINALLY, BOTH MODULES WERE FITTED WITH BYPASS DUCTS AND HYDRAULIC SEAL DAMPERS, WHICH WERE LATER REMOVED BECAUSE OF EXTENSIVE CORROSION AND PLUGGING.

THE PLANT HAS FACILITIES FOR STORING AND MILLING THE LIMESTONE, WHICH CONTAINS 93 PERCENT CALCIUM CARBONATE, 6 PERCENT SILICA, AND 1 PERCENT MAGNESIUM CARBONATE.

SPENT SLURRY FROM THE UNIT, ALONG WITH THE SLURRY FROM UNIT NO. 5, IS SENT TO THREE INTERCONNECTED UNLINED SLUDGE DISPOSAL PONDS OF 16, 28 AND 4 ACRES. KANSAS RIVER WATER IS ADDED TO THE 4-ACRE POND. THE CLARIFIED WATER FROM THIS POND IS RECYCLED. THE SLUDGE IS NOT TREATED FURTHER AND IS REPORTED TO SET AND SOLIDIFY IN THE PONDS.

**PROBLEMS AND SOLUTIONS**

PROBLEMS WITH THE FGD SYSTEM ON BOILER NO. 4 HAVE INCLUDED BUILDUP AND PLUGGING OF THE INLET DUCT WHERE HOT GASES ENTER THE SCRUBBERS, EROSION OF SCRUBBERS WALLS, CORROSION OF SCRUBBERS INTERNALS, BUILDUP ON ID FAN ROTORS, AND PLUGGING OF DRAIN LINES, MARBLE BEDS, AND DEMISTERS. LOW SO<sub>2</sub> REMOVAL WAS CAUSED BY OVERBURNING OF THE LIMESTONE AND DROPOUT OF THE LIME WITH THE ASH IN THE BOTTOM OF THE SCRUBBER.

THE SCRUBBERS WERE MODIFIED IN 1969 BY RAISING THE DEMISTER AND ADDING SOOT BLOWERS IN THE INLET DUCT AND REHEATER TO REDUCE PLUGGING. NEW SPRAY NOZZLES WERE ALSO INSTALLED. REHEATER PLUGGING WAS ELIMINATED BY REPLACING COPPER REHEAT COILS WITH A CARBON STEEL UNIT HAVING WIDELY SPACED FINS.

LAWRENCE UNIT NO. 4 (Continued)

MAJOR MODIFICATIONS IN 1970 WERE SANDBLASTING AND COATING OF THE INTERIOR OF THE SCRUBBERS, REPLACEMENT OF ALL INTERNAL STEEL PIPES WITH PLASTIC AND FIBERGLASS, AND REPLACEMENT OF STAINLESS STEEL DEMISTERS WITH FIBERGLASS. SINCE DEMISTER PLUGGING WAS NOT COMPLETELY ELIMINATED, THE UNIT WAS WASHED MANUALLY EVERY NIGHT TO MAINTAIN THE REQUIRED OUTPUT.

THE MODIFICATIONS IN THE SUMMER OF 1972 ON THE TWO FGD MODULES INCLUDED ENLARGEMENT OF THE CRYSTALLIZATION TANK, AND INSTALLATION OF NEW PLASTIC SPRAY NOZZLES, NEW SLURRY PUMPS AND STRAINERS, AND NEW MULTIPLE MIXERS IN THE TANK.

PROBLEMS REMAINING ARE CORROSION, UNSATISFACTORY DAMPER OPERATION, EXPANSION JOINT FAILURE, DEMISTER FOULING, RAPID WEARING OF THE SLURRY PUMP, AND VALVE FAILURE. OPERATION OF THE FGD SYSTEM SINCE THE FALL OF 1973 HAS BEEN THE MOST SUCCESSFUL TO DATE.

OPERATION OF THE SCRUBBER SYSTEM ON THE WYOMING COAL HAS PROVED TO BE MORE EFFICIENT AND ECONOMICAL THAN EARLIER OPERATIONS BECAUSE A LESSER DEGREE OF SO<sub>2</sub> REMOVAL IS REQUIRED FOR COMPLIANCE. THE SCRUBBER SYSTEM IS STILL OPERATING IN THE HIGH-SOLIDS MODE AS AN SO<sub>2</sub> AND PARTICULATE REMOVAL SYSTEM. NORMAL MANUAL CLEANING REQUIREMENTS HAVE BEEN REDUCED TO TWO-4-HOUR SHIFTS PER SCRUBBER PER WEEK.

IN 1974 THIS UNIT WAS AVAILABLE FOR OPERATION 343 DAYS. FIFTY PERCENT OF THE FUEL CONSUMED WAS COAL, 2 PERCENT FUEL OIL, AND 48 PERCENT NATURAL GAS. DURING 1975 THIS UNIT WAS AVAILABLE FOR OPERATING 333 DAYS. SIXTY-FOUR PERCENT OF THE FUEL CONSUMED WAS COAL, 3 PERCENT FUEL OIL, AND 33 PERCENT NATURAL GAS.

BY 1977, THE TWO FGD MODULES WILL BE REPLACED BY TWO NEW C.E. UNITS, EACH CONSISTING OF A VENTURI ROD UNIT AND A SPRAY CHAMBER. A NEW ELECTRO-STATIC PRECIPITATOR IS ALSO TO BE INSTALLED.

## LAWRENCE NO. 4

<u>Month</u>	<u>Boiler</u>	<u>Operating hours</u>		<u>Availability</u>		<u>Comments</u>
		<u>Module A</u>	<u>Module B</u>	<u>Module A</u>	<u>Module B</u>	
						The FGD system has operated satisfactorily for over a year. Availability is reported to be adequate for the operation of this station. Station load is reduced to 50 percent every night. Therefore, one of the modules can be taken off-line nightly for cleaning or repair. Wyoming coal (0.5 percent sulfur is being burned in this boiler. Some natural gas has been burned since June 20.
Jul. 75		Not logged				Burned coal 100 percent of time. Each module shut down once per week for inspection and cleanup. No boiler outages in July and August.
Aug. 75		Not logged				
Sep. 75		Not logged				Present projections by the utility call for this unit to be available 330 days during 1976. The fuel consumption will be 80 percent coal, 12 percent natural gas, and 8 percent fuel oil. The utility is replacing this scrubber system with a venturi rod-section followed by a spray tower.
Oct. 75		Not logged				
Nov. 75		Not Logged				
Dec. 75		Not logged				
Jan. 76		Not logged				
Feb. 76		Not logged				
Mar. 76						
Apr. 76						

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	44
UTILITY NAME	KANSAS POWER & LIGHT
UNIT NAME	LAWRENCE NO 5
UNIT LOCATION	LAWRENCE KANSAS
UNIT RATING	400 MW
FUEL CHARACTERISTICS	COAL 0.5 PERCENT SULFUR
FGD VENDOR	COMBUSTION ENGINEERING
PROCESS	LIMESTONE INJECTION & WET SCRUB
NEW OR RETROFIT	NEW
START UP DATE	11/71
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT
S02	65 PERCENT
WATER MAKE UP	
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1971. THIS UNIT IS CURRENTLY BURNING LOW SULFUR WYOMING COAL. THE OPERATION OF THE SCRUBBER HAS BEEN MORE EFFICIENT AND ECONOMICAL FOR THIS COAL TYPE BECAUSE A LESSER DEGREE OF S02 REMOVAL IS REQUIRED FOR COMPLIANCE. THE UTILITY PLANS TO REPLACE THIS SCRUBBING SYSTEM WITH A VENTRI-ROD AND SPRAY TOWER SCRUBBING SYSTEM.



BACKGROUND INFORMATION  
ON  
THE LAWRENCE POWER STATION: UNIT NO. 5

UNIT NO. 5 AT LAWRENCE POWER STATION IS A CYCLIC-LOAD STEAM BOILER EQUIPPED TO BURN COAL, NATURAL GAS SUPPLEMENTED WITH OIL, OR COMBINATIONS OF THESE FUELS. THE BOILER, PLACED IN SERVICE IN 1971, HAS A RATED CAPACITY OF 400 MW WHEN BURNING COAL AND NATURAL GAS.

THE COAL NOW BURNED AT THE LAWRENCE POWER PLANT IS A LOW-SULFUR SOUTHEAST WYOMING COAL, HAVING AN AVERAGE HEATING VALUE OF 10,000 BTU/LB AND SULFUR AND ASH CONTENTS OF 0.5 AND 11 PERCENT RESPECTIVELY.

THE BOILER'S FGD SYSTEM WAS BUILT BY COMBUSTION ENGINEERING AND PLACED IN SERVICE IN 1971. THE BOILER HAS EIGHT IDENTICAL MODULES, EACH DESIGNED TO HANDLE ROUGHLY 150,000 SCFM OF FLUE GAS. EACH MODULE CONSISTS OF A SINGLE-STAGE MARBLE BED SCRUBBER FOLLOWED BY A CHEVRON-TYPE DEMISTER AND AN INDIRECT C.S. REHEATER. ALL THE MODULES ARE FITTED WITH BYPASS DUCTS AND HYDRAULIC SEAL DAMPERS. THE PLANT FACILITIES FOR STORING AND MILLING THE LIMESTONE, WHICH CONTAINS 93 PERCENT CALCIUM CARBONATE, 6 PERCENT SILICA, AND 1 PERCENT MAGNESIUM CARBONATE.

SPENT SLURRY FROM THE UNIT ALONG WITH THE SLURRY FROM UNIT NO. 4 IS SENT TO THREE INTERCONNECTED UNLINED SLUDGE DISPOSAL PONDS OF 16, 28, AND 4 ACRES. COOLING TOWER BLOWDOWN SUPPLIES MAKE-UP WATER TO THE POND SYSTEM. CLARIFIED POND WATER IS RECYCLED. THE SLUDGE IS NOT TREATED FURTHER AND IS REPORTED TO SET AND SOLIDIFY IN THE PONDS.

PROBLEMS AND SOLUTIONS

PROBLEMS WITH THE FGD SYSTEM ON BOILER NO. 5 WERE SIMILAR PROBLEMS TO THOSE OF THE SYSTEM ON BOILER NO. 4: LOCALIZED CORROSION IN SOME EQUIPMENT, UNSATISFACTORY DAMPER OPERATION, DEMISTER FOULING, EXPANSION JOINT FAILURE, AND RAPID WEAR OF SLURRY-RECIRCULATING PUMPS. IN ADDITION TO THESE PROBLEMS, BOILER No. 5 IS PLAGUED WITH POOR FLUE GAS DISTRIBUTION TO THE EIGHT FGD MODULES WHICH, UNLIKE THE MODULES ON BOILER NO. 4 ARE ALL INTER-CONNECTED TO A COMMON STACK.

FGD SYSTEM AVAILABILITY IS REPORTED TO BE ADEQUATE FOR OPERATION OF THIS STATION. BECAUSE STATION LOAD IS REDUCED TO 50 PERCENT EVERY NIGHT, AS MANY AS FOUR MODULES CAN BE SHUT DOWN FOR CLEANING AND REPAIR EACH EVENING.

OPERATION OF THE SCRUBBER SYSTEM ON WYOMING COAL HAS PROVED TO BE MORE EFFICIENT AND ECONOMICAL BECAUSE OF THE LESSER DEGREE OF SO<sub>2</sub> REMOVAL REQUIRED.

**LAWRENCE UNIT NO. 5 (Continued)**

**IN 1974 THE UNIT WAS AVAILABLE FOR OPERATION 338 DAYS: 66 PERCENT OF THE FUEL CONSUMED WAS NATURAL GAS, 27 PERCENT COAL, AND 6 PERCENT FUEL OIL.  
DURING 1975 THE UNIT WAS AVAILABLE FOR OPERATION 352 DAYS, FUEL CONSUMPTION WAS 45 PERCENT NATURAL GAS, 42 PERCENT COAL, AND 13 PERCENT FUEL OIL.**

LAWRENCE NO. 5

<u>Months</u>	<u>Operating hours</u>		<u>Comments</u>
	<u>Boiler</u>	<u>FGD modules</u>	
			Wyoming coal is being burned in this unit. FGD system availability is reported to be adequate for operation of this station. Since station load is reduced to 50 percent every night, as many as four modules can be shut down for cleaning and repair each evening.
			FGD units were off-line most of June for major rebuilding of the spray systems in all modules. Some oil was burned to allow bypassing of the repair.
Jul. 75		Not logged	Oil and gas were burned in July and August. No FGD operation.
Aug. 75			
Sep. 75		Not logged	Gas and oil burned on a part-time basis during September and October. Boiler outage was due to inspection, turbine repair, and replacement of the slurry tank screen.
Oct. 75			
Nov. 75		Not logged	
Dec. 75			
Jan. 76		Not logged	Projections by the utility for this unit call for 330 days of operation in 1976 with fuel consumption being 60 percent coal, 25 percent fuel oil, and 15 percent natural gas. Like Unit 4, this unit will be converted to a venturi-rod and spray tower system.
Feb. 76		Not logged	
Mar. 76			
Apr. 76			

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	45
UTILITY NAME	KENTUCKY UTILITIES
UNIT NAME	GREEN RIVER UNITS 1 AND 2
UNIT LOCATION	CENTRAL CITY KENTUCKY
UNIT RATING	64 MW
FUEL CHARACTERISTICS	COAL 3.8 PERCENT SULFUR
FGD VENDOR	AMERICAN AIR FILTER
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	9/75
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99.7 PERCENT
S02	80 PERCENT GUARANTEE
WATER MAKE UP	CLOSED LOOP
SLUDGE DISPOSAL	STABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$64/KW CAPITAL
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS SYSTEM BECAME OPERATIONAL SEPTEMBER 13, 1975. THE OPERATIONAL DATA SUPPLIED BY THE UTILITY FOR THE REPORT PERIOD SHOWS THAT SYSTEM AVAILABILITY, RELIABILITY, OPERABILITY, AND UTILIZATION WAS 97, 95, 85, AND 52 PERCENT RESPECTIVELY FOR THE MONTH OF MARCH AND 90, 100, 100, AND 77 PERCENT RESPECTIVELY FOR THE MONTH OF APRIL.

**BACKGROUND INFORMATION  
ON  
GREEN RIVER POWER STATION**

THE GREEN RIVER POWER STATION OF THE KENTUCKY UTILITIES COMPANY IS SITUATED ON GREEN RIVER, NEAR CENTRAL CITY, IN MUHLENBERG COUNTY, KENTUCKY. THE STATION CONSISTS OF TWO POWER GENERATING UNITS AND FOUR BOILERS. THE POWER GENERATORS ARE PEAK LOAD UNITS. THE BOILERS PROVIDING STEAM TO THE GENERATORS ARE NORMALLY OPERATIONAL 5 DAYS PER WEEK, WITH ONE OR MORE OFTEN OPERATING AT REDUCED CAPACITY.

THE  $\text{SO}_2$  AND PARTICULATE CONTROL SYSTEMS FOR BOILERS 1, 2, AND 3 CONSIST OF MECHANICAL COLLECTORS AND A TAIL-END LIME SCRUBBING SYSTEM.

A CONTRACT FOR THE LIME SCRUBBING SYSTEM WAS AWARDED TO AMERICAN AIR FILTER IN JUNE 1973. CONSTRUCTION WAS COMPLETED AND THE SYSTEM STARTED UP SEPTEMBER 13, 1975. THE SYSTEM WAS DESIGNED TO TREAT FLUE GAS FROM BOILERS 1, 2, AND 3, WHICH HAVE A COMBINED RATED CAPACITY OF 64 MW. THE FUEL IS PRIMARILY A HIGH-SULFUR (3.5 TO 4.0 PERCENT) WESTERN KENTUCKY COAL.

THE FGD SYSTEM CONSISTS OF ONE SCRUBBER MODULE DESIGNED TO HANDLE A MAXIMUM GAS CAPACITY OF 360,000 ACFM AT 300°F. THE FLUE GAS IS DRAWN FROM THE EXISTING BREECHING THROUGH A GUILLotine-TYPE ISOLATION DAMPER AND DUCT SYSTEM TO THE SCRUBBER FAN. THE GASES THEN FLOW THROUGH AN ADJUSTABLE-THROAT VENTURI SCRUBBER AND FLOODED ELBOW, WHICH WAS PROVIDED PRIMARILY FOR PARTICULATE REMOVAL.  $\text{SO}_2$  IS REMOVED BY REACTION WITH THE LIME SLURRY IN THE MOBILE BED CONTACTOR, WHICH CONSISTS OF TEN COMPARTMENT SECTIONS WITH OVERHEAD SLURRY SPRAYS AND UNDERBED DAMPERS TO ACCOMMODATE GAS VOLUME TURNDOWN.

THE SLURRY/RECYCLE SYSTEM CONSISTS OF A PARTITIONED REACTANT TANK WITH RECYCLE PUMPS FOR SUPPLYING THE CONTACTOR AND VENTURI, A LIME SLURRY SLAKING AND FEED SYSTEM, AND A BLEED SYSTEM DISCHARGING TO A SETTLING POND. RETURN WATER FROM THE POND IS USED AS PRIMARY MAKE-UP.

**FGD SYSTEM AVAILABILITY  
GREEN RIVER NOS. 1 AND 2**

<u>Period</u>	<u>Total period (hr)</u>	<u>Boiler operation (hr)</u>	<u>Module availability (hr)</u>	<u>No. hr. module called upon to operate</u>	<u>Hr. module operated</u>	<u>Comments</u>
Dec. 75	744	398	550	331	257	System became operational September 13, 1975, on a half-load basis because of turbine overhaul. The half-load mode continued throughout the report period. Logging of operating data began December 1975.
Availability = 74% Reliability = 78% Operability = 65% Utilization = 35%						
Jan. 76	744	572	312	456	64	System was down a total of 432 hours in January. Major problems were failure of the recycle pumps and feed tank agitator, thawing and repair of numerous frozen lines, and shutdown of sump pumps.
Availability = 42% Reliability = 14% Operability = 11% Utilization = 9%						
Feb. 76	696	499	486	499	211	The system was inoperative a total of 210 hours in February. Outage was due to repairs of tank agitators, recycle pumps, and reactant pumps and to cleanout of reactant pumps, slurry pumps, slake tanks, and mix-hold tank.
Availability = 70% Reliability = 42% Operability = 42% Utilization = 30%						
Mar. 76	744	450	722	409	386	During the report period all the rubber-lined impellers were replaced in the pumps.
Availability = 97% Reliability = 95% Operability = 85% Utilization = 52%						

**FGD SYSTEM AVAILABILITY (Continued)**

**GREEN RIVER NOS. 1 AND 2**

<u>Period</u>	<u>Total period (hr)</u>	<u>Boiler operation (hr)</u>	<u>Module availability (hr)</u>	<u>No. hr. module called upon to operate</u>	<u>Hr. module operated</u>	<u>Comments</u>
Apr. 76	720	552	648	552	552	The utility made a prior commitment to run at 100 percent operability during the month of April.
Availability = 90%						
Reliability = 100%						
Operability = 100%						
Utilization = 77%						

TABLE 3  
PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76

IDENTIFICATION NO.	46
UTILITY NAME	KEY WEST UTILITY BOARD
UNIT NAME	STOCK ISLAND PLANT
UNIT LOCATION	KEY WEST FLORIDA
UNIT RATING	37 MW
FUEL CHARACTERISTICS	OIL 2.4 PERCENT SULFUR
FGD VENDOR	ZURN AIR SYSTEMS
PROCESS	LIMESTONE SCRUBBING
NEW OR RETROFIT	NEW
START UP DATE	10/72
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	90 PERCENT
SO2	85 PERCENT-ESTIMATED
WATER MAKE UP	MAKE UP RATE ESTIMATED 100 GPM
SLUDGE DISPOSAL	UNLINED POND
UNIT COST	\$ 21.6/KW CAPITAL COST
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE OCTOBER 1972. THE FGD SYSTEM HAS BEEN OUT OF SERVICE SINCE JANUARY 28, 1975. MODIFICATIONS AND REPAIRS ARE CURRENTLY IN PROGRESS. SYSTEM RESTART IS STILL INDEFINITE. A CHECKOUT OF ALL SYSTEM MOTORS AND PUMPS MUST BE COMPLETED BEFORE STARTUP CAN COMMENCE.



## BACKGROUND INFORMATION

### ON

## STOCK ISLAND PLANT

THE UTILITY BOARD OF THE CITY OF KEY WEST OPERATES AN OIL-FIRED 37 MW POWER PLANT ON STOCK ISLAND, ADJACENT TO THE ISLAND CITY OF KEY WEST. THIS STEAM GENERATOR BURNS A HIGH SULFUR FUEL OIL (2.4 - 2.75% SULFUR) GENERATING 210,000 CFM OF FLUE GAS AT 390°F. TO REMOVE THE SULFUR DIOXIDE FROM THE FLUE GAS A SCRUBBING SYSTEM, CONSISTING OF TWO MODULES, HAS BEEN DESIGNED BY ZURN AIR SYSTEMS. THE SYSTEM USES PULVERIZED CORAL AND SEAWATER. THE CORAL IS INITIALLY GROUND TO A FINE POWDER IN A HAMMER-MILL CRUSHER, THEN MIXED WITH SEAWATER TO FORM A DILUTE SLURRY AND TRANSFERRED TO THE SCRUBBING SYSTEM TO ABSORB SULFUR DIOXIDE. THE CLEANED GAS IS DISCHARGED TO ATMOSPHERE AND THE SPENT SLURRY IS PUMPED TO A SETTLING POND. THE CLARIFIED SEAWATER IS DISCHARGED INTO THE GULF.

THE TWO SCRUBBER MODULES ARE DESIGNED TO HANDLE A COMBINED TOTAL OF 126,950 CFM AT 150°F. FLUE GASES FROM THE BOILER ARE DRAWN THROUGH AN INDUCED DRAFT FAN AND FORCED EITHER THROUGH THE BYPASS DUCT OR THROUGH ONE OR BOTH SCRUBBERS VIA THREE SETS OF DAMPERS BETWEEN THE INDUCED-DRAFT FAN AND THE STACK. BEFORE ENTERING THE SCRUBBING SYSTEM THE GAS IS COOLED FROM 360°F TO 160°F BY SEAWATER SPRAYS. THIS COOLING PROTECTS THE FIBERGLASS COMPONENTS OF THE SCRUBBER MODULES. A PRESSURE DROP OF 12 TO 14 INCHES WATER GAUGE IS THE NORMAL OPERATING RANGE FOR THE SCRUBBERS.

