United States Environmental Protection Agency Industrial Environmental Research Laboratory Research Triangle Park NC 27711

Research and Development

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Project Summary

EPA Utility FGD Survey April — June 1981

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The report, generated by a computerized data base system, presents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems, operational domestic particle scrubbers, and Japanese coal-fired utility FGD installations. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. It presents data on system design, fuel characteristics, operating history, and actual performance. Unit by unit dependability parameters are included and problems and solutions associated with the boilers, scrubbers, and FGD systems are discussed.

The domestic FGD systems are tabulated alphabetically by development status (operational, under construction, or in the planning stages), utility company, system supplier, process, waste disposal practice, and regulatory class. FGD system economic data, definitions, and a glossary of terms are appended to the report. Current data for domestic FGD systems show 88 systems in operation, 40 systems under construction, and 99 planned systems. Projected 1999 FGD controlled capacity in the U.S. is 108,857 MW.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report

of the same title (see Project Report ordering information at back).

This report is prepared quarterly by PEDCo Environmental, Inc., under contract to the Industrial Environmental Research Laboratory/Research Triangle Park of the U.S. Environmental Protection Agency. It is generated by a computerized data base system, the structure of which is illustrated in Figure 1 (see pages 6 and 7).

Table 1 summarizes the status of FGD systems in the U.S. at the end of June 1981. Table 2 lists the units that have changed status during the second quarter 1981, and Table 3 shows the performance of operating units during this period.

Current projections indicate that the total power generating capacity of the U.S. electric utility industry will be about 831 GW by the end of 1999.¹ (This value reflects the annual loss resulting from the retirement of older units; i.e., about 0.4 percent of the average generating capacity at the end of each year.²) Approximately 373 GW (45 percent of the 1999 total) will come from coal-fired units. The distribution of power generation sources, both present (December 1980) and future (December 1999) is shown in Table 4.¹

Based on the known commitments to FGD by utilities as presented in Table 1, the percentage of electrical generating capacity controlled by FGD for both the present (June 1981) and the future (December 1999) is shown in Table 5.

In light of the revised New Source Performance Standards, actual FGD

Table 1. Number and Total Capacity of FGD Systems

Status	No. of units	Total controlled capacity, MWª	Equivalent scrubbed capacity, MW ^b
Operational	88	33,357	30,158
Under construction	40	16,106	15,887
Planned:			
Contract awarded	21	11,815	11,815
Letter of intent	11	<i>8,235</i>	8,235
Requesting/evaluating bids	19	10,456	10,340
Considering only FGD systems	48	28,888	28,850
Total	227	108,857	105,285

^{*}The summation of the gross unit capacities (MW) brought into compliance with FGD systems regardless of the percent of the flue gas scrubbed by the FGD system(s).

control is expected to be greater t that reflected by the figures above. example, about 50 to 60 systems rej senting approximately 29,000 to 31,0 MW of generating capacity prese fall into the uncommitted categorial These are systems that cannot included in the committed group at 1 time because information regard their status is not ready for pul release.

in an effort to show general F usage and projected usage trends, Ta 6 gives a current (June 1981) and projected (December 1999) breakdo of throwaway product systems vers salable product systems as a percent the total known commitments to FGD of the end of the second quarter 198

Table 2. Summary of Changes April - June 1981

	Ор	erational		Under struction		ontract warded		etter intent		uesting/ al bids		nsidering FGD		Total
FGD status report March 31, 1981	No 87	MW* 29,503 ^b	No. 35	MW* 14,481	No 27	MW* 13,796	No. 11	MW* 8,235	No 18	MW* 10,075	No. 48	MW* 28,850	No. 226	MW* 104,94
Big Rivers Electric D.B. Wilson 1			+1	440	-1	440								
Deseret Gen & Trans. Moon Lake 1			+1	410	-1	410								
Gulf Power Scholz 1	-1	20											-1	2 (
Marquette Board of Light & Power Shiras 3			+1	44	-1	44								
Montana-Dakota Utilities Coyote 1	+1	440	-1	440										
Muscatine Power & Water Muscatine 9			+1	166	-1	166								
Northern Indiana Pub Service Schahfer 17			+1	421	-1	421								
Pacific Power & Light Jim Bridger 2A			+1	100									+1	100
Sikeston Brd of Municipal Utilities Sikeston 1	+1	235	-1	235										
South Carolina Public Service Cross 2			+1	500	-1	500								
Southern Indiana Gas & Elec. A.B. Brown 2									+1	265			+1	265
Total	88	30,158	40	15,887	21	11,815	11	8,235	19	10,340	48	28,850	227	105,285

Performance of Operational Units April - June 1981 Table 3.

