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PROJECT SUMMARY
UTILITY FGD SURVEY
JANUARY - DECEMBER 1989

by

S. L. Hance, R. S. McKibben,
and F. M. Jones
IT Corporation
(formerly PEI Associates, Inc.)
11499 Chester Road
Cincinnati, Ohio 45246

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Oak Ridge, Tennessee 37831

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INTRODUCTION

The FGD survey report is prepared annually by International Technology (IT) Corporation (formerly PEI Associates, Inc.) for the U.S. Department of Energy. The current issue (and preceding issues from 1974 to 1981 and October 1984 to the present) of the utility FGD survey are available only through the National Technical Information Service (NTIS). Preceding issues covering January 1982 through September 1984 may be purchased from the Research Reports Center of the Electric Power Research Institute (EPRI). The information in this report is generated by a computerized data base system known as the Flue Gas Desulfurization Information System (FGDIS). The design information contained in the FGDIS encompasses the entire emission control system and the power generating unit to which it is applied. Performance data for operational FGD systems include monthly dependability parameters, service time, and descriptions of operational problems and solutions.

IT Corporation has been reporting on the status of utility flue gas desulfurization (FGD) technology since 1974. From 1974 to 1982, this effort was supported by the U.S. Environmental Protection Agency (EPA) under the direction of the Industrial Environmental Research Laboratory-Research Triangle Park. In 1983 and 1984, it was jointly sponsored by EPA and the Electric Power Research Institute. Since January 1985, the program has been sponsored by the U.S. Department of Energy (DOE), Office of Environmental Analysis.

Information for this program is obtained through regular contacts with owner/operator utilities and nonutility generators that sell power to utilities who are currently operating FGD systems or planning to install them. Supplemental information is also solicited from FGD system and equipment suppliers, design/engineering firms, research organizations, and regulatory agencies.

The information collected is stored in the Flue Gas Desulfurization Information System (FGDIS). This data base contains computerized files of descriptive, design, performance, and cost data on all the FGD systems identified in the FGDIS.

This report summarizes the status of FGD technology as of December 1989. It highlights the status of the electric utility power industry, projected growth of coal-fired power generation, and the current status and future trends in FGD application. Also

discussed is the status of FGD technology used by nonutility generators that sell or are projected to sell electric energy or capacity (or both) to electric utilities.

Several ways are available for identifying individual power plant units. Power plants are usually represented by turbine or boiler number in government and industry documents. Because more than one boiler may feed a given turbine in some cases, or a particular boiler may not be dedicated to a single power plant turbine, such identification can be misleading. This situation may be further complicated when FGD systems are being identified. In general, a one-to-one relationship exists between boilers or turbines and FGD systems for power plants included in this report. For the most part, the power plant boiler designation is used to identify FGD systems in this document. When several boilers feed a single FGD system, however, the boilers feeding the FGD system are indicated in the FGD system name. For example, Duquesne Light's Elrama plant consists of four boilers, the exhausts of which are ducted to a common header that serves a single multimodule FGD system. The plant is thus identified in the data base as "Elrama 1-4."

PROJECT SUMMARY

Table 1 summarizes the status of flue gas desulfurization (FGD) systems in the United States as of the end of December 1989. Total controlled capacity is listed in the table as the summation of the gross unit capacities (MW) brought into compliance by the use of FGD systems, regardless of the percentage of the flue gas scrubbed by the FGD system(s). Equivalent scrubbed capacity is the summation of the effective scrubbed flue gas capacities in equivalent MW, based on the percentage of flue gas scrubbed by the FGD system(s). Table 2 lists the units on which the status has changed during the January-December 1989 period. Details on each status change are given in the Highlights section of this summary. The units included in the figures presented in Table 1 are identified in Table 3.

TABLE 1. NUMBER AND TOTAL CAPACITY OF FGD SYSTEMS

Status	No. of units	Total controlled capacity, MW	Equivalent scrubbed capacity, MW
Operational	157	67,624	62,722
Under construction	14	4,455	4,335
Planned:			
Contract awarded	16	7,006	7,006
Letter of intent	-	-	-
Requesting/evaluating bids	2	110	110
Considering only FGD systems for SO ₂ control	35	17,310	16,814
TOTAL	224	96,505	90,987

Figure 1 presents a historic breakdown of utility status reports for operational, under-construction, and planned FGD capacity.¹ The operating FGD capacity has grown significantly each year since 1972. From 1977 to 1982 the capacity under construction was fairly stable, but has steadily decreased since 1982 because of the deferment of planned units. The planned capacity reported by the utilities has increased each year in the past until 1980, when it reached its peak, and has dropped sharply since that time. This drop resulted because fewer power plants were built than had been planned.