THE FGD SYSTEM WAS PLACED IN OPERATION IN OCTOBER 1972. THE SYSTEM WAS SHUT DOWN ON JANUARY 28, 1975, FOR REPAIR OF THE BOILER FOUNDATION AND DUCTWORK BAFFLES. OTHER IMPORTANT MODIFICATIONS TO BE COMPLETED ARE: REPLACING SPRAY TREES AND OTHER STAINLESS STEEL PARTS WITH MONEL; MODIFYING AND SEALING INLET DAMPERS; REPAIRING THE INDUCED-DRAFT FAN; AND REPAIRING HOLE IN HOPPER WALL AND DUCT FLOOR.

# STOCK ISLAND

<u>Month</u>	<u>Operating hours</u>		<u>FGD system Availability</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
				FGD system was shut down on January 28, 1975, because of damaged ductwork baffles. Spray trees and other stainless steel parts have been replaced with Monel.
Jul. 75		0	0	FGD system is still out of service but is scheduled for restart in early October.
Aug. 75		0	0	Boiler has been down since August 30 for repairs of the induced-draft fan.
Sep. 75		0	0	FGD system is still out of service. Date of system restart is indefinite.
Oct. 75		0	0	
Nov. 75		0	0	FGD system is still out of service. The utility is replacing dampers and various system parts. Date of system restart is still indefinite.
Dec. 75		0	0	
Jan. 76		0	0	Repairs to outlet damper are complete. All holes in the hopper wall and ductwork have been patched. New spray trees have been installed. The utility is still repairing the inlet damper. The system will not restart for at least another month pending checkout of all pumps and motors.
Feb. 76		0	0	
Mar. 76		0	0	The FGD system restart has been delayed because of boiler-related problems. Date of system restart is still indefinite.
Apr. 76		0	0	

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	54
UTILITY NAME	LOUISVILLE GAS & ELECTRIC
UNIT NAME	PADDYS RUN NO 6
UNIT LOCATION	LOUISVILLE KENTUCKY
UNIT RATING	65 MW
FUEL CHARACTERISTICS	COAL 3.5-4.0 PERCENT SULFUR
FGD VENDOR	COMBUSTION ENGINEERING
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/73
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT DESIGN
S02	80 PERCENT (DESIGN)
WATER MAKE UP	33 GAL/LB MOLE S02 REMOVED
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$57/KW CAPITAL
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1973. OPERABILITY WAS 100 PERCENT IN JANUARY. S02 REMOVAL EFFICIENCY WAS 99 PERCENT DURING THIS OPERATING PERIOD. THE SYSTEM WAS SHUTDOWN IN EARLY FEBRUARY IN PREPARATION FOR THE EPA SCRUBBER AND SLUDGE STUDY WHICH MAY COMMENCE IN JUNE OR JULY OF 1976. THE SCRUBBER WILL NOT BE OPERATED UNTIL THIS TIME UNLESS THE NEED ARISES (PEAK LOAD DEMAND). CURRENTLY, THE UTILITY IS COMPLETING MODIFICATIONS ON THIS UNIT IN ANTICIPATION OF THE STUDY PROGRAM.

**BACKGROUND INFORMATION**  
**ON**  
**PADDY'S RUN POWER STATION**

PADDY'S RUN POWER STATION IS LOCATED IN LOUISVILLE, KENTUCKY. THE PLANT HAS SIX ELECTRIC POWER GENERATING UNITS WITH A TOTAL RATED CAPACITY OF 320 MW. UNIT NO. 6 IS RETROFITTED WITH A CARBIDE LIME-BASE FGD SYSTEM.

UNIT NO. 6 IS A PEAK LOAD COAL-FIRED BOILER, MANUFACTURED BY FOSTER WHEELER AND INSTALLED IN 1950. IN 1973, THE BOILER BURNED COAL WITH A GROSS HEATING VALUE OF 11,500 BTU/LB AND AVERAGE SULFUR AND ASH CONTENTS OF 3.7 PERCENT AND 13 PERCENT, RESPECTIVELY.

THE FGD SYSTEM CONSISTS OF TWO MODULES. EACH HANDLES 175,000 ACFM OF 350°F FLUE GAS. EACH MODULE IS MADE UP OF TWO STAGES OF 3-INCH MARBLE BEDS, FOLLOWED BY A TWO-STAGE CHEVRON-TYPE DEMISTER. THE GAS IS REHEATED BY DIRECT COMBUSTION OF NATURAL GAS. SO<sub>2</sub> REMOVAL EFFICIENCY IS REPORTED TO BE 80 PERCENT.

THE LIME USED CONTAINS 90 TO 92.0 PERCENT CALCIUM HYDROXIDE, 2.0 TO 2.5 PERCENT SILICA, 3.0 TO 8.0 PERCENT CALCIUM CARBONATE, AND 0.1 PERCENT MAGNESIUM OXIDE.

THE UNIT OPERATES ON A CLOSED-LOOP MODE: THE SO<sub>2</sub> IS ABSORBED IN THE MARBLE BED BY A SLURRY OF CALCIUM SULFITE TO FORM A MIXTURE OF CALCIUM SULFITE/BISULFITE. EFFLUENT FROM THE MARBLE-BED TOWER IS CONVERTED IN THE REACTION TANK TO CALCIUM SULFITE BY THE ADDITION OF CALCIUM HYDROXIDE. HALF OF THE REACTION TANK EFFLUENT IS RETURNED TO THE SO<sub>2</sub> TOWERS, WHILE THE OTHER HALF IS FED TO A CLARIFIER TANK. THE CALCIUM SULFITE CRYSTALS PRECIPITATE WITH THE AID OF A FLOCCULANT, WHICH IS ADDED AT THE RATE OF 4 TO 7 PPM. THE OVERFLOW IS RETURNED TO THE REACTION TANK; THE UNDERFLOW, CONTAINING 22 TO 24 PERCENT SOLIDS, IS STABILIZED BY MIXING IT WITH LIME. ABOUT 60 TO 100 POUNDS OF LIME ARE USED PER TON OF DRY SOLIDS OF SLUDGE. THE FIXED SLUDGE IS TRANSPORTED BY TRUCKS TO A 10-ACRE OFF-SITE SUMP FOR USE AS LANDFILL.

DURING THE INITIAL 45 DAYS OF OPERATION ONLY ONE ABSORBER WAS PLACED IN SERVICE, ALLOWING OPERATORS TO OBSERVE THE EQUIPMENT AND TO DETERMINE ANY NEEDED MODIFICATIONS. BEGINNING MAY 19, 1974, THE SYSTEM WAS SHUT DOWN FOR A MONTH FOR MODIFICATIONS, THE MOST SIGNIFICANT BEING INSTALLATION OF EQUIPMENT FOR INJECTING A FLOCCULATING AGENT INTO THE CLARIFIER TANK. DURING THE PERIOD JUNE 19 TO JULY 11, INCONSISTENT SIZING OF SLURRY ADDITIVE MATERIAL AS RECEIVED CAUSED MALFUNCTION OF THE ADDITIVE CONTROL VALVES AND UNDUE PLUGGING OF SLURRY LINE STRAINERS. THESE PROBLEMS WERE CORRECTED BY INSTALLATION OF A DISINTEGRATOR IN THE SLURRY ADDITIVE SYSTEM. FROM AUGUST 19 TO SEPTEMBER 5, THE UNIT WAS SHUT DOWN TO ENLARGE THE CLARIFIER'S OVERFLOW SYSTEM. ANOTHER MODIFICATION MADE WAS LOWERING OF THE SLURRY pH TO REMOVE SULFITE SCALING FORMED ON THE UPPER BED PERFORATED SUPPORT PLATE AND ON THE MARBLES.

OPERATING DATA, DESIGN MODIFICATIONS, PROBLEMS AND SOLUTIONS SINCE THE SYSTEM START-UP ARE PRESENTED AND DISCUSSED IN THE FOLLOWING TABLE.

# FGD SYSTEM AVAILABILITY

## PADDY'S RUN UNIT NO. 6

<u>Month</u>	<u>Operability (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Apr. 73	18	56	Modules were operated one at a time, with frequent shutdowns for inspection of equipment and minor repairs.
May 73	11	65	Single-module operation continued through May 19, when the unit was shut down for modifications. The most significant modification was installation of equipment for injection of a flocculating agent into the clarifier tank.
Jun. 73	0.1	6	Operation was intermittent from June 19 to July 11 because of mechanical problems with the slurry pumps.
Jul. 73	21	21	During a scheduled outage from July 12 through August 1, several repairs were made to the lime slurry makeup system. A disintegrator unit was installed to reduce plugging of strainers and slurry control valves.
Aug. 73	53	64	The operation was continuous from August 2 to August 18 except for a brief shutdown due to a boiler-related problem. From August 19 to September 5, the system was shut down to replace the clarifier's underflow line with one of larger diameter and to install additional pump capacity in the clarifier's overflow system.
Sep. 73	85	72	The unit operated continuously between September 6 and September 20 except for a 7-hour shutdown to repair a marble bed support plate. The unit was shut down the remainder of the month because of trouble in the boiler's turbine generator.
Oct. 73	49	94	The FGD system was in service through December 20 after which the boiler (and the scrubbers) were shut down because of "no demand" (this is a peaking-load boiler).
Nov. 73	35	100	
Dec. 73	44	78	
Jan. 74	0	0	Boiler shut down because of "no demand."
through Jun. 74			

**FGD SYSTEM AVAILABILITY**  
**PADDY'S RUN UNIT NO. 6 (Continued)**

<u>Month</u>	<u>Operability (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
Jul. 74	51	81	Boiler and FGD system resumed operation July 10, 1974.
Aug. 74	50	77	Unit has been on and off frequently due to fluctuation in power demand.
Sep. 74	0	0	Boiler is down because of "no demand."
Oct. 74	100	100	Boiler turned on specifically to perform limestone tests on FGD system.
Nov. 74	0	0	Boiler is down because of "no demand."
through			
Aug. 75			
Sep. 75	100	100	Boiler and FGD system operational all of September and first two weeks in October. System outage during the last two weeks of October was due primarily to breeching in the boiler section. Operability for both modules during the operational period was 100 percent (based upon LG&E's Peak Load Determination). SO <sub>2</sub> removal was reported to be over 98 percent.
Oct. 75	100	100	
Nov. 75	100	100	Boiler and scrubber system ran most of the report period on a Monday-through-Friday basis. Two minor outages in December were due to malfunction and repair of the dual strainer switch shaft in bottom of the scrubber module.
Dec. 75	90	90	
Jan. 76	100	100	SO <sub>2</sub> removal efficiency was reported to be 99 percent during January. The system was shut down in early February in preparation for an EPA scrubber/sludge study scheduled for June or July. The scrubber will not be operated until the start of the study program unless the boiler is required for peaking power demands. Highlights of the scrubber/sludge study program are as follows:
Feb. 76	0	0	
			<ul style="list-style-type: none"> <li>• 6 month duration.</li> <li>• One scheduled shutdown for test modifications.</li> <li>• Scrubber will run on carbide lime and commercial lime.</li> <li>• Determination of minimum retention times.</li> </ul>

**FGD SYSTEM AVAILABILITY**  
**PADDY'S RUN UNIT NO. 6 (Continued)**

<u>Month</u>	<u>Operability (%)</u>		<u>Comments</u>
	<u>Module A</u>	<u>Module B</u>	
			<ul style="list-style-type: none"> <li>• Deliberate high chloride concentration operation.</li> <li>• MgO inoculation.</li> <li>• Extensive sludge study: Fixation, leachates, seasonal variations.</li> </ul>
Mar. 76	0	0	The unit did not operate during the report period in anticipation of the EPA scrubber/sludge study. The utility is now completing system modifications for the operation of the test program.
Apr. 76	0	0	

**Note:** Since Paddy's Run No. 6 is a peak load boiler, it operated for less than a day on several occasions in July and August 1974. During these short boiler runs, the FGD system was not turned on and was bypassed although it was available.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	56
UTILITY NAME	MONTANA POWER CO.
UNIT NAME	COLSTRIP NO 1
UNIT LOCATION	COLSTRIP MONTANA
UNIT RATING	360 MW
FUEL CHARACTERISTICS	COAL 0.8 PERCENT SULFUR
FGD VENDOR	COMBUSTION EQUIP. ASSOCIATES
PROCESS	LIME/ALKALINE FLYASH SCRUBBING
NEW OR RETROFIT	NEW
START UP DATE	10/75
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT
S02	60 PERCENT
WATER MAKE UP	CLOSED LOOP
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$50/KW CAPITAL
OPERATIONAL EXPERIENCE	THE COLSTRIP PLANT IS A MINE MOUTH INSTALLATION. CONSTRUCTION ON THIS UNIT WAS COMPLETED BEHIND SCHEDULE. THE FGD SYSTEM STARTED UP IN LATE 1975 AND PROCEEDED THROUGH A SHAKEDOWN AND DEBUGGING OPERATION PHASE. THE UNIT IS NOW OPERATING AT FULL COMMERCIAL CAPACITY. OPERATING DATA ACCUMULATED TO-DATE IS IN THE PROCESS OF BEING EVALUATED BY THE UTILITY FOR PRESENTATION TO STATE REGULATORY AGENCIES.



**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	64
UTILITY NAME	NEVADA POWER
UNIT NAME	REID GARDNER NO 1
UNIT LOCATION	MOAPA NEVADA
UNIT RATING	125 MW
FUEL CHARACTERISTICS	COAL 0.5- 1.0 PERCENT SULFUR
FGD VENDOR	COMBUSTION EQUIP. ASSOCIATES
PROCESS	SODIUM CARBONATE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/74
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT
S02	85 PERCENT
WATER MAKE UP	190 GPM
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$44/KW CAPITAL (1974 DOLLARS) \$600,000 ANNUALIZED
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1974. SYSTEM OPERABILITY FOR THE MONTHS OF MARCH AND APRIL WAS 72 AND 91 PERCENT RESPECTIVELY. ONE FORCED SCRUBBER OUTAGE OCCURRED DURING THE REPORT PERIOD BECAUSE OF A VENTURI LEAK. THE BOILER WAS SHUTDOWN APRIL 5 FOR A VALVE AND COAL CONDUIT INSPECTION.

## BACKGROUND INFORMATION

### ON

#### REID GARDNER UNIT NO. 1

THE REID GARDNER POWER STATION IS LOCATED NEAR MOAPA, NEVADA, ABOUT 50 MILES NORTH OF LAS VEGAS. THE STATION HAS TWO ELECTRIC POWER GENERATING UNITS, (REID GARDNER 1 AND 2) EACH RATED AT 125 MW. BOTH UNITS ARE RETROFITTED WITH SODIUM CARBONATE BASED FGD SYSTEMS. THE COAL BURNED AT THE PLANT HAS AN AVERAGE GROSS HEATING VALUE OF 12,450 BTU/LB, AND ASH AND SULFUR CONTENTS OF 8 AND 0.5 PERCENT RESPECTIVELY.

THE FGD SYSTEM ON REID GARDNER 1 WAS MANUFACTURED BY COMBUSTION EQUIPMENT ASSOCIATES AND PLACED IN OPERATION IN APRIL 1974. SYSTEM DESIGN WAS BASED ON DATA GATHERED FROM OPERATION OF AN 8000-ACFM PILOT PLANT AT THE REID GARDNER POWER STATION IN 1971 AND 1972.

THE FGD SYSTEM CONSISTS OF A SINGLE MODULE, DESIGNED TO HANDLE 473,000 ACFM OF GAS AT 350°F. THE MODULE IS MADE UP OF A TWIN VARIABLE-THROAT VENTURI SCRUBBER, FOLLOWED BY A SINGLE-STAGE WASH TRAY. BYPASSING OF THE MODULE IS POSSIBLE THROUGH A GUILLOTINE-TYPE BYPASS VALVE. A COMMON FACILITY FOR TRONA (SODIUM CARBONATE ORE) STORAGE AND SAND REMOVAL SERVES BOTH FGD MODULES ON REID GARDNER UNITS 1 AND 2. SO<sub>2</sub> REMOVAL EFFICIENCY IS REPORTED TO BE 85 PERCENT.

IN THIS SODIUM CARBONATE PROCESS, HOT FLUE GAS FROM THE BOILER PASSES FIRST THROUGH MECHANICAL COLLECTOR (MULTICYCLONE), WHERE ABOUT 75 PERCENT OF THE FLY ASH IS REMOVED. PRESSURE IS THEN BOOSTED BY AN INDUCED-DRAFT FAN BEFORE THE GAS STREAM SPLITS AS IT ENTERS THE TWIN-THROAT VENTURI SCRUBBER. THE HOT FLUE GAS IS QUENCHED BY A SHOWER OF CIRCULATED SODIUM BASE LIQUOR. THE GAS THEN ENTERS THE WASH TRAY AND BUBBLES THROUGH THE RADIAL-VANE MIST ELIMINATOR, WHERE THE REMAINING LIQUID DROPLETS CARRIED OVER WITH THE GAS ARE TRAPPED AND REMOVED.

EFFLUENT FROM THE FGD SYSTEM IS FROM TWO SOURCES: THE SLIP STREAM OF SPENT LIQUOR DISCHARGED FROM THE RECIRCULATION TANK, AND THE ALKALINE CLARIFIER UNDERFLOW, WHICH SERVES TO NEUTRALIZE THE pH OF THE COMBINED LIQUOR BEFORE IT IS DISCHARGED TO THE SLUDGE SETTLING PONDS. THE SPENT LIQUOR IS PUMPED INTO ONE OF TWO SETTLING PONDS. THE OVERFLOW FROM THIS POND IS PUMPED TO A LARGER 45-ACRE POND, WHERE THE BRINE IS EVAPORATED. THE FGD SYSTEM OPERATES ON AN OPEN WATER LOOP WITH NO LIQUOR RECYCLED TO THE MODULES FROM THE PONDS.

<u>Month</u>	<u>Operating Hours</u>		<u>Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
Jul. 75			85%	During February the FGD system operated with 95 percent availability on trona supplemented with soda ash. Availability in January was only about 65 percent because of frozen sodium carbonate feed lines. Problems in February included a 2-day lack of chemicals. No significant problems occurred in March. The unit ran April 1 through April 12 with 100 percent availability. The boiler was then shut down for routine maintenance. The system was placed back on line May 12. Second performance test was passed. Problems included an abrasion of rubber-lined pipes and routine mechanical and instrumental problems. High ash content, up to 20 percent, had no effect on emissions.
Aug. 75				
Sep. 75	716	559	77	Of four forced outages, three were caused by scrubber malfunctions.
Oct. 75	303	106	35	Low operating time was due to scheduled boiler maintenance. One outage was due to the malfunction of a soda ash blower.
Nov. 75	654	394	60	The utility reports system performance in terms of the operability index. Unit No. 1 operability was low for the month of November because of delays in delivery of repair materials.
Dec. 75				
Jan. 76	646	186	29	Three forced outages during the month were due to reheater steam leaks, collapse of a venturi strainer, and a frozen carbonate line. The system was shut down for 16 days for completion of piping conversion; this outage was not due to scrubber malfunction. The utility reported five scrubber inoperative periods during the month of February, three of which were scrubber related outages. The forced scrubber occurred because of guillotine damper unit switch problems, depletion of chemical, chemical line plugging and seal water problems.
Feb. 76	664	520	78	
Mar. 76	398	287	72	Only one scrubber-related outage occurred during the month, because of a venturi leak.

REID GARDNER 1 (Continued)

<u>Month</u>	<u>Operating Hours</u>		<u>Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
Apr. 76	106	97	91	The boiler was taken out of service on April 5 for inspection of valves and coal conduits.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	65
UTILITY NAME	NEVADA POWER
UNIT NAME	REID GARDNER NO 2
UNIT LOCATION	MOAPA NEVADA
UNIT RATING	125 MW
FUEL CHARACTERISTICS	COAL 0.5- 1.0 PERCENT SULFUR
FGD VENDOR	COMBUSTION EQUIP. ASSOCIATES
PROCESS	SODIUM CARBONATE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/74
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT
S02	85 PERCENT
WATER MAKE UP	190 GPM
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$44/KW(1974 DOLLARS)* \$600,000ANNUALIZED
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APR. 1974. SYSTEM OPERABILITY FOR THE MONTHS OF MARCH AND APRIL WAS 60 AND 77 PERCENT RESPECTIVELY. DURING THE REPORT PERIOD SEVERAL FORCED SCRUBBER OUTAGES WERE REPORTED, PRIMARILY CAUSED BY PLUGGED SENSING LINES, REHEATER REPAIRS, AND MALFUNCTIONS IN THE TRAY SYSTEM.

BACKGROUND INFORMATION  
ON  
REID GARDNER UNIT NO. 2

THE REID GARDNER POWER STATION IS LOCATED NEAR MOAPA, NEVADA, ABOUT 50 MILES NORTH OF LAS VEGAS. THE STATIONS HAS TWO ELECTRIC POWER GENERATING UNITS, (REID GARDNER 1 AND 2) EACH RATED AT 125 MW. BOTH UNITS ARE RETROFITTED WITH SODIUM CARBONATE BASED FGD SYSTEMS. THE COAL BURNED AT THE PLANT HAS AN AVERAGE GROSS HEATING VALUE OF 12,450 BTU/LB, AND ASH AND SULFUR CONTENTS OF 8 AND 0.5 PERCENT RESPECTIVELY.

THE FGD SYSTEM ON REID GARDNER WAS MANUFACTURED BY COMBUSTION EQUIPMENT ASSOCIATES AND PLACES IN OPERATION IN APRIL 1974. SYSTEM DESIGN WAS BASED ON DATA GATHERED FROM OPERATION OF AN 8000 ACFM PILOT PLANT AT THE REID GARDNER POWER STATION IN 1971 AND 1972.