FGD system Flue			FGD capacity on line during	No Information Shut down April 1981 for this throughout Dependability % ^{c,a}				•	May 1981 Dependability % ^{c.a}					June 1981 Dependability % ^{c.a}				
Plant	capacity, MW ^a	gas % scrubbed	period, MW ^{a,b}	period, MW*	period, MW*	AVL	OPR	REL	UTL	AVL	OPR	REL	UTL	AVL	OPR	REL	UTL	
Alabama Electric																		
Tombigbee 2	179	70		179														
Tombigbee 3	179	70		179														
Arizona Electric Power																		
Apache 2	98	50	9 8			100	100	100	100	100	100	100	100	100	100	100	100	
Apache 3	98	50	98			100	75	100	36	100	87	100	87	100	87	100	87	

^bThe summation of the effective scrubbed flue gas in equivalent MW based on the percent of flue gas scrubbed by the FGD system(s).

^{*}Equivalent scrubbed capacity

bThis value was modified slightly due to a MW correction

Table 3. (continued)

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Table 3.	(continued)

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	FGD system	Flue	capacity on line during	for this	Shut down throughout		Aprıl Dependa	1981 bility %°			May Dependa	1981 bility %°				1981 bility %	
Plant	capacity, MW*	gas % scrubbed	period, MW ^{a,b}	period, MW*	period, MW	AVL	OPR	REL	UTL	AVL	OPR	REL	UTL	AVL	OPR	REL	UTL
Montana Power Colstrip 1 Colstrip 2	360 360	100 100		360 360													
Montana-Dakota Utilities Coyote 1	440	100	440														
Nevada Power Reid Gardner 1 Reid Gardner 2 Reid Gardner 3	125 125 125	100 100 100	125 125 125			96 100 100	99 95 100	99 95 100	96 7 94	88 96 98	67 96 98	67 96 98	27 94 96	94 91 100	90 89 100	93 89 100	81 76 100
Northern Indiana Public Service Dean H. Mitchell II	115	99			115	100	o		o	100	0		o	100	0		o
Northern States Power Riverside 6-7 Sherburne 1 Sherburne 2	110 740 740	N/A ^d 91 91	110	740 740													
Pacific Power & Light Jim Bridger 4	550	100		550													
Pennsylvania Power Bruce Mansfield 1 Bruce Mansfield 2 Bruce Mansfield 3	917 917 917	100 100 100	917 917 917											100 100 98			
Public Service Co. of New Mexico San Juan 1 San Juan 2 San Juan 3	361 350 534	100 100 100	361 350 534			100 78 20	99 62 74	100 66 100	89 47 20	100 98 8	100 84 37	100 96 37	100 64 6	65 63 71	45 42 56	51 47 56	39 42 28
Salt River Project Coronado 1 Coronado 2	280 280	80 80		280 280													
Sikeston Brd. of Municipal Utilities Sikeston 1	235	100	235														
South Carolina Public Service Winyah 2 Winyah 3	140 280	50 100	140 280														
South Mississippi Electric R.D. Morrow, Sr. 1 R.D. Morrow, Sr. 2	124 124	62 62	124 124			50 100	94 98	34 100	26 87	0 100	99	100	0 93	91 98	91 97	91 97	91 97
Southern Illinois Power Marion 4	173	100	173			81	71	83	62	84	84	96	84	68	68	72	68
Southern Indiana Gas & Electric A.B. Brown 1	265	100	265			100	o		o	88	81	82	51	100	99	99	97
Springfield City Utilities Southwest 1	194	100	194			61	80	81	59	44	74	91	31	78	75	84	61
Springfield Water, Light & Power Dallman 3	185	90	185			o	o		0	40	19	19	15				
St Joe Zinc GF Weaton 1	60	N/A ^d	60			11	11	11	11	o	o		o	o	o		0
Tennesse Valley Authority Shawnee 10A	10	N/A ^d	10														
Shawnee 10B Widows Creek 7 Widows Creek 8	10 575 550	N/A ^d 100 100	10 575		550												
Texas Power & Light Sandow 4	382	70	382														
Texas Utilities Martin Lake 1 Martin Lake 2	595 595	75 75	595 595														
Martin Lake 3 Monticello 3	595 800	75 100	595 800														