TABLE 2. SUMMARY OF FGD SYSTEM STATUS CHANGES, JANUARY-DECEMBER 1989

	Operational		Under construction		Contract awarded		Letter of intent		Requesting/eval. bids		Considering FGD		Total	
	No.	MW ^a	No.	MW ^a	No.	MW ^a	No.	MW ^a	No.	MW ^a	No.	MW ^a	No.	MW ^a
FGD status report December 31, 1988	154	62,248 ^b	15	4,674	11	4,625	0	0	3	140	35	18,154 ^b	218	89,841 ^b
Indeck Energy Services														
Turner's Falls	+1	19	-1	19										
Ohio Edison Co. Edgewater 4	+1	105												
Old Dominion Elec. Coop.													+1	105
Clover 1					+1	424							+1	424
Clover 2					+1	424							+1	424
Oxford Energy Co. Erie Energy Project 1					+1	33							+1	33
Exeter Energy Project 2			+1	30					-1	30				
Public Service Co. of Colorado														
Cherokee 4	+1	350	-1	350										
Texas Utilities Elec. Co.														
Twin Oak 1					+1	750					-1	750		
Twin Oak 2					+1	750					-1	750		
Wisconsin Elec. Power Co.														
Port Washington 1											+1	80	+1	80
Port Washington 4											+1	80	+1	80
TOTAL	157	62,722	14	4,335	16	7,006	0	0	2	110	35	16,814	224	90,987

^a Equivalent scrubber capacity.

^b This value was modified slightly to reflect a MW correction.

TABLE 3. SUMMARY OF OPERATIONAL AND PLANNED DOMESTIC FGD SYSTEMS

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status ^b	System supplier	Initial start-up date ^c
Alabama Electric									
Lowman	2	Leroy	Alabama	255	1.80	Limestone	1	Peabody Process Systems	9/1978
Lowman	3	Leroy	Alabama	255	1.80	Limestone	1	Peabody Process Systems	6/1979
Applied Energy Service ^d									
Beaver Valley	2-5	Monaca	Pennsylvania	126	2.25	Lime	1	FMC	8/1980
Deepwater	1	Pasadena	Texas	165	4.00	Limestone	1	Babcock & Wilcox	3/1986
Arizona Electric Power									
Apache	2	Cochise	Arizona	195	0.70	Limestone	1	Research-Cottrell	8/1978
Apache	3	Cochise	Arizona	195	0.70	Limestone	1	Research-Cottrell	6/1979
Arizona Public Service									
Cholla	1	Joseph City	Arizona	126	0.60	Limestone	1	Research-Cottrell	10/1973
Cholla	2	Joseph City	Arizona	250	0.60	Limestone	1	Research-Cottrell	4/1978
Cholla	4	Joseph City	Arizona	380	0.60	Limestone	1	Research-Cottrell	3/1981
Cholla	5	Joseph City	Arizona	375	0.60	Process not selected	6	Vendor not selected	99/2050
Four Corners	1	Fruitland	New Mexico	186	0.80	Lime/alkaline fly ash	1	GE Environmental Services	11/1979
Four Corners	2	Fruitland	New Mexico	186	0.80	Lime/alkaline fly ash	1	GE Environmental Services	11/1979
Four Corners	3	Fruitland	New Mexico	244	0.80	Lime/alkaline fly ash	1	GE Environmental Services	11/1979
Four Corners	4	Farmington	New Mexico	786	0.80	Lime	1	Babcock & Wilcox	10/1984
Four Corners	5	Farmington	New Mexico	786	0.80	Lime	1	Babcock & Wilcox	10/1984
Associated Electric									
Thomas Hill	3	Hoberly	Missouri	670	4.80	Limestone	1	M.W. Kellogg	10/1982
Basin Electric Power									
Antelope Valley	1	Beulah	North Dakota	490	1.22	Lime/spray drying	1	Joy Mfg./Niro Atomizer	5/1983
Antelope Valley	2	Beulah	North Dakota	490	1.22	Lime/spray drying	1	Joy Mfg./Niro Atomizer	10/1985
Antelope Valley	3	Beulah	North Dakota	560	1.22	Lime/spray drying	6	Vendor not selected	99/2050
Laramie River	1	Wheatland	Wyoming	600	0.81	Limestone	1	Research-Cottrell	7/1980
Laramie River	2	Wheatland	Wyoming	600	0.81	Limestone	1	Research-Cottrell	7/1981
Laramie River	3	Wheatland	Wyoming	600	0.81	Lime/spray drying	1	Babcock & Wilcox	11/1982
Big Rivers Electric									
D.B. Wilson	1	Centertown	Kentucky	440	3.80	Limestone	1	M.W. Kellogg	9/1984
Green	1	Sebree	Kentucky	250	4.00	Lime	1	American Air Filter	12/1979
Green	2	Sebree	Kentucky	242	4.00	Lime	1	American Air Filter	11/1980
Central Illinois Light									
Duck Creek	1	Canton	Illinois	396	3.40	Limestone	1	Enviroengineering, Riley Stoker	7/1976
Central Illinois Public Service									
Newton	1	Newton	Illinois	590	4.00	Dual alkali	1	GE Environmental Services	9/1979