THE FGD SYSTEM CONSISTS OF A SINGLE MODULE, DESIGNED TO HANDLE 473,000 ACFM OF GAS AT 350°F. THE MODULE IS MADE UP OF A TWIN VARIABLE-THROAT VENTURI SCRUBBER, FOLLOWED BY A SINGLE-STAGE WASH TRAY. BYPASSING OF THE MODULE IS POSSIBLE THROUGH A GUILLOTINE-TYPE BAYPASS VALVE. A COMMON FACILITY FOR TRONA (SODIUM CARBONATE ORE) STORAGE AND SAND REMOVAL SERVES BOTH FGD MODULE ON REID GARDNER UNITS 1 AND 2. SO<sub>2</sub> REMOVAL EFFICIENCY IS REPORTED TO BE 85 PERCENT.

IN THIS SODIUM CARBONATE PROCESS, HOT FLUE GAS FROM THE BOILER PASSES FIRST THROUGH A MECHANICAL COLLECTOR (MULTICYCLONE), WHERE ABOUT 75 PERCENT OF THE FLY ASH IS REMOVED. PRESSURE IS THEN BOOSTED BY AN INDUCED DRAFT FAN BEFORE THE GAS STREAM SPLITS AS IT ENTERS THE TWIN THROAT VENTURI SCRUBBER. THE HOT FLUE GAS IS QUENCHED BY A SHOWER OF CIRCULATED SODIUM BASE LIQUOR. THE GAS THEN ENTERS THE WASH TRAY AND BUBBLES THROUGH THE WATER ON THE SIEVE TRAY. THE SCRUBBER GAS, WHICH IS ESSENTIALLY FREE OF FLY ASH AND SULFUR DIOXIDE, PASSES THROUGH THE RADIAL VANE MIST ELIMINATOR, WHERE THE REMAINING LIQUID DROPLETS CARRIED OVER WITH THE GAS ARE TRAPPED AND REMOVED.

EFFLUENT FROM THE FGD SYSTEM IS FROM TWO SOURCES: THE SLIP STREAM OF SPENT LIQUOR DISCHARGED FROM THE RECIRCULATION TANK, AND THE ALKALINE CLARIFIER UNDERFLOW, WHICH SERVES TO NEUTRALIZE THE pH OF THE COMBINED LIQUOR BEFORE IT IS DISCHARGED TO THE SLUDGE SETTLING PONDS. THE SPENT LIQUOR IS PUMPED INTO ONE OF TWO SETTLING PONDS. THE OVERFLOW FROM THIS POND IS PUMPED TO A LARGER 45 ACRE POND WHERE THE BRINE IS EVAPORATED. THE FGD SYSTEM OPERATES ON AN OPEN WATER LOOP WITH NO LIQUOR RECYCLED TO THE MODULES FROM THE PONDS.

REID GARDNER 2

<u>Operating Hours</u>				<u>Comments</u>
<u>Month</u>	<u>Boiler</u>	<u>FGD system</u>	<u>FGD System Operability (%)</u>	
Jul. 75			85%	During February the FGD system operated with 90 percent operability on trona supplemented with soda ash. Problems included a plugged recycle line strainer, seal water filters, and boiler controls. Unit has restarted after shutdown for 5-year turbine overhaul. Second performance test was passed. Problems included abrasion of rubber-lined pipes and routine mechanical and instrumental problems. High ash content, up to 20%, had no effect on emissions.
Aug. 75				
Sep. 75	645	496	77%	Three forced outages were due to strainer plugging, broken bucket elevator, worn re-circulation piping, and rubber liner leakage.
Oct. 75	531	464	87	Three forced outages during October were due to pump repair, instrument plugging, and repair of piping leakage.
Nov. 75	603	596	99	The utility reports system performance in terms of the operability index.
Dec. 75				
Jan. 76	691	458	66	Boiler was out of service a total of 3 days during the month. Scrubber outages were caused by frozen carbonate lines, plugged pressure-sensing lines, and overhaul of a tray recycle pump.
Feb. 76	675	578	86	The utility reported four scrubber inoperative periods during the month, three of which were scrubber-related outages. The forced scrubber outages occurred because of plugging in a venturi pump, depletion of chemical, chemical line plugging, and seal water problems.
Mar. 76	660	395	60	The utility reported that the FGD system was operational over 395 hours during this period.

REID GARDNER 2 (Continued)

<u>Month</u>	<u>Operating Hours</u>		<u>FGD System Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD system</u>		
Apr. 76	629	488	77	<p>One scrubber-related outage occurred during the month, because of plugging in the tray system and subsequent overhaul of the tray recycle pumps.</p> <p>Four forced scrubber outages, totaling over 98 hours, were reported by the utility for the month of April. The scrubber has been in operation 8711 hours since startup.</p>



**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	74
UTILITY NAME	NORTHERN STATES POWER CO.
UNIT NAME	SHERBURNE NO 1
UNIT LOCATION	BECKER MINNESOTA
UNIT RATING	680 MW
FUEL CHARACTERISTICS	COAL 0.8 PERCENT SULFUR
FGD VENDOR	COMBUSTION ENGINEERING
PROCESS	LIMESTONE SCRUBBING
NEW OR RETROFIT	NEW
START UP DATE	3/76
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT GUARANTEE
S02	50 PERCENT GUARANTEE
WATER MAKE UP	
SLUDGE DISPOSAL	UNLINED POND
UNIT COST	\$60/KW CAPITAL
OPERATIONAL EXPERIENCE	A PRELIMINARY SYSTEM CHECKOUT BY PASSING WATER AND AIR THROUGH THE EQUIP- MENT WAS SUCCESSFULLY COMPLETED BY THE UTILITY. THE SYSTEM WAS PUT IN SERVICE ON MARCH 16, 1976, TREATING FLUE GAS FROM BOILER NO.1, WHICH FIRES A LOW SULFUR WESTERN COAL. FOLLOWING THE 3/16 STARTUP THE SYSTEM WAS TESTED ON VARIOUS LOAD CAPACITIES AND IS CURRENTLY OPERATING AT FULL COMMERCIAL LOAD. A 30-DAY VENDOR RELIABILITY TEST PROGRAM IS SCHEDULED TO COMMENCE IN MID-SUMMER 1976.

TABLE 3  
PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76

IDENTIFICATION NO.	76
UTILITY NAME	PENNSYLVANIA POWER CO.
UNIT NAME	BRUCE MANSFIELD NO. 1
UNIT LOCATION	SHIPPINGPORT PENNSYLVANIA
UNIT RATING	835 MW
FUEL CHARACTERISTICS	COAL 4.3 PERCENT SULFUR
FGD VENDOR	CHEMICO
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	NEW
START UP DATE	4/76
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99.8 PERCENT
SO2	92 PERCENT GUARANTEE
WATER MAKE UP	
SLUDGE DISPOSAL	STABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	\$93/KW CAPITAL*2.7 MILLS/KWH ANNUALIZED
OPERATIONAL EXPERIENCE	REFER TO THE BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS EMISSION CONTROL SYSTEM IS CAPABLE OF REMOVING FLYASH AND SO2 FROM 3.35 MM ACFM OF FLUE GAS VIA WET LIME SCRUBBING. THE INITIAL SHAKEDOWN AND DEBUGGING PHASE OF OPERATION BEGAN FOR PART OF THE SYSTEM IN DECEMBER 1975. FULL COMMERCIAL OPERATION COMMENCED IN APRIL 1976. TO DATE, ALL 6 OF THE SCRUBBER/ABSORBER TRAINS HAVE BEEN PUT INTO OPERATION.

## BACKGROUND INFORMATION

• ON

### BRUCE MANSFIELD UNIT NO. 1

THE BRUCE MANSFIELD PLANT IS A 2700-MW, THREE-UNIT, COAL-FIRED FACILITY LOCATED ON THE OHIO RIVER IN THE BOROUGH OF SHIPPING PORT, PENNSYLVANIA. THIS NEW FACILITY IS BEING BUILT BY PENNSYLVANIA POWER CO., WHICH IS ACTING ON ITS OWN BEHALF AND AS AGENT FOR THE OTHER PARTICIPATING COMPANIES - CLEVELAND ELECTRIC ILLUMINATING CO., DUQUESNE LIGHT CO., OHIO EDISON CO., AND TOLEDO EDISON CO.

BRUCE MANSFIELD NO. 1 IS A COAL-FIRED, ONCE-THROUGH, SUPERCRITICAL STEAM GENERATOR WHICH FIRES 333 TONS/HR. OF COAL, NEARLY 6.5 MM LB/HR. OF STEAM AT 3,785 PSIG, 1005°F/1005°F. THE EMISSION CONTROL EQUIPMENT REQUIRED FOR THIS UNIT IS DESIGNED TO MEET STATE EMISSION REGULATIONS OF 0.6 LBS SO<sub>2</sub>/10<sup>6</sup> BTU OF HEAT INPUT AND 0.0175 GR/SCF OF PARTICULATE WHEN BURNING 11,900 BTU/LB COAL HAVING AVERAGE ASH AND SULFUR CONTENTS OF 12.5 AND 4.3 PERCENT.

IN LATE 1970, AN INTENSIVE INVESTIGATION OF MORE THAN 30 POTENTIAL DESULFURIZATION SYSTEMS WAS INITIATED. THE SYSTEM ULTIMATELY CHOSEN FOR THE REMOVAL OF FLY ASH AND SULFUR OXIDES WAS THE VENTURI WET-SCRUBBING SYSTEM, MANUFACTURED BY CHEMICO AIR POLLUTION CONTROL CO., EMPLOYING DRAVO CORPORATION'S THIOSORBIC LIME.

THE DESIGN FEATURES OF THE SCRUBBING SYSTEM CALLS FOR EACH SCRUBBING TRAIN TO CONSIST OF A SCRUBBING VESSEL, A 9000-HP I.D. FAN, AND AN ABSORBER VESSEL. THERE ARE 6 SCRUBBER TRAINS PER UNIT, 5 OF WHICH ARE REQUIRED TO HANDLE THE FLUE GAS FLOW FROM THE BOILER AT FULL LOAD (3.35 MM ACFM AT 285°F). THE SCRUBBER/ABSORBER TRAINS ARE ARRANGED IN TWO GROUPS OF THREE. THE TREATED FLUE GAS, WHICH HAS PASSED THROUGH THE SCRUBBING SYSTEM, IS DUCTED THROUGH A COMMON REHEAT CHAMBER AND THEN EXHAUSTED UP THE 950-FT. STACK.

THE ADJUSTABLE VENTURI THROAT SCRUBBING MODULE REMOVES NEARLY ALL OF THE FLY ASH CONTAINED IN THE FLUE GAS. THE ABSORBER MODULE, WHICH IS A FIXED-THROAT VENTURI, REMOVES THE REMAINING FLY ASH. SO<sub>2</sub> IS ABSORBED IN BOTH THE SCRUBBER AND ABSORBER BY DROPLETS OF LIME SLURRY, CONTAINING 2 TO 6 PERCENT MgO.

THE SCRUBBER-RECYCLE BLEED IS THEN COMBINED WITH A FLY ASH SLURRY FROM THE BOILER AND A FLOCCULANT AND PUMPED TO A 200 FT. DIAMETER THICKENER. SLUDGE FROM THE THICKENER IS THEN PUMPED TO A WASTE DISPOSAL SYSTEM WHERE IT IS MIXED WITH A STABILIZING AGENT (CALCILOX) AND THEN PUMPED APPROXIMATELY 7 MILES TO THE LITTLE BLUE RUN RAVINE FOR LAND FILL.

BRUCE MANSFIELD NO. 1

<u>Month</u>	<u>Boiler</u>	<u>Operating Hours</u> <u>FGD Modules</u>						<u>Comments</u>
		1	2	3	4	5	6	
Dec. 75								Initial operation (shakedown and debugging) for part of the system commenced in December 1975.
Jan. 76								
Feb. 76								
Mar. 76								
Apr. 76		2600	2900	2300	1100	400		The installation began full commercial operation in April. The scrubbing system is currently handling flue gas at a total equivalent capacity of 840 to 850-MW (gross). The total module by module operation hours logged to-date are posted in the accompanying table.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	80
UTILITY NAME	PHILADELPHIA ELECTRIC CO.
UNIT NAME	EDDYSTONE NO 1A
UNIT LOCATION	EDDYSTONE PENNSYLVANIA
UNIT RATING	120 MW
FUEL CHARACTERISTICS	COAL 2.5 PERCENT SULFUR
FGD VENDOR	UNITED ENGINEERS
PROCESS	MAGNESIUM OXIDE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	9/75
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	

S02

WATER MAKE UP

SLUDGE DISPOSAL

UNIT COST \$17 MILLION CAPITAL

OPERATIONAL EXPERIENCE	THE SO2 SCRUBBER HAS BEEN TEMPORARILY SHUTDOWN BECAUSE THE ACID PLANT RE-GENERATION FACILITY AT THE OLIN CHEMICAL SULFURIC ACID PLANT IN PAULSBORO NEW JERSEY HAS PERMANENTLY CEASED OPERATIONS. CONSIDERATIONS ARE NOW BEING GIVEN TO THE RELOCATION OF THE REGENERATION FACILITY. ONCE THIS DECISION IS MADE A MINIMUM PERIOD OF SIX MONTHS WILL BE REQUIRED TO RELOCATE THE REGENERATION FACILITY. THE PARTICULATE SCRUBBERS ARE CONTINUING TO OPERATE. THE UTILITY IS STILL EXPERIENCING PROBLEMS WITH THE FANS, RE-HEAT BURNERS, DAMPERS, AND EXPANSION JOINTS.
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TABLE 3  
PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76

IDENTIFICATION NO.	83
UTILITY NAME	PUBLIC SERVICE CO OF COLORADO
UNIT NAME	VALMONT NO. 5
UNIT LOCATION	VALMONT COLORADO
UNIT RATING	50 MW
FUEL CHARACTERISTICS	COAL 0.72 PERCENT SULFUR
FGD VENDOR	UOP / PUB SERVICE OF COLORADO
PROCESS	LIMESTONE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	10/74
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	95 PERCENT
SO2	85 PERCENT
WATER MAKE UP	CLOSED LOOP
SLUDGE DISPOSAL	UNSTABILIZED SLUDGE DISPOSED IN LINED POND
UNIT COST	
OPERATIONAL EXPERIENCE	REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS SYSTEM HAS BEEN OPERATIONAL SINCE NOVEMBER 1974. THE FGD SYSTEM CURRENTLY OPERATIONAL AT THIS STATION IS AN EXPERIMENTAL UNIT, ORIGINALLY DESIGNED BY UNIVERSAL OIL PRODUCTS FOR PARTICULATE REMOVAL ONLY. ONE OF THE TWO PARALLEL SCRUBBING MODULES WAS CONVERTED TO LIMESTONE SCRUBBING FOR EXPERIMENTAL PURPOSES ONLY.

## BACKGROUND INFORMATION

### ON

#### VALMONT NO. 5

THE VALMONT POWER STATION OF THE PUBLIC SERVICE COMPANY OF COLORADO IS LOCATED IN VALMONT, COLORADO, APPROXIMATELY 20 MILES NORTH OF DENVER. VALMONT NO. 5 IS A COAL-FIRED UNIT BURNS THAT FIRES GAS A FEW MONTHS DURING THE YEAR. THE COAL GENERALLY EMPLOYED FOR THIS UNIT IS WYOMING ROSEBUD, WHICH HAS AN AVERAGE GROSS HEATING VALUE OF 10,780 BUT/LB WITH ASH CONTENT IN THE 6 TO 7 PERCENT RANGE AND SULFUR CONTENT LESS THAN 1 PERCENT.

THE FGD SYSTEM BEING TESTED AT THIS STATION IS AN EXPERIMENTAL UNIT ORIGINALLY DESIGNED BY UNIVERSAL OIL PRODUCTS FOR PARTICULATE REMOVAL ONLY. THIS TCA UNIT CONSISTS OF TWO PARALLEL MODULES WITH A COMBINED CAPABILITY OF TREATING APPROXIMATELY 50 PERCENT OF THE TOTAL FLUE GAS LOAD OR THE EQUIVALENT OF APPROXIMATELY 100 MW GENERATING CAPACITY (50 MW PER MODULE). THIS SYSTEM WAS COMPLETED AND OPERATIONAL IN 1971 AND RAN UNTIL OCTOBER 1974. PARTICULATE REMOVAL EFFICIENCY WAS MEASURED AT 95 PERCENT,  $\text{SO}_2$  REMOVAL EFFICIENCY WAS 45 PERCENT, AND AVAILABILITY WAS APPROXIMATELY 70 PERCENT. FREQUENT SCRUBBER OUTAGES WERE CAUSED PRIMARILY BY SUPERSATURATED CALCIUM SULFATE IN THE SCRUBBING LIQUOR. TO MINIMIZE CLEANOUTS AND RECTIFY THE SCALING PROBLEM, A pH CONTROL PROGRAM WAS IMPLEMENTED FOR ONE OF THE SCRUBBING MODULES WITH ADDITION OF LIMESTONE TO THE SCRUBBING LIQUOR. THIS MODIFICATION WAS EXPECTED TO MINIMIZE SCALING, DECREASE SCRUBBER OUTAGES FOR CLEANOUTS, AND INCREASE AVAILABILITY. THE EXPECTED RESULTS DID NOT MATERIALIZE. SCALE BUILDUP CONTINUED AND AVAILABILITY DECREASED. TESTS DURING THE pH CONTROL PROGRAM SHOWED PARTICULATE REMOVAL EFFICIENCY AT 95 PERCENT.  $\text{SO}_2$  REMOVAL EFFICIENCY INCREASED TO 85 PERCENT, AND AVAILABILITY DROPPED TO 70 PERCENT. THE UNSTABILIZED SLUDGE GENERATED DURING THIS OPERATION WAS PUMPED TO A LINED POND. THE OPERATIONAL DATA GENERATED FROM THE LIMESTONE MODIFICATION PROGRAM ARE PRELIMINARY, BASED ON A 4.5-MONTH TESTING PROGRAM.

VALMONT NO. 5

<u>Month</u>	<u>Operating Hours</u>		<u>FGD System Operability (%)</u>	<u>Comments</u>
	<u>Boiler</u>	<u>FGD System</u>		
Sep. 75	0	0	0	This facility has been inactive since September 1, 1976, because of a turbine generator failure. The unit is scheduled to go on line again in December 1975.
Oct. 75	0	0	0	
Nov. 75	0	0	0	This unit is still inactive because of a boiler overhaul. The scrubber/absorber train is available and will be coupled into the system when the boiler goes back on-line.
Dec. 75	0	0	0	
Jan. 76	0	0	0	The boiler overhaul has been completed. The unit is available in the particulate removal mode only. The utility is suspending resumption of the limestone modification operation for an indefinite period.
Feb. 76	0	0	0	
Mar. 76		0	0	The experimental limestone scrubbing program was inactive during the report period.
Apr. 76		0	0	Resumption of the program is considered indefinite at the present time.



**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	90
UTILITY NAME	RICKENBACKER AFB
UNIT NAME	RICKENBACKER
UNIT LOCATION	COLUMBUS OHIO
UNIT RATING	20 MW
FUEL CHARACTERISTICS	COAL 3.6 PERCENT SULFUR
FGD VENDOR	RESEARCH COTTRELL
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	3/76
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	99 PERCENT
S02	90 PERCENT

WATER MAKE UP

SLUDGE DISPOSAL

UNIT COST

OPERATIONAL EXPERIENCE	THE SYSTEM SUPPLIER REPORTED THAT THE FGD SYSTEM BECAME OPERATIONAL ON MARCH 11, 1976. SYSTEM OPERABILITY WAS REPORTED TO BE 97 PERCENT FOR THE DURATION OF THE MONTH. THE SYSTEM WAS BROUGHT DOWN ON APRIL 14 BECAUSE OF PUMP PROBLEMS. A 1.5 WEEK OUTAGE RESULTED BECAUSE OF A SPARE PART SHIPMENT. SO2 INLET CONCENTRATIONS HAVE BEEN AT THE 1800 PPM LEVEL. LIME UTILIZATION HAS BEEN GOOD. THE SO2 REMOVAL EFFICIENCY WAS REPORTED TO BE AS HIGH AS 96 PERCENT.
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**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	98
UTILITY NAME	TENNESSEE VALLEY AUTHORITY
UNIT NAME	SHAWNEE NO.10A
UNIT LOCATION	PADUCAH KENTUCKY
UNIT RATING	10 MW
FUEL CHARACTERISTICS	COAL 2.9 PERCENT SULFUR
FGD VENDOR	UNIVERSAL OIL PRODUCTS
PROCESS	LIME/LIMESTONE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/72
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	

S02

WATER MAKE UP

SLUDGE DISPOSAL

UNIT COST

OPERATIONAL  
EXPERIENCE

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS TURBULENT CONTACT ABSORBER(TCA) LIME/LIMESTONE SCRUBBING SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1972. THIS TEST PROGRAM IS FUNDED BY THE EPA. TVA IS THE CONSTRUCTOR AND FACILITY OPERATOR. THE BECHTEL CORP. OF SAN FRANCISCO IS THE MAJOR CONTRACTOR, TEST DIRECTOR, AND REPORT WRITER.

**TABLE 3**  
**PERFORMANCE DESCRIPTION FOR OPERATIONAL FGD SYSTEMS 05/76**

IDENTIFICATION NO.	99
UTILITY NAME	TENNESSEE VALLEY AUTHORITY
UNIT NAME	SHAWNEE NO.10B
UNIT LOCATION	PADUCAH KENTUCKY
UNIT RATING	10 MW
FUEL CHARACTERISTICS	COAL 2.9 PERCENT SULFUR
FGD VENDOR	CHEMICO
PROCESS	LIME/LIMESTONE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/72
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	

S02

WATER MAKE UP

SLUDGE DISPOSAL

UNIT COST

OPERATIONAL  
EXPERIENCE

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 3 OF THIS REPORT. THIS VENTURI/SPRAY TOWER LIME/LIMESTONE SCRUBBING SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1972. THIS TEST PROGRAM IS FUNDED BY THE EPA. TVA IS THE CONSTRUCTOR AND FACILITY OPERATOR. THE BECHTEL CORP. OF SAN FRANCISCO IS THE MAJOR CONTRACTOR, TEST DIRECTOR, AND REPORT WRITER.