Table 3. (continued)

	Flue	FGD capacity on line during	for this	Shut down throughout	April 1981 Dependability %.*					May Dependa		June 1981 Dependability % ^{c.e}					
Plant	capacity, MW*	gas % scrubbed	period, MW ^{a,b}	period, MW*	period, MW*	AVL	OPR	REL	UTL	AVL	OPR	REL	UTL	AVL	OPR	REL	UTL
ltah Power & Light Hunter 1	360	90	360				100		66		100		90		100		89
nunter i Hunter 2	360	90	360				100		100		100		63		100		91
Huntington 1	366	85	366				100		35		100		4		100		78
Total	30,158		20,560	8,387	1,211												

^{*}Equivalent scrubbed capacity.

Table 4. Power Generation Sources: Present and Future

	Coal	Nuclear	Oil	Hydro	Gas	Other	GW (total)
December 1980	41%	10%	24%	12%	12%	1%	616
December 1999	45%	15%	19%	11%	9%	1%	831

Table 5. FGD Controlled Generating Capacity: Present and Future

	Coal-fired generating capacity controlled by FGD, %	Total generating capacity controlled by FGD, %
June 1981*	11.9	5.4
December 1999	28.2	13.1

^{*}The number of committed FGD systems is as of June 1981; however, the figures used for total generating capacity and coal-fired generating capacity are based on available December 1980 figures.

Highlights: April - June 1981

The following paragraphs highlight FGD system developments during the second quarter 1981.

The limestone FGD systems on Apache 2 and 3 of Arizona Electric Power achieved 100 percent availabilities during the second quarter 1981. Both systems operated during the 3-month period with no major problems reported.

The Laramie River limestone FGD system of Basin Electric Power achieved 100 percent availability for April and May. No major operational problems were encountered during this period. Information for June was not made available.

Big Rivers Electric announced that, during the second quarter 1981, construction started on D.B. Wilson 1 in Centertown, KY. The 440-MW (gross) unit will consist of a wet limestone FGD system, supplied by Pullman Kellogg, for SO₂ control. The unit is scheduled to commence operations in 1984.

Central Illinois Public Service reported that the dual alkali FGD system installed

on Newton 1 achieved 100 percent availability during the second quarter 1981. The utility reported no major problems during this period.

Columbus and Southern Ohio Electric reported that the lime FGD system installed on Conesville 5 achieved monthly availabilities of 97, 100, and 99 percent during the second quarter 1981. No major operational problems were reported during the period.

Cooperative Power reported that the Coal Creek 1 and 2 lime/alkaline flyash FGD systems achieved 100 percent availabilities during the second quarter 1981. The utility reported no major problems during the period.

Construction of the Moon Lake 1 wet limestone FGD system of Deseret Generation and Transmission started during the period. The 410-MW (gross) unit will fire a bituminous coal with an average sulfur content of 0.5 percent. The FGD system is supplied by Combustion Engineering and will feature a baghouse, supplied by Ecolaire, to remove particulate matter. Moon Lake 1 is scheduled for service in September 1984.

Duquesne Light reported that the lime FGD system operating at Elrama achieved availabilities of 100 and 97 percent for April and May, respectively. Except for some recycle pump replacements, no major operational problems were reported during the period. Information for June was not made available.