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel percent sulfur	FGD process	FGD status ^b	System supplier	Initial start-up date ^c
Central Power & Light Coleto Creek Valley	2 1	Fannin Rio Valley	Texas Texas	720 680	0.39 NA	Lime/spray drying Process not selected	3 6	Joy Mfg./Niro Atomizer Vendor not selected	0/2002 0/2006
Century Power Springerville Springerville Springerville	1 2 3	Springerville Springerville Springerville	Arizona Arizona Arizona	400 400 400	0.70 0.70 0.70	Lime/spray drying Lime/spray drying Process not selected	1 2 6	Joy Mfg./Niro Atomizer Joy Mfg./Niro Atomizer Vendor not selected	2/1985 6/1990 0/1992
Cincinnati Gas & Electric East Bend Zimmer	2 1	Rabbit Hash Moscow	Kentucky Ohio	643 1389	5.20 4.50	Lime Lime	1 2	Babcock & Wilcox Babcock & Wilcox	3/1981 4/1991
City Utilities of Springfield Southwest	1	Springfield	Missouri	195	3.50	Limestone	1	Air Correction Division, UOP	4/1977
CMS Generation ^d Filer City Filer City	1 2	Filer City Filer City	Michigan Michigan	30 30	3.00 3.00	Lime Lime	2 2	GE Environmental Services GE Environmental Services	0/1990 0/1990
Cogentrix ^d Adrian Otsego	1 1	Adrian Otsego	Michigan Michigan	55 55	1.00 1.00	Lime/spray drying Lime/spray drying	5 5	Vendor not selected Vendor not selected	1/1991 1/1991
Colorado Springs Dept. of Pub. R.D. Nixon	2	Colorado Springs	Colorado	235	0.50	Process not selected	6	Vendor not selected	0/1999
Colorado Ute Electric Craig Craig Craig	1 2 3	Craig Craig Craig	Colorado Colorado Colorado	454 454 427	0.96 0.96 0.96	Limestone Limestone Lime/spray drying	1 1 1	Peabody Process Systems Peabody Process Systems Babcock & Wilcox	10/1980 12/1979 6/1984
Columbus & Southern Ohio Electric Conesville Conesville	5 6	Conesville Conesville	Ohio Ohio	405 405	4.50 4.50	Lime Lime	1 1	Air Correction Division, UOP Air Correction Division, UOP	1/1977 6/1978
Cooperative Power Association Coal Creek Coal Creek	1 2	Underwood Underwood	North Dakota North Dakota	550 550	0.63 0.63	Lime/alkaline fly ash Lime/alkaline fly ash	1 1	Combustion Engineering Combustion Engineering	7/1979 7/1980
Delmarva Power & Light Delaware City Delaware City Delaware City	1 2 3	Delaware City Delaware City Delaware City	Delaware Delaware Delaware	28 28 75	8.00 8.00 8.00	Wellman Lord Wellman Lord Wellman Lord	1 1 1	Davy McKee Davy McKee Davy McKee	5/1980 5/1980 5/1980