BACKGROUND INFORMATION  
ON  
SHAWNEE NOS. 10A, 10B, AND 10C

IN JUNE 1968, THE EPA INITIATED A PROGRAM TO TEST PROTOTYPE LIME AND LIMESTONE SYSTEMS FOR REMOVAL OF SULFUR DIOXIDE AND PARTICULATES FROM COAL-FIRED BOILER FLUE GASES. THE PROGRAM WAS CARRIED OUT IN A TEST FACILITY INCORPORATED INTO THE FLUE GAS DUCTWORK OF UNIT NO. 10, A COAL-FIRED BOILER AT THE TVA SHAWNEE POWER STATION, PADUCAH, KENTUCKY. TVA IS THE CONSTRUCTOR AND FACILITY OPERATOR; BECHTEL CORP. IS THE MAJOR CONTRACTOR, TEST DIRECTOR, AND REPORT WRITER.

THE TEST FACILITY CONSISTS OF THREE PARALLEL SCRUBBER SYSTEMS OF PROTOTYPE SIZE, TREATING PART OF THE FLUE GAS FROM THE BOILER. EACH SCRUBBER TRAIN IS CAPABLE OF TREATING APPROXIMATELY 30,000 ACFM OR THE EQUIVALENT OF APPROXIMATELY 10 MW OF POWER PLANT GENERATING CAPACITY.

THREE PARALLEL WET SCRUBBER SYSTEMS WERE SELECTED FOR THE TEST PROJECT: 1) A VENTURI WITH A SPRAY TOWER AFTER ABSORBER; 2) A TURBULENT CONTACT ABSORBER (TCA) AND 3) A MARBLE-BED ABSORBER. THE VENTURI SYSTEM, MANUFACTURED BY CHEMICAL CONSTRUCTION CO., CONTAINS AN ADJUSTABLE THROAT THAT PERMITS CONTROL AND VARIATION OF PRESSURE DROP UNDER A WIDE RANGE OF FLOW CONDITIONS. THE TCA UNIT, MANUFACTURED BY UNIVERSAL OIL PRODUCTS, INCORPORATES A FLUIDIZED BED OF LOW DENSITY PLASTIC SPHERES THAT ARE FREE TO MOVE BETWEEN RETURNING GRIDS. THE MARBLE-BED ABSORBER, SUPPLIED BY COMBUSTION ENGINEERING CO., USES A PACKING OF 3/4-INCH GLASS MARBLE SPHERES AND A TURBULENT LAYER OF LIQUID AND GAS ABOVE THE MARBLE LAYER TO ENHANCE MASS TRANSFER.

IN JUNE 1974, THE EPA INITIATED A 3-YEAR ADVANCED TEST PROGRAM AT THE SHAWNEE FACILITY WITH THESE MAJOR GOALS: (1) CONTINUATION OF LONG-TERM TESTING, EMPHASIZING RELIABLE OPERATION OF MIST ELIMINATION SYSTEMS AT INCREASED GAS VELOCITY, (2) INVESTIGATION OF ADVANCED PROCESS AND EQUIPMENT DESIGN VARIATIONS FOR IMPROVING SYSTEM RELIABILITY AND PROCESS ECONOMICS, AND (3) LONG-TERM RELIABILITY TESTING ON PROMISING PROCESS AND EQUIPMENT DESIGN VARIATIONS.

THE TWO PARALLEL SCRUBBING SYSTEMS OPERATING DURING THE ADVANCED PROGRAM ARE THE VENTURI/SPRAY TOWER SYSTEM AND THE TCA UNIT. OPERATION OF THE MARBLE-BED ABSORBER UNIT HAS BEEN PERMANENTLY DISCONTINUED.

EACH OF THE SCRUBBING SYSTEMS CONTAINS ITS OWN SLURRY HANDLING FACILITIES AND CAN TREAT APPROXIMATELY 30,000 ACFM OF GAS AT 300°F CONTAINING 1800 TO 4000 PPM OF SO<sub>2</sub> AND 2 TO 4 GRAINS/SCF OF PARTICULATES. BOILER NO. 1 NORMALLY BURNS A HIGH-SULFUR BITUMINOUS COAL.

FROM JUNE 1974 TO JANUARY, 1976, MIST ELIMINATION AND LIMESTONE UTILIZATION TESTS WERE CONDUCTED AT THE SHAWNEE FACILITY. DURING THIS TEST PERIOD THE VENTURI/SPRAY TOWER SYSTEM WAS OPERATED ON BOTH LIME AND LIMESTONE AND THE TCA SYSTEM WITH LIMESTONE. TESTING WAS PERFORMED UNDER A CLOSED LIQUOR LOOP OPERATION MODE. DURING THIS PERIOD THE SLURRY SOLIDS CONTAINED APPROXIMATELY 40 TO 50 WEIGHT PERCENT FLY ASH BECAUSE OF RELATIVELY HIGH GAS INLET PARTICULATE LOADING. THIS TESTING PROGRAM IS SCHEDULED TO RUN TILL JUNE 1977.

SHAWNEE NOS. 10A AND 10B

<u>Test Run Period</u>	<u>FGD System Operating Hours</u>		<u>Comments</u>
	<u>10A</u>	<u>10B</u>	
Sep. 75			This experimental EPA-funded operation is proceeding with the test program. Two absorber modules are currently operational (10 MW each); the marble-bed absorber is still inoperative (since July 1973). Current experiments are related to mist eliminator section.
Oct. 75			
Nov. 75			Recent testing at Shawnee has shown that the chevron mist eliminators in both the spray tower and the TCA can be kept free of solids buildup at high alkali utilization (greater than 90 percent) using only intermittent washing with available raw water. This high utilization is normally achieved with lime; it has been achieved with limestone at reduced scrubber inlet slurry pH (about 5.2) and with three effluent tanks in series to simulate a plug-flow reactor.
Dec. 75			
			Testing is continuing to determine the effects of process variables on mist eliminator performance and on limestone utilization. Future plans include: (1) factorial testing with lime and limestone to determine the effects of process variables on SO <sub>2</sub> removal and (2) testing the oxidation of sludge to gypsum in the venturi/spray tower system using air sparging of an acidified slurry bleed stream.
Jan. 75			The advanced test program is continuing. Highlights of this program are as follows: <ul style="list-style-type: none"> <li>• Evaluate scrubber operability during variable load operation.</li> <li>• Continue long-term reliability testing.</li> <li>• Investigate methods for improving waste solids separation.</li> <li>• Continue sludge oxidation and sludge fixation study programs.</li> <li>• Evaluate system performance at reduced fly ash loadings.</li> <li>• Determine the practical upper limits of SO<sub>2</sub> removal efficiency.</li> <li>• Evaluate addition of magnesium ion to the scrubbing slurry.</li> </ul>

SHAWNEE NOS. 10A AND 10B (Continued)

<u>Test Run Period</u>	<u>FGD System Operating Hours</u>		<u>Comments</u>
	<u>10A</u>	<u>10B</u>	
			<ul style="list-style-type: none"> <li>• Characterize all stack gas emission components.</li> <li>• Evaluate materials of construction of all scrubber and plant-related components.</li> <li>• Develop a computer program for design and cost analysis of full-scale lime/limestone systems.</li> </ul>
Mar. 76			<p>Bechtel reported that the factorial test program, evaluating the performance of the lime/limestone scrubbing systems with and without magnesium addition, has been completed. Currently, testing is proceeding on the evaluation of system performance as a function of low residence times (1.5 to 5.0 minutes) in the recycle tanks. In addition, a fly ash-free duct is being installed at the test facility, thus enabling evaluation of system performance in the absence of fly ash.</p>
Apr. 76			

**Table 4**  
**NUMBER AND TOTAL MW OF FGD SYSTEMS**

**TABLE 4**  
**NUMBER AND TOTAL MW OF FGD SYSTEMS**

<b>STATUS</b>	<b>NO.OF UNITS</b>	<b>MW</b>
<b>OPERATIONAL</b>	<b>27</b>	<b>5543.</b>
<b>UNDER CONSTRUCTION</b>	<b>19</b>	<b>7562.</b>
<b>PLANNING</b>		
<b>CONTRACT AWARDED</b>	<b>18</b>	<b>7344.</b>
<b>LETTER OF INTENT</b>	<b>8</b>	<b>3356.</b>
<b>REQUESTING/EVALUATING BIDS</b>	<b>5</b>	<b>2467.</b>
<b>CONSIDERING ONLY FGD SYSTEMS</b>	<b>31</b>	<b>15003.</b>
<b>TOTAL</b>	<b>108</b>	<b>41275.</b>



**Table 5**  
**SUMMARY OF FGD SYSTEMS BY COMPANY**

TABLE 5  
SUMMARY OF FGD SYSTEMS BY COMPANY

UTILITY	-----STATUS-----													
	TOTAL		OPERATIONAL		CONSTRUCTION		-----PLANNED-----							
	NO.	MW	NO.	MW	NO.	MW	CONTRACT AWARDED NO.	MW	LETTER OF INTENT NO.	MW	REQUESTING/ EVAL. BIDS NO.	MW	CONSIDERING FGD SYSTEMS NO.	MW
ALABAMA ELECTRIC COOP	2	450.	0	0.	0	0.	2	450.	0	0.	0	0.	0	0.
ALLEGHENY POWER SYSTEM	2	1250.	0	0.	0	0.	2	1250.	0	0.	0	0.	0	0.
ARIZONA ELECTRIC POWER COOP	2	405.	0	0.	0	0.	0	0.	2	405.	0	0.	0	0.
ARIZONA PUBLIC SERVICE	5	1875.	2	275.	1	250.	0	0.	0	0.	0	0.	2	1350.
BASIN ELECTRIC POWER COOP	5	2550.	0	0.	0	0.	0	0.	0	0.	0	0.	5	2550.
BRAZOS ELECTRIC POWER COOP	1	400.	0	0.	0	0.	1	400.	0	0.	0	0.	0	0.
CENTRAL ILLINOIS LIGHT CO.	3	857.	0	0.	1	100.	0	0.	0	0.	0	0.	2	757.
CENTRAL ILLINOIS PUBLIC SERV	1	600.	0	0.	0	0.	0	0.	0	0.	1	600.	0	0.
CINCINNATI GAS & ELECTRIC CO.	2	1100.	0	0.	0	0.	0	0.	0	0.	1	500.	1	600.
COLUMBUS & SOUTHERN OHIO ELEC.	4	1550.	0	0.	1	400.	1	400.	0	0.	0	0.	2	750.
COMMONWEALTH EDISON	2	592.	1	167.	0	0.	1	425.	0	0.	0	0.	0	0.
DETROIT EDISON	1	180.	0	0.	1	180.	0	0.	0	0.	0	0.	0	0.
DUQUESNE LIGHT	2	920.	2	920.	0	0.	0	0.	0	0.	0	0.	0	0.
GENERAL MOTORS	1	32.	1	32.	0	0.	0	0.	0	0.	0	0.	0	0.
GULF POWER CO.	3	63.	3	63.	0	0.	0	0.	0	0.	0	0.	0	0.
INDIANAPOLIS POWER & LIGHT CO.	1	530.	0	0.	1	530.	0	0.	0	0.	0	0.	0	0.
KANSAS CITY POWER & LIGHT	3	1060.	3	1060.	0	0.	0	0.	0	0.	0	0.	0	0.
KANSAS POWER & LIGHT	4	1885.	2	525.	0	0.	2	1360.	0	0.	0	0.	0	0.
KENTUCKY UTILITIES	1	64.	1	64.	0	0.	0	0.	0	0.	0	0.	0	0.
KEY WEST UTILITY BOARD	1	37.	1	37.	0	0.	0	0.	0	0.	0	0.	0	0.
LOUISVILLE GAS & ELECTRIC	8	2213.	1	65.	3	786.	1	425.	0	0.	1	277.	2	660.
MINNKOTA POWER COOPERATIVE	1	450.	0	0.	1	450.	0	0.	0	0.	0	0.	0	0.
MONTANA POWER CO.	4	2120.	1	360.	1	360.	0	0.	0	0.	0	0.	2	1400.
NEVADA POWER	10	3000.	2	250.	1	125.	0	0.	1	125.	0	0.	6	2500.
NEW ENGLAND ELEC SYSTEM	1	650.	0	0.	0	0.	0	0.	0	0.	0	0.	1	650.
NORTHERN INDIANA PUB SERVICE	3	705.	0	0.	1	115.	0	0.	0	0.	0	0.	2	590.
NORTHERN STATES POWER CO.	2	1360.	1	680.	1	680.	0	0.	0	0.	0	0.	0	0.
PENNSYLVANIA POWER CO.	3	2505.	1	835.	1	835.	1	835.	0	0.	0	0.	0	0.
PHILADELPHIA ELECTRIC CO.	4	846.	1	120.	0	0.	0	0.	1	240.	0	0.	2	486.
PUBLIC SERVICE CO OF COLORADO	1	50.	1	50.	0	0.	0	0.	0	0.	0	0.	0	0.
PUBLIC SERVICE CO OF NEW MEX.	4	1715.	0	0.	0	0.	2	715.	2	1000.	0	0.	0	0.
PUBLIC SERVICE INDIANA	2	1300.	0	0.	0	0.	0	0.	0	0.	0	0.	2	1300.
RICKENBACKER AFB	1	20.	1	20.	0	0.	0	0.	0	0.	0	0.	0	0.
S. CAROLINA PUB SERV AUTHORITY	1	140.	0	0.	0	0.	1	140.	0	0.	0	0.	0	0.
S. MISSISSIPPI ELEC PWR ASSOC	2	360.	0	0.	0	0.	2	360.	0	0.	0	0.	0	0.
SOUTHERN CALIFORNIA EDISON	2	1410.	0	0.	0	0.	0	0.	0	0.	0	0.	2	1410.
SOUTHERN ILLINOIS POWER COOP	1	184.	0	0.	0	0.	1	184.	0	0.	0	0.	0	0.
SPRINGFIELD CITY UTILITIES	1	200.	0	0.	1	200.	0	0.	0	0.	0	0.	0	0.
TENNESSEE VALLEY AUTHORITY	3	570.	2	20.	1	550.	0	0.	0	0.	0	0.	0	0.
TEXAS UTILITIES CO.	4	2379.	0	0.	2	1586.	0	0.	2	793.	0	0.	0	0.
UNITED POWER ASSOCIATION	2	1090.	0	0.	0	0.	0	0.	0	0.	2	1090.	0	0.
UTAH POWER & LIGHT CO.	2	815.	0	0.	1	415.	1	400.	0	0.	0	0.	0	0.
TOTALS	108	40482.	27	5543.	19	7562.	18	7344.	8	2563.	5	2467.	31	15003.

**Table 6**  
**SUMMARY OF FGD SYSTEMS BY VENDOR**

TABLE 6  
SUMMARY OF FGD SYSTEMS BY VENDOR

MANUFACTURER/PROCESS	TOTAL		STATUS			
	NO.	MW	OPERATIONAL		CONSTRUCTION	
	---	---	---	---	---	---
ADL/COMBUSTION EQUIP ASSOCIATE						
DOUBLE ALKALI	1	20.	1	20.	0	0.
TOTAL, ADL/COMBUSTION EQUIP ASS	1	20.	1	20.	0	0.
AMERICAN AIR FILTER						
LIME SCRUBBING	3	667.	1	64.	2	603.
TOTAL, AMERICAN AIR FILTER	3	667.	1	64.	2	603.
BABCOCK & WILCOX						
LIMESTONE SCRUBBING	2	987.	2	987.	0	0.
TOTAL, BABCOCK & WILCOX	2	987.	2	987.	0	0.
CHEMICO						
LIME SCRUBBING	5	3005.	3	1755.	2	1250.
LIME/LIMESTONE SCRUBBING	1	10.	1	10.	0	0.
TOTAL, CHEMICO	6	3015.	4	1765.	2	1250.
CHIYODA INTERNATIONAL						
THOROUGHbred 101	1	23.	1	23.	0	0.
TOTAL, CHIYODA INTERNATIONAL	1	23.	1	23.	0	0.
COMBUSTION ENGINEERING						
LIME SCRUBBING	2	248.	1	65.	1	183.
LIMESTONE INJECTION & WET SCRUB	4	765.	4	765.	0	0.
LIMESTONE SCRUBBING	2	1360.	1	680.	1	680.
TOTAL, COMBUSTION ENGINEERING	8	2373.	6	1510.	2	863.
COMBUSTION EQUIP. ASSOCIATES						
SODIUM CARBONATE SCRUBBING	3	375.	2	250.	1	125.
TOTAL, COMBUSTION EQUIP. ASSOCI	3	375.	2	250.	1	125.
DAVY POWERGAS/ALLIED CHEMICAL						
WELLMAN LORD/ALLIED CHEMICAL	1	115.	0	0.	1	115.
TOTAL, DAVY POWERGAS/ALLIED CHE	1	115.	0	0.	1	115.
FOSTER WHEELER						
ACTIVATED CARBON	1	20.	1	20.	0	0.
TOTAL, FOSTER WHEELER	1	20.	1	20.	0	0.
KOCH						
DOUBLE ALKALI	1	32.	1	32.	0	0.
TOTAL, KOCH	1	32.	1	32.	0	0.

TABLE 6  
SUMMARY OF FGD SYSTEMS BY VENDOR

MANUFACTURER/PROCESS	TOTAL		STATUS			
	NO.	MW	OPERATIONAL		CONSTRUCTION	
	NO.	MW	NO.	MW	NO.	MW
COMBUSTION EQUIP. ASSOCIATES						
LIME/ALKALINE FLYASH SCRUBBING	3	1170.	1	360.	2	810.
TOTAL, COMBUSTION EQUIP. ASSOCIA	3	1170.	1	360.	2	810.
PEABODY ENGINEERING						
LIMESTONE SCRUBBING	1	180.	0	0.	1	180.
TOTAL, PEABODY ENGINEERING	1	180.	0	0.	1	180.
RESEARCH COTTRELL						
LIME SCRUBBING	1	20.	1	20.	0	0.
LIMESTONE SCRUBBING	4	1951.	1	115.	3	1836.
TOTAL, RESEARCH COTTRELL	5	1971.	2	135.	3	1836.
RILEY STOKER/ENVIRONEERING						
LIMESTONE SCRUBBING	1	100.	0	0.	1	100.
TOTAL, RILEY STOKER/ENVIRONEERI	1	100.	0	0.	1	100.
SCE						
LIME SCRUBBING	1	160.	1	160.	0	0.
TOTAL, SCE	1	160.	1	160.	0	0.
TENNESSEE VALLEY AUTHORITY						
LIMESTONE SCRUBBING	1	550.	0	0.	1	550.
TOTAL, TENNESSEE VALLEY AUTHORI	1	550.	0	0.	1	550.
UNITED ENGINEERS						
MAGNESIUM OXIDE SCRUBBING	1	120.	1	120.	0	0.
TOTAL, UNITED ENGINEERS	1	120.	1	120.	0	0.
UNIVERSAL OIL PRODUCTS						
LIME SCRUBBING	1	400.	0	0.	1	400.
LIME/LIMESTONE SCRUBBING	1	10.	1	10.	0	0.
LIMESTONE SCRUBBING	2	730.	0	0.	2	730.
TOTAL, UNIVERSAL OIL PRODUCTS	4	1140.	1	10.	3	1130.
UOP / PUB SERVICE OF COLORADO						
LIMESTONE SCRUBBING	1	50.	1	50.	0	0.
TOTAL, UOP / PUB SERVICE OF COL	1	50.	1	50.	0	0.
ZURN AIR SYSTEMS						
LIMESTONE SCRUBBING	1	37.	1	37.	0	0.
TOTAL, ZURN AIR SYSTEMS	1	37.	1	37.	0	0.
	46	13105.	27	5543.	19	7562.