The lime FGD system installed on Hawthorn 3 of Kansas City Power and Light achieved 100 percent availability for April through June.

Marquette Board of Light and Power announced that construction of the lime/spray drying FGD system at the Shiras Station has started. This 44-MW (gross) unit is in Marquette, MI. The system is supplied by General Electric Environmental Services, Inc. and will feature a fabric filter for primary particulate matter control. Operation of Shiras 3 is scheduled for October 1982.

Montana-Dakota Utilities announced that Coyote 1 commenced operation in April 1981. This unit, rated at 440 MW (gross), fires lignite with an average sulfur content of 0.9 percent. The sodium carbonate/spray drying FGD system, supplied by Wheelabrator-Frye/Rockwell International, is designed to remove 70 percent of the SO₂. A fabric filter is used for particulate matter collection.

Muscatine Power and Water announced that construction of Muscatine 9 has started. This 166-MW (gross) unit is in Muscatine, IA, and will fire bituminous coal with an average sulfur content of 3.0 percent. The wet limestone FGD system, supplied by Research-Cottrell, is expected to begin operation in September 1982.

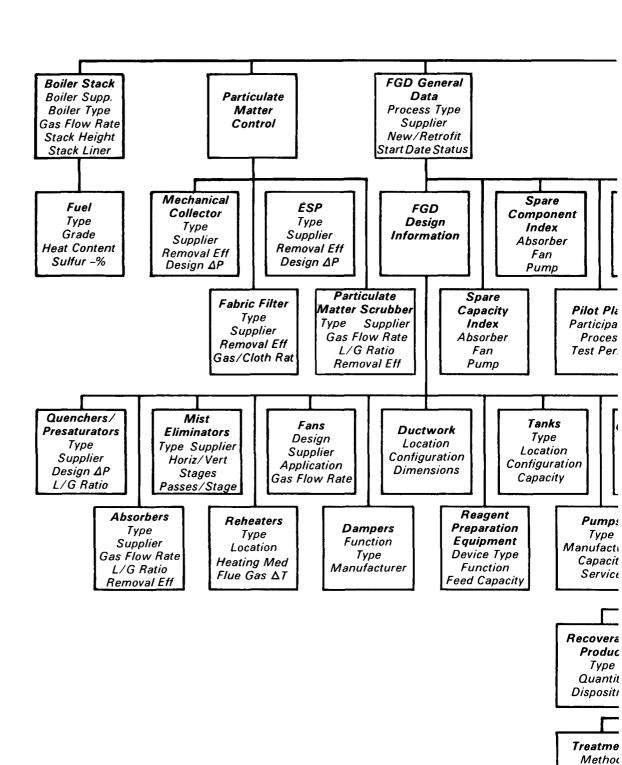
Nevada Power reported that the Reid Gardner 2 FGD system achieved availabilities of 100, 96, and 91 percent for April, May, and June, respectively. The Reid Gardner 3 FGD system achieved

This category includes the flue gas capacity being handled by the FGD systems at least part of the time during the report period

[°]The percent figures listed are average values for all system scrubbing trains during the period

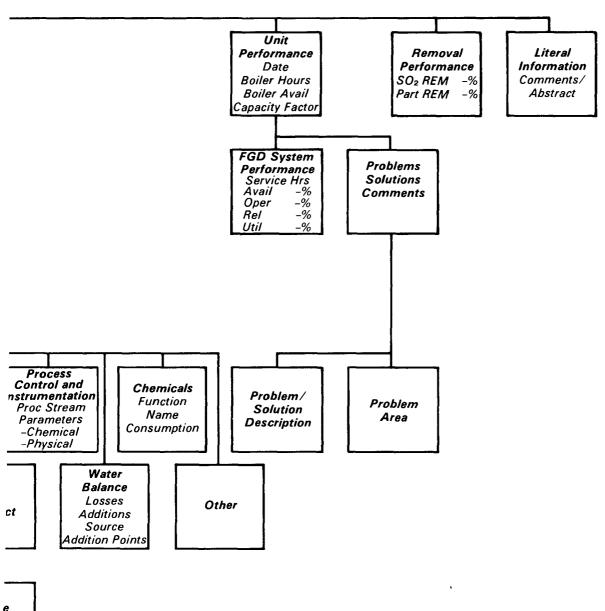
⁴Flue gas % scrubbed for prototype and demonstration units is not applicable unless the system is designed to bring a unit into compliance with SO₂ emission standard

^{*}Availability, operability, reliability, and utilization as defined in Appendix C of the full report



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Figure 1. Computerized data base structure diagram.