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capac- ity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status ^b	System supplier	Initial start-up date ^c
Deseret Gen. & Trans. Bonanza Bonanza	1 2	Vernal Vernal	Utah Utah	427 427	0.50 0.50	Limestone Limestone	1 6	Combustion Engineering Vendor not selected	12/1985 99/2050
Duquesne Light Elrama Phillips	1-4 1-6	Elrama South Heights	Pennsylvania Pennsylvania	510 408	2.50 2.50	Lime Lime	1 1	GE Environmental Services GE Environmental Services	10/1975 7/1973
East Kentucky Power J.K. Smith Spurlock	1 2	Winchester Maysville	Kentucky Kentucky	650 550	3.00 3.60	Lime Lime	3 1	Babcock & Wilcox Thyssen/CEA	0/2001 12/1982
Grand Haven Board of Light & Power J.B. Sims	3	Grand Haven	Michigan	65	2.80	Lime	1	Babcock & Wilcox	5/1983
Grand River Dam Authority GRDA	2	Pryor	Oklahoma	575	1.50	Lime/spray drying	1	Flakt	10/1985
Hadson Corporation ^d Altavista Buena Vista Hopewell Southampton	1 1 1 1	Altavista Buena Vista Hopewell Southampton	Virginia Virginia Virginia Virginia	70 70 70 70	1.60 1.60 1.60 1.60	Lime Lime Lime Lime	3 3 3 3	Flakt Flakt Flakt Flakt	6/1992 8/1992 7/1992 3/1992
Hoosier Energy Merom Merom	1 2	Merom Merom	Indiana Indiana	490 490	4.20 4.20	Limestone Limestone	1 1	Mitsubishi Heavy Industries Mitsubishi Heavy Industries	8/1982 12/1981
Houston Lighting & Power Limestone Limestone Malakoff Malakoff W.A. Parish	1 2 1 2 8	Jewitt Jewitt Malakoff Malakoff Thompsons	Texas Texas Texas Texas Texas	780 780 690 690 570	3.10 3.10 1.10 1.10 0.44	Limestone Limestone Limestone Limestone Limestone	1 1 3 3 1	Combustion Engineering Combustion Engineering GE Environmental Services GE Environmental Services GE Environmental Services	10/1985 10/1986 0/1997 0/1999 10/1982
Indeck Energy Services, ^d Inc. Turners Falls	1	Turners Falls	Massachusetts	19	1.00	Lime	2	GE Environmental Services	8/1989
Indianapolis Power & Light Patriot Patriot Patriot Petersburg Petersburg	1 2 3 4	Patriot Patriot Patriot Petersburg Petersburg	Indiana Indiana Indiana Indiana Indiana	650 650 650 532 526	3.50 3.50 3.50 4.50 4.50	Limestone Limestone Limestone Limestone Limestone	6 6 6 1 1	Vendor not selected Vendor not selected Vendor not selected Air Correction Division, UOP Research-Cottrell	99/2050 99/2050 99/2050 12/1977 1/1986

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status ^b	System supplier	Initial start-up date ^c
Jacksonville Electric Authority									
St. Johns River Power	1	Jacksonville	Florida	660	2.50	Limestone	1	Research-Cottrell	12/1986
St. Johns River Power	2	Jacksonville	Florida	660	2.50	Limestone	1	Research-Cottrell	3/1988
Kansas City Power & Light									
La Cygne	1	La Cygne	Kansas	740	5.40	Limestone	1	Babcock & Wilcox	12/1972
Kansas Power & Light									
Jeffrey	1	Wamego	Kansas	720	0.32	Limestone	1	Combustion Engineering	8/1978
Jeffrey	2	Wamego	Kansas	720	0.32	Limestone	1	Combustion Engineering	1/1980
Jeffrey	3	Wamego	Kansas	720	0.32	Limestone	1	Combustion Engineering	5/1983
Lawrence	4	Lawrence	Kansas	119	0.55	Limestone	1	Combustion Engineering	1/1977
Lawrence	5	Lawrence	Kansas	355	0.55	Limestone	1	Combustion Engineering	4/1978
Kentucky Utilities									
Green River	1-3	Central City	Kentucky	60	3.80	Lime	1	American Air Filter	9/1975
Lakeland Utilities									
McIntosh	3	Lakeland	Florida	364	1.80	Limestone	1	Babcock & Wilcox	7/1982
Los Angeles Department of Water & Power									
Intermountain	1	Delta	Utah	841	1.00	Limestone	1	GE Environmental Services	2/1986
Intermountain	2	Delta	Utah	841	1.00	Limestone	1	GE Environmental Services	3/1987
Louisville Gas & Electric									
Cane Run	4	Louisville	Kentucky	170	4.00	Lime	1	American Air Filter	8/1976
Cane Run	5	Louisville	Kentucky	181	4.00	Lime	1	Combustion Engineering	12/1977
Cane Run	6	Louisville	Kentucky	260	4.00	Dual alkali	1	Thyssen/CEA	4/1979
Mill Creek	1	Louisville	Kentucky	321	4.50	Limestone	1	Combustion Engineering	12/1980
Mill Creek	2	Louisville	Kentucky	338	4.50	Limestone	1	Combustion Engineering	12/1981
Mill Creek	3	Louisville	Kentucky	412	4.00	Limestone	1	Combustion Engineering	12/1978
Mill Creek	4	Louisville	Kentucky	496	4.00	Limestone	1	American Air Filter	7/1982
Trimble County	1	Bedford	Kentucky	495	4.50	Limestone	2	Combustion Engineering	12/1990
Lower Colorado River Authority									
Fayette Power Project	3	LaGrange	Texas	451	1.70	Limestone	1	Combustion Engineering	3/1988
Fayette Power Project	4	LaGrange	Texas	451	1.70	Limestone	6	Vendor not selected	99/2050
Marquette Board of Light and Power									
Shiras	3	Marquette	Michigan	44	0.60	Lime/spray drying	1	GE Environmental Services	3/1983
Michigan Southern Central Power Agency									
Endicott	1	Litchfield	Michigan	55	2.25	Limestone	1	Babcock & Wilcox	5/1983