PEDCo-ENVIRONMENTAL

**Table 7**  
**SUMMARY OF NEW AND RETROFIT FGD SYSTEMS BY PROCESS**

**TABLE 7**  
**SUMMARY OF NEW AND RETROFIT FGD SYSTEMS BY PROCESS**

**MW CAPACITY(NO. OF PLANTS)**

PROCESS	NEW OR RETROFIT	OPERATIONAL		CONSTRUCTION		CONTRACT AWARDED		LETTER OF INTENT		REQUESTING/ EVAL. BIDS		CONSIDERING FGD SYSTEM		TOTAL NO. OF PLANTS	
		NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW
LIME SCRUBBING	N	1	835	3	1660	5	2475	0	0	0	0	0	0	9	4970
	R	6	1229	3	776	0	0	0	0	0	0	2	660	11	2665
LIME/ALKALINE FLYASH SCRUBBING (PROCESS NOT SELECTED)	N	1	360	1	450	0	0	0	0	0	0	0	0	2	810
	R	0	0	1	360	0	0	0	0	0	0	0	0	1	360
LIME/LIMESTONE (PROCESS NOT SELECTED)	N	0	0	0	0	0	0	0	0	2	1090	0	0	2	1090
	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIME/LIMESTONE SCRUBBING (PROCESS NOT SELECTED)	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	2	20	0	0	0	0	0	0	0	0	2	1410	4	1430
LIMESTONE SCRUBBING	N	4	1937	7	3346	10	3729	4	1198	0	0	1	400	26	10610
	R	6	697	2	730	1	425	0	0	0	0	0	0	9	1852
SUBTOTAL - LIME/LIMESTONE	N	6.	3132.	11.	5456.	15.	6204.	4.	1198.	2.	1090.	1.	400.	39.	17480.
	R	14.	1946.	6.	1866.	1.	425.	0.	0.	0.	0.	4.	2070.	25.	6307.
ACTIVATED CARBON	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	1	20	0	0	0	0	0	0	0	0	0	0	1	20
DOUBLE ALKALI	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	2	52	0	0	0	0	0	0	0	0	0	0	2	52
MAGNESIUM OXIDE SCRUBBING	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	1	120	0	0	0	0	1	240	0	0	2	486	4	846
NOT SELECTED	N	0	0	0	0	0	0	0	0	2	1100	18	9100	20	10200
	R	0	0	0	0	0	0	0	0	1	277	5	2297	6	2574
REGENERABLE NOT SELECTED	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	0	0	0	0	0	0	0	0	0	0	1	650	1	650
SODIUM CARBONATE SCRUBBING	N	0	0	1	125	0	0	1	125	0	0	0	0	2	250
	R	2	250	0	0	0	0	0	0	0	0	0	0	2	250
THOROUGHMBRED 101	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	1	23	0	0	0	0	0	0	0	0	0	0	1	23
WELLMAN LORD	N	0	0	0	0	0	0	2	1000	0	0	0	0	2	1000
	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WELLMAN LORD/ALLIED CHEMICAL	N	0	0	0	0	1	375	0	0	0	0	0	0	1	375
	R	0	0	1	115	1	340	0	0	0	0	0	0	2	455
TOTALS	N	6.	3132.	12.	5581.	16.	6579.	7.	2323.	4.	2190.	19.	9500.	64.	29305.
	R	21.	2411.	7.	1981.	2.	765.	1.	240.	1.	277.	12.	5503.	44.	11177.
LIME/LIMESTONE % OF TOTAL MW	N	100		98		94		52		50		4		60	
	R	81		94		56		0		0		38		56	

**Table 8**  
**SUMMARY OF OPERATING FGD SYSTEMS BY PROCESS AND GENERATING UNITS**



TABLE 8  
SUMMARY OF OPERATING FGD SYSTEMS BY  
PROCESS AND GENERATING UNITS AS OF 05/76

PROCESS/GENERATING UNITS	FGD/MW	STARTUP	EXPERIENCE(MO.)
ACTIVATED CARBON			
SCHOLZ NO. 2A	20	2-76	3
	-----		----
	20.		3
DOUBLE ALKALI			
CHEVROLET PARMA 1 2 3 & 4	32	3-74	26
SCHOLZ NO. 1A	20	2-75	15
	-----		----
	52.		41
LIME SCRUBBING			
BRUCE MANSFIELD NO. 1	835	4-76	1
ELRAMA	510	10-75	7
FOUR CORNERS NO. 5A	160	2-76	3
GREEN RIVER UNITS 1 AND 2	64	9-75	8
PADDYS RUN NO 6	65	4-73	37
PHILLIPS	410	7-73	34
RICKENBACKER	20	3-76	2
	-----		----
	2064.		92
LIME/ALKALINE FLYASH SCRUBBING			
COLSTRIP NO 1	360	10-75	7
	-----		----
	360.		7
LIME/LIMESTONE SCRUBBING			
SHAWNEE NO.10A	10	4-72	49
SHAWNEE NO.10B	10	4-72	49
	-----		----
	20.		98

TABLE 8  
SUMMARY OF OPERATING FGD SYSTEMS BY  
PROCESS AND GENERATING UNITS AS OF 05/76

PROCESS/GENERATING UNITS	FGD/MW	STARTUP	EXPERIENCE(MO.)
LIMESTONE SCRUBBING			
HAWTHORN NO 3	140	11-72	42
HAWTHORN NO 4	100	8-72	45
LAWRENCE NO 4	125	12-68	89
LAWRENCE NO 5	400	11-71	54
CHOLLA NO 1	115	10-73	31
LA CYGNE NO 1	820	2-73	39
SHERBURNE NO 1	680	3-76	2
STOCK ISLAND PLANT	37	10-72	43
VALMONT NO. 5	50	10-74	19
WILL COUNTY NO 1	167	2-72	51
	-----		-----
	2634.		415
MAGNESIUM OXIDE SCRUBBING			
EDDYSTONE NO 1A	120	9-75	8
	-----		-----
	120.		8
SODIUM CARBONATE SCRUBBING			
REID GARDNER NO 1	125	4-74	25
REID GARDNER NO 2	125	4-74	25
	-----		-----
	250.		50
THOROUGHbred 101			
SCHOLZ NOS. 1B & 2B	23	3-75	14
	-----		-----
	23.		14

**Table 9**  
**SUMMARY OF SLUDGE DISPOSAL PRACTICES FOR OPERATIONAL FGD SYSTEMS**

TABLE 9  
SUMMARY OF SLUDGE DISPOSAL PRACTICES FOR OPERATIONAL FGD SYSTEMS AS OF 05/76

PROCESS/GENERATING UNIT	--SLUDGE-- STABILIZED	--SLUDGE-- UNSTABILIZED	---POND--- LINED	---POND--- UNLINED
<b>DOUBLE ALKALI</b>				
CHEVROLET PARMA 1 2 3 & 4		32		32
SCHOLZ NO. 1A		20	20	
TOTAL	0.	52.	20.	32.
<b>LIME SCRUBBING</b>				
BRUCE MANSFIELD NO. 1	835			835
ELRAMA	510			510
GREEN RIVER UNITS 1 AND 2	64			64
PADDYS RUN NO 6		65		65
PHILLIPS	410			410
TOTAL	1819.	65.	0.	1884.
<b>LIME/ALKALINE FLYASH SCRUBBING</b>				
COLSTRIP NO 1		360		360
TOTAL	0.	360.	0.	360.
<b>LIMESTONE SCRUBBING</b>				
HAWTHORN NO 3		140		140
HAWTHORN NO 4		100		100
LAWRENCE NO 4		125		125
LAWRENCE NO 5		400		400
CHOLLA NO 1		115		115
LA CYGNE NO 1		820		820
SHERBURN: NO 1				680
STOCK ISLAND PLANT				37
VALMONT NO. 5		50	50	
WILL COUNTY NO 1	167		167	
TOTAL	167.	1750.	217.	2417.
<b>SODIUM CARBONATE SCRUBBING</b>				

TABLE 9  
SUMMARY OF SLUDGE DISPOSAL PRACTICES FOR OPERATIONAL FGD SYSTEMS AS OF 05/76

PROCESS/GENERATING UNIT	--SLUDGE-- STABILIZED	--SLUDGE-- UNSTABILIZED	---POND--- LINED	---POND--- UNLINED
REID GARDNER NO 1		125		125
REID GARDNER NO 2		125		125
TOTAL	0.	250.	0.	250.
THOROUGHbred 101				
SCHOLZ NOS. 1B & 2B		23	23	
TOTAL	0.	23.	23.	0.

**Table 10**  
**SUMMARY OF FGD SYSTEMS BY PROCESS AND REGULATORY CLASS**

TABLE 10  
SUMMARY OF FGD SYSTEMS BY PROCESS AND REGULATORY CLASS  
MW CAPACITY(NO. OF PLANTS)

PROCESS	REGULATORY CLASS	OPERATIONAL		CONSTRUCTION		CONTRACT AWARDED		LETTER OF INTENT		REQUESTING/EVAL. BIDS		CONSIDERING FGD SYSTEM		TOTAL NO. OF PLANTS	
		NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW
LIME SCRUBBING	A	0	0	2	840	4	2075	0	0	0	0	0	0	6	2915
	B	4	1915	2	1235	1	400	0	0	0	0	0	0	7	3550
	C	2	129	2	361	0	0	0	0	0	0	2	660	6	1150
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	1	20	0	0	0	0	0	0	0	0	0	0	1	20
LIME/ALKALINE FLYASH SCRUBBING (PROCESS NOT SELECTED)	A	0	0	1	360	0	0	0	0	0	0	0	0	1	360
	B	0	0	1	450	0	0	0	0	0	0	0	0	1	450
	C	1	360	0	0	0	0	0	0	0	0	0	0	1	360
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIME/LIMESTONE (PROCESS NOT SELECTED)	A	0	0	0	0	0	0	0	0	2	1090	0	0	2	1090
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIME/LIMESTONE SCRUBBING (PROCESS NOT SELECTED)	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	2	20	0	0	0	0	0	0	0	0	0	0	2	20
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	2	1410	2	1410
LIMESTONE SCRUBBING	A	0	0	5	2416	6	1134	2	793	0	0	1	400	14	4743
	B	4	1035	2	930	3	2195	2	405	0	0	0	0	11	4565
	C	3	1024	1	550	1	425	0	0	0	0	0	0	5	1999
	D	2	525	0	0	0	0	0	0	0	0	0	0	2	525
	E	1	50	1	180	1	400	0	0	0	0	0	0	3	630
SUBTOTAL - LIME/LIMESTONE	A	0.	0.	8.	3616.	10.	3209.	2.	793.	2.	1090.	1.	400.	23.	9108.
	B	8.	2950.	5.	2615.	4.	2595.	2.	405.	0.	0.	0.	0.	19.	8565.
	C	8.	1533.	3.	911.	1.	425.	0.	0.	0.	0.	2.	660.	14.	3529.
	D	2.	525.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	525.
	E	2.	70.	1.	180.	1.	400.	0.	0.	0.	0.	2.	1410.	6.	2060.

- A. BOILER CONSTRUCTED SUBJECT TO FEDERAL NSPS  
B. BOILER SUBJECT TO STATE STANDARD THAT IS MORE STRINGENT THAN THE FEDERAL NSPS  
C. BOILER SUBJECT TO STATE STANDARD THAT IS EQUAL TO OR LESS STRINGENT THAN NSPS  
D. OTHER  
E. REGULATORY CLASS UNKNOWN

PEDCo-ENVIRONMENTAL

**TABLE 10  
SUMMARY OF FGD SYSTEMS BY PROCESS AND REGULATORY CLASS**

**MW CAPACITY(NO. OF PLANTS)**

PROCESS	REGULATORY CLASS	OPERATIONAL		CONSTRUCTION		CONTRACT AWARDED		LETTER OF INTENT		PLANNED REQUESTING/EVAL. BIDS		CONSIDERING FGD SYSTEM		TOTAL NO. OF PLANTS	
		NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW
ACTIVATED CARBON	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	1	20	0	0	0	0	0	0	0	0	0	0	1	20
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DOUBLE ALKALI	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	1	32	0	0	0	0	0	0	0	0	0	0	1	32
	C	1	20	0	0	0	0	0	0	0	0	0	0	1	20
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAGNESIUM OXIDE SCRUBBING	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	1	120	0	0	0	0	1	240	0	0	0	0	2	360
	C	0	0	0	0	0	0	0	0	0	0	2	486	2	486
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOT SELECTED	A	0	0	0	0	0	0	0	0	1	600	5	3300	6	3900
	B	0	0	0	0	0	0	0	0	0	0	15	7150	15	7150
	C	0	0	0	0	0	0	0	0	1	277	3	947	4	1224
	D	0	0	0	0	0	0	0	0	1	500	0	0	1	500
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REGENERABLE NOT SELECTED	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	1	650	1	650
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0

- A. BOILER CONSTRUCTED SUBJECT TO FEDERAL NSPS  
 B. BOILER SUBJECT TO STATE STANDARD THAT IS MORE STRINGENT THAN THE FEDERAL NSPS  
 C. BOILER SUBJECT TO STATE STANDARD THAT IS EQUAL TO OR LESS STRINGENT THAN NSPS  
 D. OTHER  
 E. REGULATORY CLASS UNKNOWN



**TABLE 10**  
**SUMMARY OF FGD SYSTEMS BY PROCESS AND REGULATORY CLASS**  
**MW CAPACITY(NO. OF PLANTS)**

PROCESS	REGULATORY CLASS	OPERATIONAL		CONSTRUCTION		CONTRACT AWARDED		LETTER OF INTENT		PLANNED REQUESTING/EVAL. BIDS		CONSIDERING FGD SYSTEM		TOTAL NO. OF PLANTS	
		NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW	NO.	MW
SODIUM CARBONATE SCRUBBING	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	2	250	1	125	0	0	1	125	0	0	0	0	4	500
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THOROUGHbred 101	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	1	23	0	0	0	0	0	0	0	0	0	0	1	23
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WELLMAN LORD	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	2	1000	0	0	0	0	2	1000
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WELLMAN LORD/ALLIED CHEMICAL	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	2	715	0	0	0	0	0	0	2	715
	C	0	0	1	115	0	0	0	0	0	0	0	0	1	115
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	A	0.	0.	8.	3616.	10.	3209.	2.	793.	3.	1690.	6.	3700.	29.	13008.
	B	12.	3352.	6.	2740.	6.	3310.	6.	1770.	0.	0.	15.	7150.	45.	18322.
	C	11.	1596.	4.	1026.	1.	425.	0.	0.	1.	277.	8.	2743.	25.	6067.
	D	2.	525.	0.	0.	0.	0.	0.	0.	1.	500.	0.	0.	3.	1025.
	E	2.	70.	1.	180.	1.	400.	0.	0.	0.	0.	2.	1410.	6.	2060.
LIME/STONE % OF TOTAL MW	A	0		100		100		100		64		11		70	
	B	88		95		78		23		0		0		47	
	C	96		89		100		0		0		24		58	
	D	100		0		0		0		0		0		51	
	E	100		100		100		0		0		100		100	

- A. BOILER CONSTRUCTED SUBJECT TO FEDERAL NSPS  
B. BOILER SUBJECT TO STATE STANDARD THAT IS MORE STRINGENT THAN THE FEDERAL NSPS  
C. BOILER SUBJECT TO STATE STANDARD THAT IS EQUAL TO OR LESS STRINGENT THAN NSPS  
D. OTHER  
E. REGULATORY CLASS UNKNOWN

**Table 11**  
**SUMMARY OF OPERATIONAL FGD SYSTEMS**

**TABLE 11**  
**SUMMARY OF OPERATIONAL FGD SYSTEMS AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	PROCESS/VENDOR	FUEL CHARACTERISTICS	MO/YR
ARIZONA PUBLIC SERVICE CHOLLA NO 1	R	115	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 0.44-1 PERCENT SULFUR	10/73
ARIZONA PUBLIC SERVICE FOUR CORNERS NO. 5A	R	160	SCE LIME SCRUBBING	COAL, 0.7 PERCENT SULFUR	2/76
COMMONWEALTH EDISON WILL COUNTY NO 1	R	167	BABCOCK & WILCOX LIMESTONE SCRUBBING	COAL - 9463 BTU, 2.1% SULFUR	2/72
DUQUESNE LIGHT PHILLIPS	R	410	CHEMICO LIME SCRUBBING	COAL 1.0- 2.8 PERCENT SULFUR	7/73
DUQUESNE LIGHT ELRAMA	R	510	CHEMICO LIME SCRUBBING	COAL 1.0 - 2.8 PERCENT SULFUR	10/75
GENERAL MOTORS CHEVROLET PARMA 1 2 3 & 4	R	32	KOCH DOUBLE ALKALI	COAL 2.5 PERCENT SULFUR	3/74
GULF POWER CO. SCHOLZ NO. 1A	R	20	ADL/COMBUSTION EQUIP ASSOCIATE DOUBLE ALKALI	COAL 3.0 PERCENT SULFUR	2/75
GULF POWER CO. SCHOLZ NO. 2A	R	20	FOSTER WHEELER ACTIVATED CARBON	COAL 3.0 PERCENT SULFUR	2/76
GULF POWER CO. SCHOLZ NOS. 1B & 2B	R	23	CHIYODA INTERNATIONAL THOROUGHbred 101	COAL 5.0 PERCENT SULFUR (MAX)	3/75
KANSAS CITY POWER & LIGHT LA CYGNE NO 1	N	820	BABCOCK & WILCOX LIMESTONE SCRUBBING	COAL 5.0 PERCENT SULFUR	2/73
KANSAS CITY POWER & LIGHT HAWTHORN NO 4	R	100	COMBUSTION ENGINEERING LIMESTONE INJECTION &WET SCRUB	COAL 0.6- 3.0 PERCENT SULFUR	8/72
KANSAS CITY POWER & LIGHT HAWTHORN NO 3	R	140	COMBUSTION ENGINEERING LIMESTONE INJECTION &WET SCRUB	COAL 0.6- 3.0 PERCENT SULFUR	11/72
KANSAS POWER & LIGHT LAWRENCE NO 4	R	125	COMBUSTION ENGINEERING LIMESTONE INJECTION &WET SCRUB	COAL 0.5 PERCENT SULFUR	12/68
KANSAS POWER & LIGHT LAWRENCE NO 5	N	400	COMBUSTION ENGINEERING LIMESTONE INJECTION &WET SCRUB	COAL 0.5 PERCENT SULFUR	11/71
KENTUCKY UTILITIES GREEN RIVER UNITS 1 AND 2	R	64	AMERICAN AIR FILTER LIME SCRUBBING	COAL 3.8 PERCENT SULFUR	9/75

**TABLE 11**  
**SUMMARY OF OPERATIONAL FGD SYSTEMS AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	PROCESS/VENDOR	FUEL CHARACTERISTICS	MO/YR
KEY WEST UTILITY BOARD STOCK ISLAND PLANT	N	37	ZURN AIR SYSTEMS LIMESTONE SCRUBBING	OIL 2.4 PERCENT SULFUR	10/72
LOUISVILLE GAS & ELECTRIC PADDYS RUN NO 6	R	65	COMBUSTION ENGINEERING LIME SCRUBBING	COAL 3.5-4.0 PERCENT SULFUR	4/73
MONTANA POWER CO. COLSTRIP NO 1	N	360	COMBUSTION EQUIP. ASSOCIATES LIME/ALKALINE FLYASH SCRUBBING	COAL 0.8 PERCENT SULFUR	10/75
NEVADA POWER REID GARDNER NO 2	R	125	COMBUSTION EQUIP. ASSOCIATES SODIUM CARBONATE SCRUBBING	COAL 0.5- 1.0 PERCENT SULFUR	4/74
NEVADA POWER REID GARDNER NO 1	R	125	COMBUSTION EQUIP. ASSOCIATES SODIUM CARBONATE SCRUBBING	COAL 0.5- 1.0 PERCENT SULFUR	4/74
NORTHERN STATES POWER CO. SHERBURNE NO 1	N	680	COMBUSTION ENGINEERING LIMESTONE SCRUBBING	COAL 0.8 PERCENT SULFUR	3/76
PENNSYLVANIA POWER CO. BRUCE MANSFIELD NO. 1	N	835	CHEMICO LIME SCRUBBING	COAL 4.3 PERCENT SULFUR	4/76
PHILADELPHIA ELECTRIC CO. EDDYSTONE NO 1A	R	120	UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING	COAL 2.5 PERCENT SULFUR	9/75
PUBLIC SERVICE CO OF COLORADO VALMONT NO. 5	R	50	UOP / PUB SERVICE OF COLORADO LIMESTONE SCRUBBING	COAL 0.72 PERCENT SULFUR	10/74
RICKENBACKER AFB RICKENBACKER	R	20	RESEARCH COTTRELL LIME SCRUBBING	COAL 3.6 PERCENT SULFUR	3/76
TENNESSEE VALLEY AUTHORITY SHAWNEE NO.10A	R	10	UNIVERSAL OIL PRODUCTS LIME/LIMESTONE SCRUBBING	COAL 2.9 PERCENT SULFUR	4/72
TENNESSEE VALLEY AUTHORITY SHAWNEE NO.10B	R	10	CHEMICO LIME/LIMESTONE SCRUBBING	COAL 2.9 PERCENT SULFUR	4/72

Table 12  
SUMMARY OF FGD SYSTEMS UNDER CONSTRUCTION

**TABLE 12  
SUMMARY OF FGD SYSTEMS UNDER CONSTRUCTION AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	PROCESS/VENDOR	FUEL CHARACTERISTICS	MO/YR
ARIZONA PUBLIC SERVICE CHOLLA NO 2	N	250	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 0.44-1 PERCENT SULFUR	6/77
CENTRAL ILLINOIS LIGHT CO. DUCK CREEK NO.1	N	100	RILEY STOKER/ENVIRONEERING LIMESTONE SCRUBBING	COAL 2.5-3.0 PERCENT SULFUR	6/76
COLUMBUS & SOUTHERN OHIO ELEC. CONESVILLE NO 5	N	400	UNIVERSAL OIL PRODUCTS LIME SCRUBBING	COAL 4.5 - 4.9 PERCENT SULFUR	6/76
DETROIT EDISON ST.CLAIR NO 6	R	180	PEABODY ENGINEERING LIMESTONE SCRUBBING	COAL 3.7 PERCENT SULFUR	5/76
INDIANAPOLIS POWER & LIGHT CO. PETERSBURG NO 3	N	530	UNIVERSAL OIL PRODUCTS LIMESTONE SCRUBBING	COAL 3.0-3.5 PERCENT SULFUR	9/77
LOUISVILLE GAS & ELECTRIC MILL CREEK NO 3	N	425	AMERICAN AIR FILTER LIME SCRUBBING	COAL 3.5- 4.0 PERCENT SULFUR	7/77
LOUISVILLE GAS & ELECTRIC CANE RUN NO 5	R	183	COMBUSTION ENGINEERING LIME SCRUBBING	COAL 3.5-4.05 PERCENT SULFUR	12/77
LOUISVILLE GAS & ELECTRIC CANE RUN NO 4	R	178	AMERICAN AIR FILTER LIME SCRUBBING	COAL 3.5-4.05 PERCENT SULFUR	6/76
MINNKOTA POWER COOPERATIVE MILTON R. YOUNG NO. 2	N	450	COMBUSTION EQUIP. ASSOCIATES LIME/ALKALINE FLYASH SCRUBBING	LIGNITE - 6.500 BTU. 0.7% S	8/77
MONTANA POWER CO. COLSTRIP NO 2		360	COMBUSTION EQUIP. ASSOCIATES LIME/ALKALINE FLYASH SCRUBBING	COAL 0.8 PERCENT SULFUR	7/76
NEVADA POWER REID GARDNER NO 3	N	125	COMBUSTION EQUIP. ASSOCIATES SODIUM CARBONATE SCRUBBING	COAL 0.5- 1.0 PERCENT SULFUR	6/76
NORTHERN INDIANA PUB SERVICE MITCHELL NO 11	R	115	DAVY POWERGAS/ALLIED CHEMICAL WELLMAN LORD/ALLIED CHEMICAL	COAL 3.2- 3.5 PERCENT SULFUR	5/76
NORTHERN STATES POWER CO. SHERBURNE NO 2	N	680	COMBUSTION ENGINEERING LIMESTONE SCRUBBING	COAL 0.8 PERCENT SULFUR	5/77
PENNSYLVANIA POWER CO. BRUCE MANSFIELD NO. 2	N	835	CHEMICO LIME SCRUBBING	COAL 4.3 PERCENT SULFUR	4/77
SPRINGFIELD CITY UTILITIES SOUTHWEST NO. 1	N	200	UNIVERSAL OIL PRODUCTS LIMESTONE SCRUBBING	COAL 3.5 PERCENT SULFUR	8/76