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Table 6. Summary of FGD Systems by Process

		Percent of	total MW
		June 1981	December 1999
Throwaway product process			
°Wet systems			
Lime		38.5	21.3
Limestone		47.6	<i>36.1</i>
Dual alkali		3 .9	1.9
Sodium carbonate		3.0	<i>3.0</i>
<i>NA</i> ^a		_	5.2
°Dry systems			
Lime		0.4	3.3
Lime/sodium carbonate		_	0.1
Sodium carbonate		1.4	0.4
Salable product process			
°Process	°By-product		
Aqueous carbonate/ spray drying	Elemental sulfur		0.1
Citrate	Elemental sulfur	0.2	0.1
Lime	Gypsum	_	0.1
Limestone	Gypsum	_	0.2
Lime/limestone	Gypsum		0.5
Magnesium oxide	Sulfuric acid		0.7
Wellman Lord	Sulfuric acid	2.3	1.2
Wellman Lord	Elemental sulfur	2.7	0.8
Process undecided		_	25.0
Total		100.0	100.0

^aNA - Not available (these systems are committed to a throwaway product process; however, the actual process is unknown at this time).

availabilities of 100, 98, and 100 percent for the same period.

Northern Indiana Public Service announced that construction of Schahfer 17 has started. The 421-MW (gross) unit will fire bituminous coal with an average sulfur content of 3.2 percent. The dual alkali FGD system is supplied by FMC. Primary particulate matter control will be provided by an ESP. Start-up of the unit is scheduled for June 1983.

Pacific Power and Light announced that a demonstration spray drying FGD system is under construction at Jim Bridger 2. The unit fires subbituminous coal with an average sulfur content of 0.5 percent. The dry scrubbing system, supplied by Flakt, will be followed by an ESP for particulate matter collection. The process will be tested using lime and sodium carbonate as separate scrubbing reagents. Operation of the demonstration system is scheduled to start in January 1982.

The Sikeston Board of Municipal Utilities announced that operation of

Sikeston 1 started at the end of the quarter. The 235-MW (gross) unit fires bituminous coal with an average sulfur content of 2.8 percent. Flue gas passes through two parallel ESPs and three parallel 50 percent capacity FGD modules (venturi scrubbers) before exiting through a 450-ft (137 m) stack. Flue gas was first passed through the system on June 30, 1981.

South Carolina Public Service announced that construction of Cross 2 started during the quarter. The 500-MW (gross) unit will fire bituminous coal with an average sulfur content of 1.8 percent. The wet limestone FGD system, supplied by Peabody Process Systems, is scheduled to start operation in January 1984.

The limestone FGD system on South Mississippi Electric Power's R.D. Morrow 2 achieved monthly availabilities of 100, 100, and 98 percent during the second quarter 1981. The utility reported no problems during the period.

Southern Indiana Gas and Electric announced plans to construct a new

unit, A.B. Brown 2, with unit 1 in W Franklin, IN. The 265-MW (gross) u will fire bituminous coal with average sulfur content of 3.4 perce The utility is now requesting/evaluat bids for an FGD system. The unit scheduled to commence operation January 1985.

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- Berman, Ira M. New Generati Capacity: When, Where, and Whom. Power Engineering 85(4). April 1981.

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Norman Kaplan is the EPA Project Officer (see below).

The complete report, entitled "EPA Utility FGD Survey, April-June 1981," (Order No. PB 82-115 858; Cost: \$25.50, subject to change) will be available only from:

National Technical Information Service 5285 Port Royal Road Springfield, VA 22161 Telephone: 703-487-4650 The EPA Project Officer can be contacted at:

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