**TABLE 12**  
**SUMMARY OF FGD SYSTEMS UNDER CONSTRUCTION AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	PROCESS/VENDOR	FUEL CHARACTERISTICS	MO/YR
TENNESSEE VALLEY AUTHORITY WIDOWS CREEK NO 8	R	550	TENNESSEE VALLEY AUTHORITY LIMESTONE SCRUBBING	COAL 3.7 PERCENT SULFUR	2/77
TEXAS UTILITIES CO. MARTIN LAKE NO. 1	N	793	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 1.0 PERCENT SULFUR	1/77
TEXAS UTILITIES CO. MARTIN LAKE NO. 2	N	793	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 1.0 PERCENT SULFUR	10/77
UTAH POWER & LIGHT CO. HUNTINGTON NO.1		415	CHEMICO LIME SCRUBBING	COAL 0.5 PERCENT SULFUR	6/77

**Table 13**  
**SUMMARY OF PLANNED FGD SYSTEMS**



**TABLE 13  
SUMMARY OF PLANNED FGD SYSTEMS AS OF 05/76**

<b>UTILITY COMPANY POWER STATION</b>	<b>NEW OR RETROFIT</b>	<b>SIZE OF FGD UNIT (MW)</b>	<b>VENDOR/PROCESS</b>	<b>FUEL CHARACTERISTICS</b>	<b>MO/YR</b>
<b>CONTRACTS AWARDED</b>					
BRAZOS ELECTRIC POWER COOP G & T COOPERATIVE PROJECT NO.1	N	400	BABCOCK & WILCOX LIMESTONE SCRUBBING	COAL 1.67 PERCENT SULFUR	12/79
COLUMBUS & SOUTHERN OHIO ELEC. CONESVILLE NO 6	N	400	UNIVERSAL OIL PRODUCTS LIME SCRUBBING	COAL 4.5 - 4.9 PERCENT SULFUR	1/78
COMMONWEALTH EDISON POWERTON NO. 51	R	425	UNIVERSAL OIL PRODUCTS LIMESTONE SCRUBBING	COAL 3.6 PERCENT SULFUR	12/79
ALLEGHENY POWER SYSTEM PLEASANTS NO. 1	N	625	BABCOCK AND WILCOX LIME SCRUBBING	COAL 2.0- 5.0 PERCENT SULFUR	3/79
ALLEGHENY POWER SYSTEM PLEASANTS NO. 2	N	625	BABCOCK AND WILCOX LIME SCRUBBING	COAL 2.0- 5.0 PERCENT SULFUR	3/80
KANSAS POWER & LIGHT JEFFERY NO. 2	N	680	COMBUSTION ENGINEERING LIMESTONE SCRUBBING	COAL 0.32 PERCENT SULFUR	6/79
ALABAMA ELECTRIC COOP TOMBIGLEE NO. 2	N	225	PEABODY ENGINEERING LIMESTONE SCRUBBING	COAL 0.8- 1.5 PERCENT SULFUR	3/78
LOUISVILLE GAS & ELECTRIC MILL CREEK NO 4	N	425	AMERICAN AIR FILTER LIME SCRUBBING	COAL 3.5- 4.0 PERCENT SULFUR	7/79
PENNSYLVANIA POWER CO. BRUCE MANSFIELD NO. 3	N	835	PULLMAN KELLOGG LIMESTONE SCRUBBING	COAL 4.3 PERCENT SULFUR	4/79
KANSAS POWER & LIGHT JEFFERY NO. 1	N	680	COMBUSTION ENGINEERING LIMESTONE SCRUBBING	COAL 0.32 PERCENT SULFUR	6/78
ALABAMA ELECTRIC COOP TOMBIGREE NO. 3	N	225	PEABODY ENGINEERING LIMESTONE SCRUBBING	COAL 0.8- 1.5 PERCENT SULFUR	3/79
S. CAROLINA PUB SERV AUTHORITY WINYAH NO. 2	N	140	BABCOCK & WILCOX LIMESTONE SCRUBBING	COAL 1.0 PERCENT SULFUR	5/77
S. MISSISSIPPI ELEC PWR ASSOC H.D. MORROW NO.2	N	180	RILEY STOKER/ENVIRONEERING LIMESTONE SCRUBBING	COAL 1 PERCENT SULFUR	6/78
PUBLIC SERVICE CO OF NEW MEX. SAN JUAN NO. 1	N	375	DAVY POWERGAS/ALLIED CHEMICAL WELLMAN LORD/ALLIED CHEMICAL	COAL 0.8 PERCENT SULFUR	7/77
UTAH POWER & LIGHT CO. EMERY NO.1	N	400	CHEMICO LIME SCRUBBING	COAL 0.5 PERCENT SULFUR	6/78

**TABLE 13  
SUMMARY OF PLANNED FGD SYSTEMS AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	VENDOR/PROCESS	FUEL CHARACTERISTICS	MO/YR
PUBLIC SERVICE CO OF NEW MEX. SAN JUAN NO. 2	R	340	DAVY POWERGAS/ALLIED CHEMICAL WELLMAN LORD/ALLIED CHEMICAL	COAL 0.8 PERCENT SULFUR	7/77
SOUTHERN ILLINOIS POWER COOP SOUTHERN ILLINOIS POWER PT. 4	N	184	BABCOCK & WILCOX LIMESTONE SCRUBBING	COAL	1/78
S. MISSISSIPPI ELEC PWR ASSOC R.D. MORROW NO.1	N	180	RILEY STOKER/ENVIRONEERING LIMESTONE SCRUBBING	COAL 1 PERCENT SULFUR	11/77
LETTER OF INTENT SIGNED					
NEVADA POWER REID GARDNER NO 4	N	125	COMBUSTION EQUIP. ASSOCIATES SODIUM CARBONATE SCRUBBING	COAL 0.5- 1.0 PERCENT SULFUR	0/ 0
ARIZONA ELECTRIC POWER COOP APACHE NO 3	N	205	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 0.5- 0.8 PERCENT SULFUR	6/79
PHILADELPHIA ELECTRIC CO. EDDYSTONE NO 1B	R	240	UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING	COAL 2.5 PERCENT SULFUR	10/78
ARIZONA ELECTRIC POWER COOP APACHE NO 2	N	200	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 0.5- 0.8 PERCENT SULFUR	6/78
TEXAS UTILITIES CO. MARTIN LAKE NO. 3	N	793	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 1.0 PERCENT SULFUR	12/78
TEXAS UTILITIES CO. MARTIN LAKE NO. 4	N	0	RESEARCH COTTRELL LIMESTONE SCRUBBING	COAL 1.0 PERCENT SULFUR	12/79
PUBLIC SERVICE CO OF NEW MEX. SAN JUAN NO. 3	N	500	DAVY POWERGAS WELLMAN LORD	COAL 0.8 PERCENT SULFUR	5/79
PUBLIC SERVICE CO OF NEW MEX. SAN JUAN NO. 4	N	500	DAVY POWERGAS WELLMAN LORD	COAL 0.8 PERCENT SULFUR	5/81
REQUESTING/EVALUATING BIDS					
CINCINNATI GAS & ELECTRIC CO. MIAMI FORT NO 8	N	500	NOT SELECTED NOT SELECTED	COAL 1.3 PERCENT SULFUR	1/78
LOUISVILLE GAS & ELECTRIC CANE RUN NO 6	R	277	NOT SELECTED NOT SELECTED	COAL 3.5- 4.0 PERCENT SULFUR	9/78
CENTRAL ILLINOIS PUBLIC SERV NEWTON NO.1	N	600	NOT SELECTED NOT SELECTED	COAL 2.8-3.2 PERCENT SULFUR	12/77
UNITED POWER ASSOCIATION COAL CREEK NO. 2	N	545	NOT SELECTED LIME/LIMESTONE	LIGNITE - 0.63 PERCENT SULFUR	11/79

**TABLE 13  
SUMMARY OF PLANNED FGD SYSTEMS AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	VENDOR/PROCESS	FUEL CHARACTERISTICS	MO/YR
UNITED POWER ASSOCIATION COAL CREEK NO. 1	N	545	NOT SELECTED LIME/LIMESTONE	LIGNITE - 0.63 PERCENT SULFUR	11/78
CONSIDERING FGD SYSTEM					
CENTRAL ILLINOIS LIGHT CO. E.D.EDWARDS NO.3	R	357	NOT SELECTED NOT SELECTED	COAL 2.5 PERCENT SULFUR	7/79
NEVADA POWER HARRY ALLEN STATION NO. 1	N	500	NOT SELECTED NOT SELECTED	COAL	6/83
NEVADA POWER HARRY ALLEN STATION NO. 2	N	500	NOT SELECTED NOT SELECTED	COAL	6/84
MONTANA POWER CO. COLSTRIP NO.3	N	700	NOT SELECTED NOT SELECTED	COAL 0.7 PERCENT SULFUR	7/80
BASIN ELECTRIC POWER COOP BEULAH NO. 1	N	450	NOT SELECTED NOT SELECTED	COAL 1.0 PERCENT SULFUR	0/81
MONTANA POWER CO. COLSTRIP NO.4	N	700	NOT SELECTED NOT SELECTED	COAL 0.7 PERCENT SULFUR	7/81
CENTRAL ILLINOIS LIGHT CO. DUCK CREEK NO.2	N	400	NOT SELECTED LIMESTONE SCRUBBING	COAL 2.5-3.0 PERCENT SULFUR	1/82
CINCINNATI GAS & ELECTRIC CO. EAST BEND NO 2	N	600	NOT SELECTED NOT SELECTED	COAL	1/80
LOUISVILLE GAS & ELECTRIC MILL CREEK NO 1	R	330	NOT SELECTED LIME SCRUBBING	COAL 3.5- 4.0 PERCENT SULFUR	1/82
LOUISVILLE GAS & ELECTRIC MILL CREEK NO 2	R	330	NOT SELECTED LIME SCRUBBING	COAL 3.5- 4.0 PERCENT SULFUR	1/81
COLUMBUS & SOUTHERN OHIO ELEC. POSTON NO. 5	N	375	NOT SELECTED NOT SELECTED	COAL 2.5 PERCENT SULFUR	0/81
COLUMBUS & SOUTHERN OHIO ELEC. POSTON NO. 6	N	375	NOT SELECTED NOT SELECTED	COAL 2.5 PERCENT SULFUR	0/83
NEVADA POWER HARRY ALLEN STATION NO. 4	N	500	NOT SELECTED NOT SELECTED	COAL	6/86
NEVADA POWER HARRY ALLEN STATION NO. 3	N	500	NOT SELECTED NOT SELECTED	COAL	6/85

**TABLE 13  
SUMMARY OF PLANNED FGD SYSTEMS AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	VENDOR/PROCESS	FUEL CHARACTERISTICS	MO/YR
PHILADELPHIA ELECTRIC CO. EDDYSTONE NO 2	R	336	UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING	COAL 2.4 PERCENT SULFUR	10/78
PHILADELPHIA ELECTRIC CO. CROMBY	R	150	UNITED ENGINEERS MAGNESIUM OXIDE SCRUBBING	COAL 2-4 PERCENT SULFUR	10/78
ARIZONA PUBLIC SERVICE FOUR CORNERS NO. 5B	R	595	NOT SELECTED NOT SELECTED	COAL, 0.7 - 0.75% SULFUR (AVG)	0/ 0
ARIZONA PUBLIC SERVICE FOUR CORNERS NO. 4	R	755	NOT SELECTED NOT SELECTED	COAL, 0.7 - 0.75% SULFUR (AVG)	0/ 0
BASIN ELECTRIC POWER COOP MISSOURI BASIN NO 2	N	550	NOT SELECTED NOT SELECTED	COAL	6/80
NORTHERN INDIANA PUB SERVICE BAILLY NO. 7	R	190	NOT SELECTED NOT SELECTED	COAL 3 PERCENT SULFUR	0/ 0
NORTHERN INDIANA PUB SERVICE BAILLY NO. 8	R	400	NOT SELECTED NOT SELECTED	COAL 3 PERCENT SULFUR	0/ 0
NEW ENGLAND ELEC SYSTEM BRAYTON POINT NO.3	R	650	NOT SELECTED REGENERABLE NOT SELECTED	COAL 3.0 PERCENT SULFUR	0/ 0
BASIN ELECTRIC POWER COOP MISSOURI BASIN NO 3	N	550	NOT SELECTED NOT SELECTED	COAL	6/83
BASIN ELECTRIC POWER COOP BEULAH NO. 2	N	450	NOT SELECTED NOT SELECTED	COAL 1.0 PERCENT SULFUR	0/81
NEVADA POWER WARNER VALLEY STATION NO. 2	N	250	NOT SELECTED NOT SELECTED	COAL	6/83
BASIN ELECTRIC POWER COOP MISSOURI BASIN NO 1	N	550	NOT SELECTED NOT SELECTED	COAL	1/80
NEVADA POWER WARNER VALLEY STATION NO. 1	N	250	NOT SELECTED NOT SELECTED	COAL	6/82
SOUTHERN CALIFORNIA EDISON MOHAVE NO 1B	R	620	NOT SELECTED LIME/LIMESTONE SCRUBBING	COAL 0.5- 0.8 PERCENT SULFUR	6/77
SOUTHERN CALIFORNIA EDISON MOHAVE NO. 2	R	790	NOT SELECTED LIME/LIMESTONE SCRUBBING	COAL 0.5 TO 0.8 % SULFUR	6/77

**TABLE 13**  
**SUMMARY OF PLANNED FGD SYSTEMS AS OF 05/76**

UTILITY COMPANY POWER STATION	NEW OR RETROFIT	SIZE OF FGD UNIT (MW)	VENDOR/PROCESS	FUEL CHARACTERISTICS	MO/YR
PUBLIC SERVICE INDIANA GIBSON NO. 3	N	650	NOT SELECTED NOT SELECTED	COAL 3.3 PERCENT SULFUR	0/78
PUBLIC SERVICE INDIANA GIBSON NO. 4	N	650	NOT SELECTED NOT SELECTED	COAL 3.3 PERCENT SULFUR	0/79

**Table 14**  
**SUMMARY LIST OF FGD SYSTEMS IN THE EARLY PLANNING STAGES**

**TABLE 14**  
**SUMMARY LIST OF FGD SYSTEMS IN THE EARLY PLANNING STAGES**

**FGD STATUS REPORT 05/76**

<b>I.D. NUMBER AND COMPANY NAME</b>	<b>UNIT NAME</b>	<b>LOCATION</b>	<b>START UP DATE</b>	<b>STATUS</b>	<b>REG CLASS</b>
1 DAYTON POWER AND LIGHT CO.	KILLEN NO 1	WRIGHTSVILLE OHIO	1-83	7	D
2 DAYTON POWER AND LIGHT CO.	KILLEN NO 2	WRIGHTSVILLE OHIO	1-81	7	D
3 GENERAL PUBLIC UTILITIES	COHO NO.1	ERIE PENNSYLVANIA	5-87	7	A
4 GENERAL PUBLIC UTILITIES	SEWARD NO.7	SEWARD PENNSYLVANIA	5-84	7	A
5 GULF POWER CO.	CRIST NO. 4 AND NO. 5	PENSACOLA FLORIDA	0-78	7	B
6 GULF POWER CO.	CRIST NO. 6 AND NO. 7	PENSACOLA FLORIDA	0-80	7	B
7 GULF POWER CO.	LANSING SMITH NO. 1 AND NO. 2	PANAMA CITY FLORIDA	0-80	7	B
8 KENTUCKY UTILITIES	GHENT	GHENT KENTUCKY	1-77	7	E
9 POTOMAC ELECTRIC & POWER	CHALK POINT NO. 4	PRINCE GEORGE COUNTY MARYLAND	6-76	7	D
10 POTOMAC ELECTRIC & POWER	DICKERSON NO 4	DICKERSON MARYLAND	5-82	7	D
11 POTOMAC ELECTRIC & POWER	MORGANTOWN NO.1	NEWBURG MARYLAND	6-79	7	C
12 POTOMAC ELECTRIC & POWER	MORGANTOWN NO.2	NEWBURG MARYLAND	6-79	7	C
13 POWER AUTHORITY OF NEW YORK	ARTHUR KILL	STATEN ISLAND NEW YORK	9-82	7	B
14 SALT RIVER PROJECT	NAVAJO NO 1	PAGE ARIZONA	0- 0	7	D
15 SALT RIVER PROJECT	NAVAJO NO 2	PAGE ARIZONA	0- 0	7	D
16 SALT RIVER PROJECT	NAVAJO NO 3	PAGE ARIZONA	0- 0	7	D
17 SPRINGFIELD WATER LIGHT POWER	DALLMAN NO 3	SPRINGFIELD ILLINOIS	6-79	7	A
18 TEXAS POWER AND LIGHT CO.	TWIN OAKS NO. 1	ROBERTSON COUNTY TEXAS	8-80	7	A
19 TEXAS POWER AND LIGHT CO.	TWIN OAKS NO. 2	ROBERTSON COUNTY TEXAS	9-81	7	A
20 VIRGINIA ELECTRIC AND POWER CO	MT. STORM	MT. STORM WEST VIRGINIA	0- 0	7	C

**7. CONSIDERING FGD SYSTEM AS WELL AS ALTERNATIVE METHODS**

- A. BOILER CONSTRUCTED SUBJECT TO FEDERAL NSPS
- B. BOILER SUBJECT TO STATE STANDARD THAT IS MORE STRINGENT THAN THE FEDERAL NSPS
- C. BOILER SUBJECT TO STATE STANDARD THAT IS EQUAL TO OR LESS STRINGENT THAN NSPS
- D. OTHER
- E. REGULATORY CLASS UNKNOWN

**Table 15**  
**STATUS OF FGD SYSTEMS IN THE EARLY PLANNING STAGES**



**TABLE 15**  
**STATUS OF FGD SYSTEMS IN THE EARLY PLANNING STAGES DURING 05/76**

**COMPANY**

**CURRENT MONTH**

<b>POWER STATION</b>	
I.D. NUMBER 1 DAYTON POWER AND LIGHT CO. KILLEN NO 1 600 MW - NEW COAL NOT SELECTED LIMESTONE SCRUBBING STARTUP 1/83	SITE PREPARATION IS UNDERWAY. COMPANY IS INVESTIGATING LONG TERM SUPPLY OF LOW SULFUR COAL FOR COMPLIANCE WITH REGULATIONS WITHOUT INSTALLING FGD SYSTEM. DECISION ON THIS MATTER IS DUE MID 1976. SPACE HAS BEEN RESERVED IN THE PLANT LAYOUT FOR FGD SYSTEM IF NEEDED. KILLEN NO.1 NOW SCHEDULED FOR STARTUP AFTER KILLEN NO.2.
I.D. NUMBER 2 DAYTON POWER AND LIGHT CO. KILLEN NO 2 600 MW - NEW COAL NOT SELECTED LIMESTONE SCRUBBING STARTUP 1/81	SITE PREPARATION IS UNDERWAY. COMPANY IS INVESTIGATING LONG TERM SUPPLY OF LOW SULFUR COAL FOR COMPLIANCE WITH REGULATIONS WITHOUT INSTALLING FGD SYSTEM. DECISION ON THIS MATTER IS DUE MID 1976. SPACE HAS BEEN RESERVED IN THE PLANT LAYOUT FOR FGD SYSTEM IF NEEDED.
I.D. NUMBER 3 GENERAL PUBLIC UTILITIES COMO NO.1 800 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 5/87	STARTUP DATE CHANGED TO 5/87 FOR BOTH BOILER AND FGD SYSTEM. LIME, LIMESTONE SCRUBBING, AND COAL DESULFURIZATION ARE THE PRIMARY PROCESSES BEING CONSIDERED. NO DECISION HAS BEEN MADE YET.
I.D. NUMBER 4 GENERAL PUBLIC UTILITIES SEWARD NO.7 800 MW - NEW COAL NOT SELECTED NOT SELECTED STARTUP 5/84	STARTUP DATE CHANGED TO 5/84 FOR BOTH BOILER AND FGD SYSTEM. LIME, LIMESTONE SCRUBBING, AND COAL DESULFURIZATION ARE THE PRIMARY PROCESSES BEING CONSIDERED. NO DECISION HAS BEEN MADE YET.
I.D. NUMBER 5 GULF POWER CO. CRIST NO. 4 AND NO. 5 150 MW - RETROFIT  NOT SELECTED NOT SELECTED STARTUP 0/78	EACH UNIT IS 75 MW. IF SCRUBBERS ARE SELECTED THEY WILL BE REQUIRED IN 1978.

TABLE 15

COMPANY STATUS OF FGD SYSTEMS IN THE EARLY PLANNING STAGES DURING 05/76

POWER STATION	CURRENT MONTH
I.D. NUMBER 6 GULF POWER CO. CRIST NO. 6 AND NO. 7 820 MW - RETROFIT  NOT SELECTED NOT SELECTED STARTUP 0/80	UNIT 6 IS 320 MW. UNIT 7 IS 500 MW.
I.D. NUMBER 7 GULF POWER CO. LANSING SMITH NO. 1 AND NO. 2 305 MW - RETROFIT COAL NOT SELECTED NOT SELECTED STARTUP 0/80	UNIT NO. 1 IS 125 MW. UNIT NO. 2 IS 180 MW. IF SCRUBBERS ARE SELECTED, THEY WILL BE REQUIRED IN 1979 AND 1980 ON THE RESPECTIVE UNITS.
I.D. NUMBER 8 KENTUCKY UTILITIES GHENT 510 MW - NEW COAL 3-R PERCENT SULFUR NOT SELECTED LIME SCRUBBING STARTUP 1/77	IN THE EARLY PLANNING STAGE, COMPANY ALSO HAS AN EXISTING 510 MW UNIT AND UNDECIDED ON WHICH UNIT TO INSTALL THE FGD SYSTEM.
I.D. NUMBER 9 POTOMAC ELECTRIC & POWER CHALK POINT NO. 4 630 MW - NEW OIL NOT SELECTED NOT SELECTED STARTUP 6/76	AWAITING PERFORMANCE RESULTS FROM MGO UNIT ON DICKERSON NO. 3 (MONTGOMERY COUNTY). UNIT WILL HAVE PEABODY-LURGI 2-STAGE VENTURI SCRUBBERS FOR PARTICULATE CONTROL. COMPANY MAY ELECT NOT TO INSTALL FGD SYSTEM IF USE OF LOW SULFUR OIL IS CONTINUED. BOILER START-UP SCHEDULED FOR LATE 1976.
I.D. NUMBER 10 POTOMAC ELECTRIC & POWER DICKERSON NO 4 800 MW - NEW COAL 2.0 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 5/82	THERE ARE NO FIRM PLANS FOR INSTALLATION OF FGD SYSTEM. STARTUP DATE OF BOILER IS PLANNED FOR 1982.

TABLE 15  
 COMPANY STATUS OF FGD SYSTEMS IN THE EARLY PLANNING STAGES DURING 05/76

POWER STATION	CURRENT MONTH.
I.D. NUMBER 11 POTOMAC ELECTRIC & POWER MORGANTOWN NO.1 588 MW - RETROFIT COAL NOT SELECTED NOT SELECTED STARTUP 6/79	THERE ARE NO FIRM PLANS FOR INSTALLATION OF FGD SYSTEM. COMPANY PLANS TO EVALUATE ALL COMMERCIALY AVAILABLE SO2 CONTROL METHODS INCLUDING COAL GASIFICATION AND USE OF LOW SULFUR COAL. COMPANY IS ALSO AWAITING RESULTS OF MGO SYSTEM OPERATION AT THE DICKERSON PLANT. DECISION EXPECTED WITHIN A YEAR.
I.D. NUMBER 12 POTOMAC ELECTRIC & POWER MORGANTOWN NO.2 558 MW - RETROFIT COAL NOT SELECTED NOT SELECTED STARTUP 6/79	THERE ARE NO FIRM PLANS FOR INSTALLATION OF FGD SYSTEM. COMPANY PLANS TO EVALUATE ALL COMMERCIALY AVAILABLE SO2 CONTROL METHODS INCLUDING COAL GASIFICATION AND USE OF LOW SULFUR COAL. COMPANY IS ALSO AWAITING RESULTS OF MGO SYSTEM OPERATION AT THE DICKERSON PLANT. DECISION EXPECTED WITHIN A YEAR.
I.D. NUMBER 13 POWER AUTHORITY OF NEW YORK ARTHUR KILL 700 MW - NEW COAL - 3% SULFUR - REFUSE NOT SELECTED NOT SELECTED STARTUP 9/82	THE UTILITY IS CONSIDERING BOTH REGENERABLE AND LIMESTONE SCRUBBING PROCESSES. FGD TECHNOLOGY IS BEING CONSIDERED FOR A FOSSIL FUEL BURNING UNIT WHICH WILL EMPLOY COAL AS THE PRIMARY FUEL. REFUSE AND OIL WILL BE PROVIDED FOR SUPPLEMENTAL FUEL SUPPLIES. THE PREFERRED INSTALLATION SITE IS THE ARTHUR KILL FACILITY LOCATED ON STATEN ISLAND. THE PROJECT DESIGN ENGINEERS ARE SARGENT AND LUNDY.
I.D. NUMBER 14 SALT RIVER PROJECT NAVAJO NO 1 750 MW - RETROFIT COAL 0.45 PERCENT SULFUR NOT SELECTED LIME/LIMESTONE SCRUBBING STARTUP 0/ 0	THE UTILITY IS PRESENTLY INVESTIGATING THE USE OF LOW SULFUR COAL AND DESULFURIZATION PROCESSES. A DEFINITIVE DECISION WILL BE MADE PENDING COMPLETION OF THE SRP/EPA STUDY. NO SPECIFIC STARTUP DATE HAS YET BEEN SPECIFIED.
I.D. NUMBER 15 SALT RIVER PROJECT NAVAJO NO 2 750 MW - RETROFIT COAL 0.45 PERCENT SULFUR NOT SELECTED LIME/LIMESTONE SCRUBBING STARTUP 0/ 0	THE UTILITY IS PRESENTLY INVESTIGATING THE USE OF LOW SULFUR COAL AND DESULFURIZATION PROCESSES. A DEFINITIVE DECISION WILL BE MADE PENDING COMPLETION OF THE SRP/EPA STUDY. NO SPECIFIC STARTUP DATE HAS YET BEEN SPECIFIED.

TABLE 15  
 COMPANY STATUS OF FGD SYSTEMS IN THE EARLY PLANNING STAGES DURING 05/76

POWER STATION	CURRENT MONTH
I.D. NUMBER 16 SALT RIVER PROJECT NAVAJO NO 3 750 MW - RETROFIT COAL 0.45 PERCENT SULFUR NOT SELECTED LIME/LIMESTONE SCRUBBING STARTUP 0/0	THE UTILITY IS PRESENTLY INVESTIGATING THE USE OF LOW SULFUR COAL AND DESULFURIZATION PROCESSES. A DEFINITIVE DECISION WILL BE MADE PENDING COMPLETION OF THE SRP/EPA STUDY. NO SPECIFIC STARTUP DATE HAS YET BEEN SPECIFIED.
I.D. NUMBER 17 SPRINGFIELD WATER LIGHT POWER DALLMAN NO 3 190 MW - NEW COAL 3.0- 4.3 PERCENT SULFUR NOT SELECTED NOT SELECTED STARTUP 6/79	FGD SYSTEM IS UNDER CONSIDERATION WITH BOTH REGENERABLE AND LIMESTONE SCRUBBING BEING CONSIDERED. BECAUSE OF SPACE LIMITATIONS A REGENERABLE SYSTEM IS THE LIKELY CHOICE. THE COMPANY IS ALSO CONSIDERING COMPLIANCE THROUGH BURNING OF LOW SULFUR WESTERN COAL.
I.D. NUMBER 18 TEXAS POWER AND LIGHT CO. TWIN OAKS NO. 1 750 MW - NEW LIGNITE NOT SELECTED NOT SELECTED STARTUP 8/80	THIS UNIT WILL BE JOINTLY OWNED BY TP&L AND ALCOA. A FIRM DECISION HAS NOT BEEN MADE WHETHER TO INSTALL FGD FACILITIES.
I.D. NUMBER 19 TEXAS POWER AND LIGHT CO. TWIN OAKS NO. 2 750 MW - NEW LIGNITE NOT SELECTED NOT SELECTED STARTUP 9/81	THIS UNIT WILL BE JOINTLY OWNED BY TP&L AND ALCOA. A FIRM DECISION HAS NOT BEEN MADE WHETHER TO INSTALL FGD FACILITIES.
I.D. NUMBER 20 VIRGINIA ELECTRIC AND POWER CO MT. STORM 1147 MW - RETROFIT COAL NOT SELECTED NOT SELECTED STARTUP 0/0	THE UTILITY IS PRESENTLY CONSIDERING BOTH DESULFURIZATION AND THE USE OF LOW SULFUR COAL. A DESULFURIZATION SYSTEM WOULD TREAT 69 PERCENT OF THE FLUE GAS FROM THREE BOILERS. CONSTRUCTION AND STARTUP DATES ARE CONSIDERED INDEFINITE AT THIS TIME.

**Table 16**

**FGD SYSTEM OPERATIONS THAT HAVE BEEN TERMINATED OR SHUT DOWN INDEFINITELY**

Table 16  
TERMINATED OPERATIONAL FGD SYSTEMS

IDENTIFICATION NO.	1
UTILITY NAME	BOSTON EDISON
UNIT NAME	MYSTIC NO 6
UNIT LOCATION	EVERETT MASSACHUSETTS
UNIT RATING	150 MW
FUEL CHARACTERISTICS	OIL 2.5 PERCENT SULFUR
FGD VENDOR	CHEMICO
PROCESS	MAGNESIUM OXIDE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/72
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	50 PERCENT
SO2	90 PERCENT
WATER MAKE UP	
SLUDGE DISPOSAL	
UNIT COST	\$32/KW CAPITAL + CALCINATION
OPERATIONAL EXPERIENCE	AVERAGE FGD SYSTEM AVAILABILITY FACTORS - APRIL 72 TO MAY 73, 17%. JUNE 73 TO DEC. 73, 48%. JAN. 74 TO JUNE 74, 60%. JUNE 74, 80%. THE FGD SYSTEM HAS BEEN SHUT DOWN INDEFINITELY SINCE JUNE 74.

PEDCo-ENVIRONMENTAL

BACKGROUND INFORMATION  
ON  
THE MYSTIC POWER STATION, UNIT NO. 6

THE MAGNESIUM OXIDE FGD SYSTEM AT BOSTON EDISON CONSISTS OF A CHEMICO SINGLE-STAGE VENTURI SCRUBBER. THE SCRUBBER UNIT IS CONSTRUCTED OF CARBON STEEL WITH A SPRAY-APPLIED POLYESTER LINING. THE SCRUBBER TREATS 440,000 ACFM OF 300°F FLUE GAS CONTAINING SO<sub>2</sub> AT A CONCENTRATION OF 1410 PPM. SO<sub>2</sub> REMOVAL EFFICIENCY IS REPORTED TO BE 90 PERCENT.

THE MgO PROCESS IS A REGENERABLE PROCESS. THE SCRUBBER CAPTURES SO<sub>2</sub> BY FORMATION OF MAGNESIUM SULFITE. THIS PRODUCT SLURRY IS THEN FILTERED AND DRIED. THE DRY MATERIAL IS CALCINED AT HIGH TEMPERATURES TO DRIVE OFF THE SO<sub>2</sub> AND REGENERATE MgO. THE SO<sub>2</sub> STREAM IS PROCESSED IN A SULFURIC ACID PLANT TO MAKE 98 PERCENT GRADE OF SULFURIC ACID.

PROBLEMS AND SOLUTIONS

FROM THE INITIAL START-UP IN APRIL 1972 UNTIL MAY 1973 THE SCRUBBER OPERATED INTERMITTENTLY BECAUSE OF MECHANICAL DIFFICULTIES. THE MAJOR PROBLEM, ENTAILING DESIGN AND OPERATION OF MgSO<sub>3</sub> CRYSTAL DRYER, APPARENTLY HAS BEEN RESOLVED BY REDESIGN AND FUEL CHANGE. PROBLEMS WITH THE STACK AND PUMP OCCURRED DURING USE OF REGENERATED MgO. OVERHEATING OF THE SLURRY DURING ACTIVATION OF THE STEAM FREEZE PROTECTION SYSTEM CAUSED FORMATION OF SCALE IN THE MgO SLURRY PIPING. IN 1974, SYSTEM OPERATION WAS LIMITED BY BOILER AVAILABILITY. SINCE FEBRUARY 1974 AVAILABILITY OF THE BOILER HAS BEEN INCREASED. THE SYSTEM HAS BEEN SHUT DOWN INDEFINITELY SINCE JUNE 1974, WHEN EPA FUNDS FOR THE CALCINING PORTION OF THIS OPERATION WERE EXHAUSTED.

AVAILABILITY FACTORS AND COMMENTS CONCERNING THE OPERATION OF THIS SYSTEM SINCE STARTUP ARE PRESENTED IN THE FOLLOWING TABLE.

# FGD SYSTEM AVAILABILITY

## MYSTIC UNIT NO. 6

<u>Month</u>	<u>Availability (%)</u>	<u>Comments</u>
Apr. 72 to May 73	17	The module operated intermittently because of mechanical difficulties. A major problem concerned design and operation of the magnesium sulfite crystals dryer.
Jun. 73	68	
Jul. 73	61	
Aug. 73		The boiler was down for the annual overhaul. System availability decreased during the last quarter of the year because of heavy erosion/corrosion in the liquor recirculation pumps and centrifuge.
Sep. 73	38	
Oct. 73	60	
Nov. 73	26	
Dec. 73	13	
Jan. 74	28	System availability was limited by boiler-related problems that caused frequent shutdowns in January and February.
Feb. 74	25	
Mar. 74	87	
Apr. 74	81	
May 74	57	57 percent availability was due to 2 weeks outage of the acid plant rather than to FGD system failure. Demonstration program was completed and FGD system was shut down. EPA funding of $MgSO_3$ calcination has expired. There are no definite plans for restarting of this unit.
Jun. 74	80	

Average Availability (January to June, 1974) = 59.7 Percent.



Table 16  
TERMINATED OPERATIONAL FGD SYSTEMS

IDENTIFICATION NO.	2
UTILITY NAME	DAIRYLAND POWER COOP
UNIT NAME	ALMA STATION
UNIT LOCATION	ALMA WISCONSIN
UNIT RATING	80 MW
FUEL CHARACTERISTICS	COAL 3.0- 3.5 PERCENT SULFUR
FGD VENDOR	FOSTER WHEELER
PROCESS	LIME INJECTION
NEW OR RETROFIT	RETROFIT
START UP DATE	6/71
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	
S02	25 PERCENT
WATER MAKE UP	
SLUDGE DISPOSAL	
UNIT COST	
OPERATIONAL EXPERIENCE	THIS EXPERIMENTAL WET LIME FURNACE INJECTION SYSTEM HAS BEEN OPERATIONAL SINCE 1971 FOR PERIODS UP TO 30 DAYS. IN AUGUST 1974 THE UNIT WAS TESTED FOR TWO DAYS USING WESTERN LOW SULFUR COAL. THE TEST SHOWED ABOUT 50% S02 REMOVAL EFFICIENCY, BUT PRECIPITATOR PERFORMANCE WAS ADVERSELY AFFECTED. THE FGD PROJECT HAS BEEN SHUT DOWN INDEFINITELY SINCE AUGUST 1974, AND THERE ARE NO PLANS FOR FUTURE OPERATION.

Table 16  
TERMINATED OPERATIONAL FGD SYSTEMS

IDENTIFICATION NO.	3
UTILITY NAME	ILLINOIS POWER
UNIT NAME	WOOD RIVER NO 4
UNIT LOCATION	EAST ALTON ILLINOIS
UNIT RATING	110 MW
FUEL CHARACTERISTICS	COAL 2.9- 3.2 PERCENT SULFUR
FGD VENDOR	MONSANTO ENVIRO CHEM SYSTEMS
PROCESS	CATALYTIC OXIDATION
NEW OR RETROFIT	RETROFIT
START UP DATE	10/72
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	
S02	85 PERCENT
WATER MAKE UP	
SLUDGE DISPOSAL	
UNIT COST	\$73/KW CAPITAL*4 MILLS/KWH OP
OPERATIONAL EXPERIENCE	THE FGD SYSTEM HAS HAD CONSIDERABLE AMOUNT OF PROBLEMS SINCE STARTUP IN 1972. TOTAL OPERATION WAS 444 HOURS IN 1972, 158 HOURS IN 1973, AND 55 HOURS IN 1974. HEAT EXCHANGER LEAKS HAVE BEEN ENCOUNTERED, AND AN EVALUATION IS NOW BEING MADE TO DETERMINE WHETHER TO REPLACE THE HEAT EXCHANGER OR TO REPAIR IT. THE SYSTEM IS SHUT DOWN INDEFINITELY AT PRESENT.

## BACKGROUND INFORMATION

ON

WOOD RIVER NO. 4

THE WOOD RIVER NO. 4 BOILER IS LOCATED NEAR EAST ALTON, ILLINOIS, NORTH OF ST. LOUIS. THE BOILER HAS A RATED CAPACITY OF 110 MW. IT IS RETRO-FITTED WITH A CATALYTIC OXIDATION FGD SYSTEM DESIGNED BY MONSANTO ENVIRO-CHEM SYSTEMS. THE SYSTEM TREATS THE FLUE GAS FROM A HIGH EFFICIENCY ELECTRO-STATIC PRECIPITATOR.

THE FLUE GAS IS HEATED TO A TEMPERATURE OF 850°F AND IS PASSED THROUGH A VANADIUM PENTOXIDE FIXED-BED CATALYTIC CONVERTER, WHERE  $\text{SO}_2$  IS OXIDIZED TO  $\text{SO}_3$ . THE GAS THEN FLOWS THROUGH AN ACID ABSORPTION TOWER, WHERE THE SULFUR TRIOXIDE IN THE GAS IS CONVERTED TO SULFURIC ACID. AN ACID MIST ELIMINATOR ENSURES REMOVAL OF ENTRAINED ACID MIST FROM THE GAS STREAM. THE CLEANED GAS IS DISCHARGED TO THE STACK AND THE PRODUCT ACID IS COOLED AND STORED IN TANKS.

### PROBLEMS AND SOLUTIONS

SINCE COMPLETION OF THE SYSTEM IN JULY 1972, A SERIES OF MECHANICAL DIFFICULTIES HAS OCCURRED AND MODIFICATIONS HAVE BEEN EFFECTED. DURING JULY 1973, AN ACCEPTANCE TEST WAS CONDUCTED TO ESTABLISH THE SPECIFIED 85 PERCENT SULFUR DIOXIDE REMOVAL, WHILE PRODUCING AN ACID PRODUCT OF REQUIRED CONCENTRATION OF 77.7 PERCENT. BOTH OF THESE SPECIFICATIONS WERE MET.

LONG TERM OPERATION OF THE SYSTEM HAS BEEN DELAYED BECAUSE OF DELAYED DELIVERY OF EQUIPMENT FOR A PLANNED SYSTEM MODIFICATION TO CONVERT THE REHEATER BURNERS FROM NATURAL GAS TO FUEL OIL. SEVERAL MAJOR PROBLEMS INCLUDE FROZEN DAMPERS ON REHEAT BURNERS, CRACKS IN THE TEFLON LINER ON THE ACID PUMP'S DISCHARGE HEADER, CRACKS IN THE REHEAT DUCTING, FALL OF REFRACTORY BRICKS FROM THE REHEATER BURNER DOME, AND NEED FOR REINFORCEMENT OF THE STRUCTURE SUPPORTING THE HIGH TEMPERATURE FLUE GAS DUCT TO THE CATALYTIC CONVERTER. MOST OF THESE PROBLEMS HAVE BEEN CORRECTED. ILLINOIS POWER AND EPA ARE NOW DETERMINING HOW TO CORRECT LEAKING ACID COOLERS. PATCHING ATTEMPTS HAVE BEEN UNSUCCESSFUL. REPAIR OR REPLACEMENT OF THE COOLERS IS EXPECTED TO TAKE SEVERAL MONTHS.

OPERATING LOG  
CATALYTIC OXIDATION SYSTEM  
WOOD RIVER NO. 4 - ILLINOIS POWER CO.

<u>Date</u>	<u>System operating hours</u>	<u>Date</u>	<u>System operating hours</u>
9-4-72	12	10-8-72	24
9-5-72	24	10-9-72	24
9-6-72	24	10-10-72	18
9-7-72	2	10-12-72	16
9-10-72	6	10-13-72	20
9-11-72	2	10-14-72	16
9-12-72	16	10-30-72	24
9-13-72	24	10-31-72	16
9-14-72	24	7-21-73	18
9-15-72	24	7-22-73	24
9-16-72	24	7-23-73	18
9-17-72	24	7-24-73	24
9-18-72	24	7-25-73	14
9-19-72	3	7-26-73	13
9-24-72	17	7-17-73	19
10-6-72	12	7-28-73	19
10-7-72	24	7-29-73	9
TOTAL		602 HOURS	

**Table 16**  
**TERMINATED OPERATIONAL FGD SYSTEMS**

<b>IDENTIFICATION NO.</b>	<b>4</b>
<b>UTILITY NAME</b>	<b>POTOMAC ELECTRIC &amp; POWER</b>
<b>UNIT NAME</b>	<b>DICKERSON NO 3</b>
<b>UNIT LOCATION</b>	<b>DICKERSON MARYLAND</b>
<b>UNIT RATING</b>	<b>95 MW</b>
<b>FUEL CHARACTERISTICS</b>	<b>COAL 2.0 PERCENT SULFUR</b>
<b>FGD VENDOR</b>	<b>CHEMICO</b>
<b>PROCESS</b>	<b>MAGNESIUM OXIDE SCRUBBING</b>
<b>NEW OR RETROFIT</b>	<b>RETROFIT</b>
<b>START UP DATE</b>	<b>9/73</b>
<b>FGD STATUS</b>	<b>OPERATIONAL</b>
<b>EFFICIENCY, PARTICULATES</b>	
<b>SO2</b>	<b>90 PERCENT</b>
<b>WATER MAKE UP</b>	
<b>SLUDGE DISPOSAL</b>	
<b>UNIT COST</b>	<b>\$70/KW CAPITAL</b>
<b>OPERATIONAL EXPERIENCE</b>	<b>REFER TO BACKGROUND INFORMATION SECTION IN TABLE 16 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE SEPTEMBER 1973. THE UNIT HAS BEEN TERMINATED AS AN SO2 SCRUBBER. HOWEVER, IT WILL CONTINUE TO OPERATE AS A PARTICULATE SCRUBBER.</b>

## BACKGROUND INFORMATION

### ON

#### DICKERSON NO. 3

THE DICKERSON STATION OF POTOMAC ELECTRIC POWER CO. (PEPCO) IS LOCATED ON THE POTOMAC RIVER NEAR DICKERSON, MARYLAND, ABOUT 30 MILES NORTHWEST OF WASHINGTON, D.C. THE STATION HAS THREE ELECTRIC GENERATORS, EACH RATED AT 190 MW. UNIT NO. 3 IS A DRY BOTTOM COAL-FIRED BOILER DESIGNED BY COMBUSTION ENGINEERING AND INSTALLED IN 1962. THE COAL NOW BURNED HAS AN AVERAGE GROSS HEATING VALUE OF 11,700 BTU/LB AND AVERAGE ASH AND SULFUR CONTENTS OF 14 AND 2 PERCENT, RESPECTIVELY. THE BOILER IS FITTED WITH AN ELECTROSTATIC PRECIPITATOR DESIGNED AND INSTALLED BY RESEARCH-COTTRELL IN 1962. THE FGD SYSTEM EMPLOYS THE CHEMICO-BASIC MAGNESIUM OXIDE SCRUBBING PROCESS. THE RETROFIT SYSTEM HANDLES APPROXIMATELY 50 PERCENT OF THE EXHAUST GAS FROM THE NO. 3 UNIT.

THE FGD SYSTEM CONSISTS OF A SINGLE, TWO-STAGE SCRUBBER/ABSORBER, WHICH INCORPORATES AN ADJUSTABLE-THROAT VENTURI SCRUBBER FOR PARTICULATE REMOVAL AND A SECOND STAGE ABSORBER WITH A FIXED VENTURI TO REMOVE SULFUR DIOXIDE. THE LIQUOR STREAMS FOR BOTH STAGES ARE SEPARATE AND OPERATE IN A CLOSED LOOP MODE. UNTIL MID-1975 THE MAGNESIUM SULFITE GENERATED WAS TRANSFERRED TO AN EPA FINANCED FACILITY AT THE ESSEX CHEMICAL COMPANY SULFURIC ACID MANUFACTURING PLANT IN RUMFORD, RHODE ISLAND, WHERE MAGNESIUM OXIDE WAS REGENERATED AND SO<sub>2</sub> FROM THE REGENERATION PROCESS WAS CONVERTED TO SULFURIC ACID. THE RUMFORD FACILITY HAS SINCE BEEN CLOSED DOWN.

CONSTRUCTION WAS COMPLETED IN AUGUST AND THE SYSTEM STARTED UP IN SEPTEMBER 1973. IN INTERMITTENT OPERATIONS FOR SHAKEDOWN THROUGH JANUARY 1974, THE LONGEST CONTINUOUS RUN WAS 271 HOURS. THE SYSTEM WAS RESTARTED FROM JULY THROUGH DECEMBER 1974, AND AGAIN ON AUGUST 11, 1975, FOR APPROXIMATELY 87 HOURS.

FGD UNIT OUTAGES WERE CAUSED PRIMARILY BY PIPE AND PUMP CORROSION AND MAJOR TURBINE OVERHAUL OF THE BOILER. PARTICULATE AND SO<sub>2</sub> REMOVAL EFFICIENCY GUARANTEES WERE CORROBORATED DURING OPERATIONAL PHASES.

THE REMAINING SUPPLY OF MAGNESIUM OXIDE, ABOUT 100 TONS (10 DAYS), HAS BEEN DEPLETED, AND THE DICKERSON UNIT HAS BEEN TERMINATED AS AN FGD SYSTEM.

DICKERSON NO. 3  
FGD SYSTEM OPERATING HISTORY

<u>Operating Period</u>	<u>Comments</u>
Sep. 73 to Jan. 74	Problems during this period ranged from corrosion leaks in expansion joints to problems in material handling equipment, feeding and slaking of MgO, plugging in the MgO mix tank and suction lines to the MgO make-up pumps.
Jan. 74 to Apr. 74	Maintenance and modifications were performed on the system. The major system revision made during this period was the addition of a pre-mix tank in the MgO system.
Apr. 74 to Jul. 74	Limited operation because the utility did not have access to the EPA calcining facility at the Essex Chemical Company sulfuric acid plant. By the end of June 1974, all the MgO at Dickerson had been used and a silo plus three train cars were full of $MgSO_3$ .
Aug. 74 to Dec. 74	During this period the system generally operated at 75 percent of the design gas flow.
Jan. 75	Problems developed in the bucket elevator transporting the $MgSO_3$ from the dryer to the storage silo.
Feb. 75 to Jul. 75	Unit No. 3 was taken out of service for an 8 to 12 week turbine overhaul. The scrubber was inspected, maintenance and modifications were made.

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DICKERSON NO. 3 (Continued)  
FGD SYSTEM OPERATING HISTORY

Operating Period

Comments

Aug. 75

The FGD system was restarted in August. Steam was lost to the MgO mix tank, resulting in a very moist product from the centrifuge. Caking in the dryer occurred. At this point, the utility decided to test only the first-stage of the scrubbing system, taking gas ahead of the precipitator. FGD operation at Dickerson terminated at this point.



Table 16  
TERMINATED OPERATIONAL FGD SYSTEMS

IDENTIFICATION NO.	5
UTILITY NAME	SOUTHERN CALIFORNIA EDISON
UNIT NAME	MOHAVE NO 1A
UNIT LOCATION	LAUGHLIN NEVADA
UNIT RATING	170 MW
FUEL CHARACTERISTICS	COAL 0.5- 0.8 PERCENT SULFUR
FGD VENDOR	UNIVERSAL OIL PRODUCTS
PROCESS	LIMESTONE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	11/74
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	
SO2	
WATER MAKE UP	
SLUDGE DISPOSAL	
UNIT COST	
OPERATIONAL EXPERIENCE	THIS EXPERIMENTAL MODULE STARTED UP OCT. 31, 1974 AND OPERATED WITH AN AVAILABILITY OF 60.4% THROUGH FOUR MONTHS OF TESTING. TESTS HAVE BEEN COMPLETED, AND THE FGD SYSTEM WAS SHUT DOWN INDEFINITELY ON JULY 2, 1975. NEVADA ASSEMBLY BILL NO. 708 HAS PLACED A 2-YEAR MORATORIUM ON THE ENFORCEMENT OF THE COMPLIANCE SCHEDULE FOR THIS STATION. FURTHER FGD ACTIVITIES WILL BE DEPENDENT ON FUTURE LEGISLATION.

PEDCo-ENVIRONMENTAL

Table 16

## TERMINATED OPERATIONAL FGD SYSTEMS

IDENTIFICATION NO.	6
UTILITY NAME	SOUTHERN CALIFORNIA EDISON
UNIT NAME	MOHAVE NO. 2A
UNIT LOCATION	LAUGHLIN NEVADA
UNIT RATING	160 MW
FUEL CHARACTERISTICS	COAL 0.5- 0.8 PERCENT SULFUR
FGD VENDOR	SCE/ STEARNS ROGER
PROCESS	LIME SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	11/73
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	
SO <sub>2</sub>	90 PERCENT
WATER MAKE UP	370 GAL/LB MOLE SO <sub>2</sub> REMOVED
SLUDGE DISPOSAL	STABILIZED SLUDGE DISPOSED IN UNLINED POND
UNIT COST	

OPERATIONAL  
EXPERIENCE

SINCE STARTUP OF FORMAL TEST PROGRAM ON JANUARY 16, 1974, AND UP TO DECEMBER 20, 1974, THIS EXPERIMENTAL HORIZONTAL MODULE OPERATED 5280 HRS. WITH AN OVERALL AVAILABILITY OF 77.4 PERCENT, SO<sub>2</sub> REMOVAL EFFICIENCY WAS 90 IN FLUE GAS TO SIMULATE CONDITIONS FROM COMBUSTION OF HIGH SULFUR COAL. THIS FGD SYSTEM OPERATED FROM NOVEMBER 1973 UNTIL FEBRUARY 1975. FGD PLANS AT THIS STATION WILL BE BASED ON INFORMATION THAT INCLUDES OPERATIONAL DATA THAT HAVE BEEN OBTAINED DURING THE FGD TEST PROGRAMS AT THE MOHAVE STATION. THE PHOTOTYPE SYSTEM AT MOHAVE IS NOW BEING DISMANTLED AND IS BEING SHIPPED TO THE FOUR CORNERS PLANT, OPERATED BY ARIZONA PUBLIC SERVICE, FOR INSTALLATION.

PEDCo-ENVIRONMENTAL

## BACKGROUND INFORMATION

ON

THE MOHAVE TEST MODULES PROGRAM: NOS. 1A AND 2A

TWO PROTOTYPE SULFUR DIOXIDE ABSORBER MODULES WERE INSTALLED IN 1973 AT THE MOHAVE GENERATING STATION OF THE SOUTHERN CALIFORNIA EDISON COMPANY. A VERTICAL MODULE, RATED AT 170 MW, WAS INSTALLED TO TREAT 450,000 SCFM PORTION OF THE FLUE GAS FROM UNIT NO. 1. A HORIZONTAL MODULE, ALSO RATED AT 170 MW, WAS INSTALLED TO TREAT A SIMILAR FLUE GAS PORTION FROM UNIT NO. 2. UNITS 1 AND 2 ARE IDENTICAL BOILERS, EACH HAVING A MAXIMUM NET CONTINUOUS GENERATING CAPACITY OF 790 MW AND EACH BURNING A WESTERN, LOW-SULFUR COAL WITH A HEATING VALUE OF 11,500 BTU/LB AND ASH AND SULFUR CONTENTS OF 10 AND 0.4 PERCENT RESPECTIVELY.

### VERTICAL MODULE

THE VERTICAL MODULE, A UNIVERSAL OIL PRODUCTS TURBULENT CONTACT ABSORBER (TCA), WAS TESTED IN TWO MODES: FIRST, AS A TCA UNIT, FROM NOVEMBER 2, 1974 TO APRIL 30, 1975, AND SECOND AS A POLYGRID PACKED ABSORBER (PPA), WHEN THEN THE "PING PONG BALLS" WERE REPLACED WITH A PLASTIC "EGGCRATE" PACKING WITH TESTING CONTINUING TO JULY 2, 1975.

STARTUP OF THE VERTICAL MODULE WAS INITIATED ON SCHEDULE JANUARY 1, 1974. ON JANUARY 24, 1974, A FIRE BURNED MOST OF THE CHLOROBUTYL LINING AND SYSTEM RESTART WAS DELAYED UNTIL OCTOBER 1, 1974. TESTING OF THIS MODULE FOLLOWED A MONTH LATER AND WAS COMPLETED AFTER 3,131 HOURS OF OPERATION. THE MODULE IS PRESENTLY SHUT DOWN IN A COLD STAND-BY CONDITION AT THE MOHAVE GENERATING STATION.

### HORIZONTAL MODULE

THE HORIZONTAL MODULE, A FOUR-STAGE HORIZONTAL CROSSFLOW SPRAY SCRUBBER, WAS OPERATED BY THE UTILITY IN A SHORT SERIES OF STARTUP TESTS THAT ENDED ON JANUARY 16, 1974, WHEN A FORMAL TEST PROGRAM WAS INITIATED TO ASSESS THE PERFORMANCE AND RELIABILITY CHARACTERISTICS OF THE SCRUBBING SYSTEM. THE TEST PROGRAM WAS TERMINATED ON FEBRUARY 9, 1975, FOLLOWING 5,927 HOURS OF OPERATION. THE MODULE WAS SUBSEQUENTLY DISMANTLED, TRANSPORTED, AND REASSEMBLED AT THE FOUR CORNERS PLANT OF ARIZONA PUBLIC SERVICE WHERE ADDITIONAL TESTING IS NOW BEING CONDUCTED.

MOHAVE NO. 1A - VERTICAL TEST MODULE

OUTAGE TIME HISTORY: NOVEMBER 2, 1974 TO JULY 2, 1975

<u>Reason</u>	<u>Time (hr)</u>
1. Repair grids and redistribute TCA balls	710
2. Clean scale from scrubber internals	344
3. Repair/replace plugged nozzles	153
4. Repair leaks in trap-out tray	120
5. Repair/realign PPA packing	85
6. Correct booster fan trip problems	72
7. Conduct inspections for extended operations	46
8. Remove hardhat from thickener	46
9. Total outage time	1585

Total outage time: 1585 hours

Total calendar time: 5813 hours

Total operational time: 4228 hours

Percent availability: 72.73

MOHAVE NO. 2A - HORIZONTAL TEST MODULE

OUTAGE TIME HISTORY: JANUARY 16, 1974 TO FEBRUARY 9, 1975

<u>Reason</u>	<u>Time (hr)</u>
1. Modify and repair plastic demister blades	503
2. Correct booster fan balance problems	317
3. Pump repair	256
4. Spray nozzle replacement	238
5. Modify gas inlet flow distribution	162
6. Repair hopper leaks	135
7. Remove hardhat from thickener	82
8. Modify slaking water for scale prevention	45
9. Conduct inspections for extended operations	<u>19</u>
10. Total outage time	1757

Total outage time: 1757 hours

Total calendar time: 9328 hours

Total operating time: 7571 hours

Percent availability: 81.16%

Table 16

## TERMINATED OPERATIONAL FGD SYSTEMS 2/76

IDENTIFICATION NO.	7
UTILITY NAME	TENNESSEE VALLEY AUTHORITY
UNIT NAME	SHAWNEE NO. 10C
UNIT LOCATION	PADUCAH KENTUCKY
UNIT RATING	10 MW
FUEL CHARACTERISTICS	COAL 2.9 PERCENT SULFUR
FGD VENDOR	TENNESSEE VALLEY AUTHORITY
PROCESS	LIME/LIMESTONE SCRUBBING
NEW OR RETROFIT	RETROFIT
START UP DATE	4/72
FGD STATUS	OPERATIONAL
EFFICIENCY, PARTICULATES	

SO2

WATER MAKE UP

SLUDGE DISPOSAL

UNIT COST

OPERATIONAL  
EXPERIENCE

REFER TO BACKGROUND INFORMATION SECTION IN TABLE 16 OF THIS REPORT. THIS FGD SYSTEM HAS BEEN OPERATIONAL SINCE APRIL 1972. THIS MARBLE-BED AB-SORBER, MANUFACTURED BY COMBUSTION ENGINEERING CO., WAS DISCONTINUED EARLY IN THE TEST PROGRAM BECAUSE OF CONTINUED OPERATING PROBLEMS WITH NOZZLE FAILURE AND SUBSEQUENT PLUGGING OF THE MARBLE BED. THIS SYSTEM BECAME OPERATIONAL IN APRIL 1972 AND WAS PERMANENTLY TERMINATED IN JULY 1973.

PEDCO - ENVIRONMENTAL

BACKGROUND INFORMATION  
ON  
SHAWNEE NOS. 10A, 10B, AND 10C

IN JUNE 1968, THE EPA INITIATED A PROGRAM TO TEST PROTOTYPE WET LIME AND LIMESTONE SCRUBBING SYSTEMS FOR REMOVAL OF SULFUR DIOXIDE AND PARTICULATES FROM FLUE GAS. THE PROGRAM WAS CARRIED OUT IN A TEST FACILITY INCORPORATED INTO THE FLUE GAS DUCT WORK OF UNIT NO. 10, A COAL-IFRED BOILER AT THE TVA SHAWNEE POWER STATION, PADUCAH, KENTUCKY. TVA IS THE CONSTRUCTOR AND FACILITY OPERATOR AND THE BECHTEL CORP. IS THE MAJOR CONTRACTOR AND TEST DIRECTOR.

THE TEST FACILITY CONSISTS OF THREE PARALLEL SCRUBBER SYSTEMS OF PROTOTYPE SIZE TREATING PART OF THE FLUE GAS FROM THE BOILER. EACH SCRUBBER TRAIN IS CAPABLE OF TREATING APPROXIMATELY 30,000 ACFM, OR THE EQUIVALENT OF APPROXIMATELY 10 MW OF POWER PLANT GENERATING CAPACITY.

THREE PARALLEL WET SCRUBBER SYSTEMS WERE SELECTED FOR THE TEST PROJECT: 1) A VENTURI WITH A SPRAY TOWER AFTER ABSORBER; 2) A TURBULENT CONTACT ABSORBER (TCA) AND 3) A MARBLE-BED ABSORBER. THE VENTURI SYSTEM; MANUFACTURED BY CHEMICAL CONSTRUCTION CO., CONTAINS AN ADJUSTABLE THROAT THAT PERMITS CONTROL AND VARIATION OF PRESSURE DROP UNDER A WIDE RANGE OF FLOW CONDITIONS. THE TCA UNIT, MANUFACTURED BY UNIVERSAL OIL PRODUCTS, EMPLOYS A FLUIDIZED BED OF LOW DENSITY PLASTIC SPHERES THAT ARE FREE TO MOVE BETWEEN RETURNING GRIDS. THE MARBLE-BED ABSORBER, SUPPLIED BY COMBUSTION ENGINEERING CO., USES A PACKING OF 3/4-INCH GLASS MARBLE SPHERES AND A TURBULENT LAYER OF LIQUID AND GAS ABOVE THE MARBLE LAYER TO ENHANCE MASS TRANSFER.

THE TEST FACILITY WAS DESIGNED SO THAT MODIFICATIONS AND VARIATIONS OF SCRUBBER INTERNALS AND PIPING COULD BE READILY EMPLOYED FOR EACH SCRUBBER SYSTEM. EACH SYSTEM CAN TREAT APPROXIMATELY 30,000 ACFM OF FLUE GAS AT 300°F CONTAINING 1800 TO 4000 PPM OF SO<sub>2</sub> AND 2 TO 5 GRAINS/SCF OF PARTICULATES. TESTING OF THE TCA AND THE VENTURI SPRAY TOWER IS IN PROGRESS; OPERATION OF THE MARBLE-BED ABSORBER UNIT HAS BEEN PERMANENTLY DISCONTINUED.

## DEFINITIONS



## DEFINITIONS

Boiler Capacity Factor	(kWh generation in year)/(maximum continuous generating capacity in kW x 8760 hr/yr).
Boiler Utilization Parameter	Hours boiler operated/hours in period, expressed as a percentage.
Efficiency, Particulates	Operational - The actual percentage of particulates removed by the FGD system and the particulate control devices from the untreated flue gas. All others - The design efficiency (percentage) of particulate removed by the FGD system and the particulate control devices.
SO <sub>2</sub>	Operational - The actual percentage of SO <sub>2</sub> removed from the flue gas. All others - The design efficiency.
FGD Availability Factor	Hours the FGD system was available for operation (whether operated or not)/hours in period, expressed as a percentage.
FGD Reliability Factor	Hours the FGD system operated/hours FGD system was called upon to operate, expressed as a percentage.
FGD Operability Factor	Hours the FGD system was operated/boiler operating hours in period, expressed as a percentage.
FGD Utilization Factor	Hours FGD system operated/hours in period, expressed as a percentage.
FGD Status Category 1	Operational - Unit has been or is in service removing SO <sub>2</sub> .
Category 2	Under Construction - Ground has been broken for installation of FGD system, but FGD system has not become operational.
Category 3	Planned, Contract Awarded - Contract has been signed for purchase of FGD system but ground has not been broken for installation.

## DEFINITIONS

Category 4	Planned, Letter of Intent Signed - Letter of intent has been signed, but legal contract for purchase has not been awarded.
Category 5	Planned, Requesting/Evaluating Bids - Bid requests have been released but no letter of intent or contract has been issued.
Category 6	Considering only FGD Systems - An FGD system is proposed as a means to meet an SO <sub>2</sub> regulation.
Category 7	Considering an FGD system as well as alternative methods (Tables 14, 15).
FGD Vendor	Vendor with a signed contract, letter of intent or strong commitment because of test unit or past purchases.
Fuel Characteristics	Type of fuel, average gross heating value in Btu/lb, average percent ash and average percent sulfur content for fuel as fired.
Identification Number	Number of unit in the alphabetical listing in Tables 1, 2, 3 or Tables 14, 15.
New	FGD unit and boiler were designed at the same time or space for addition of an FGD unit was reserved when boiler was constructed.
Operational Experience	Operational - Brief summary of FGD system operation since start-up and description of current month's performance. All others - Comments regarding stage of construction, etc.
Process	Company name if process is patented. Generic name if several companies have similar processes.

## DEFINITIONS

### Regulatory Class

- A. New boiler constructed subject to Federal New Source Performance Standards.
- B. Existing boiler subject to State Standard that is more stringent than the Federal New Source Performance Standard (NSPS).
- C. Existing boiler subject to State Standard that is equal to or less stringent than NSPS.
- D. Other.
- E. Unknown.

### Retrofit

FGD unit must be added to an existing boiler not specifically designed to accommodate FGD unit.

### Sludge Disposal

Comments on disposal method for those units generating sludge including: lined or unlined ponds, stabilized or unstabilized sludge, and on- or off-site disposal.

### Start-up Date

Operational - Date when SO<sub>2</sub> removal began. All others - Date when SO<sub>2</sub> removal is scheduled to begin. Generally this will be the start-up date of the boiler.

### Unit Cost

Capital Cost in \$/kW including: SO<sub>2</sub> absorption and regeneration system, SO<sub>2</sub> recovery system, solids disposal, site improvements, land, roads, tracks, substation, engineering costs, contractors fee and interest on capital during construction.

Annualized Cost in mills/kWh including fixed and variable costs. Fixed costs include: interest on capital, depreciation, insurance, taxes, and labor costs including overhead. Variable costs include: raw materials, utilities, and maintenance.

## DEFINITIONS

Unit Location	City and State listed in mailing address.
Unit Name	Unit identification as it appears in Electrical World - Direction of Electrical Utilities, McGraw-Hill - Current Edition - or as indicated by utility representative for installations in planning stages.
Unit Rating	Operational - Maximum continuous gross generation capacity in MW; Preoperational - maximum continuous design generation capacity in MW
Utility Name	Name of corporation as it appears in Electrical World - Directory of Electrical Utilities, McGraw-Hill - Current Edition - as space permits.
Water Make-Up	Gallons per minute of make-up water required per MW of capacity.