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status	System supplier	Initial start-up date
Minnesota Power & Light Clay Boswell	4	Cohasset	Minnesota	554	1.00	Lime/alkaline fly ash	1	Peabody Process Systems	2/1980
Minnesota Power Hilton R. Young	2	Center	North Dakota	440	1.20	Lime/alkaline fly ash	1	Thyssen/CEA	9/1977
Monongahela Power Pleasants	1 2	Willow Island Willow Island	West Virginia West Virginia	684 684	3.00 3.00	Lime Lime	1 1	Babcock & Wilcox Babcock & Wilcox	12/1978 10/1980
Montana Power Colstrip	1	Colstrip	Montana	358	0.80	Lime/alkaline fly ash	1	Thyssen/CEA	9/1975
Colstrip	2	Colstrip	Montana	358	0.80	Lime/alkaline fly ash	1	Thyssen/CEA	8/1976
Colstrip	3	Colstrip	Montana	778	1.00	Lime/alkaline fly ash	1	Bechtel/Montana Power	10/1983
Colstrip	4	Colstrip	Montana	778	1.00	Lime/alkaline fly ash	1	Bechtel/Montana Power	12/1985
Montana-Dakota Utilities Coyote	1	Beulah	North Dakota	427	0.87	Sodium carbonate/ spray drying	1	Wheelabrator-Frye/R.I.	4/1981
Muscataine Power & Water Muscataine	9	Muscataine	Iowa	172	3.21	Limestone	1	Research-Cottrell	4/1983
Nevada Power Harry Allen	1	Las Vegas	Nevada	250	NA	Process not selected	6	Vendor not selected	0/1997
Harry Allen	2	Las Vegas	Nevada	250	NA	Process not selected	6	Vendor not selected	0/1999
Harry Allen	3	Las Vegas	Nevada	250	NA	Process not selected	6	Vendor not selected	0/2001
Harry Allen	4	Las Vegas	Nevada	250	NA	Process not selected	6	Vendor not selected	0/2003
Reid Gardner	1	Moapa	Nevada	125	0.50	Sodium carbonate	1	Thyssen/CEA	3/1974
Reid Gardner	2	Moapa	Nevada	125	0.50	Sodium carbonate	1	Thyssen/CEA	4/1974
Reid Gardner	3	Moapa	Nevada	125	0.50	Sodium carbonate	1	Thyssen/CEA	6/1976
Reid Gardner	4	Moapa	Nevada	285	0.90	Sodium carbonate	1	Thyssen/CEA	6/1983
New York State Electric & Gas Somerset	1	Somerset	New York	680	3.60	Limestone	1	Peabody Process Systems	7/1984
Northern Indiana Public Service Bailey	7-8	Porter	Indiana	550	NA	Limestone	3	Pure air	0/1992
R.M. Schahfer	17	Wheatfield	Indiana	379	3.25	Dual alkali	1	FMC	4/1983
R.M. Schahfer	18	Wheatfield	Indiana	376	3.25	Dual alkali	1	FMC	12/1985

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status ^b	System supplier	Initial start-up date ^c
Northern States Power Riverside	6-7	Minneapolis	Minnesota	150	1.20	Lime/spray drying	1	Joy Mfg./Niro Atomizer	11/1980
Sherburne Co.	1	Becker	Minnesota	750	0.80	Limestone/alkaline fly ash	1	Combustion Engineering	3/1976
Sherburne Co.	2	Becker	Minnesota	750	0.80	Limestone/alkaline fly ash	1	Combustion Engineering	3/1977
Sherburne Co.	3	Becker	Minnesota	850	1.00	Lime/spray drying	1	Joy Mfg./Niro Atomizer	7/1987
Ohio Edison Co. Edgewater	4	Lorain	Ohio	105	NA	Lime	1	Ohio Edison Co.	7/1989
Old Dominion Electric Clover	1	Clover	Virginia	424	NA	Limestone	3	Combustion Engineering	0/1993
Clover	2	Clover	Virginia	424	NA	Limestone	3	Combustion Engineering	0/1994
Orlando Utilities Commission	1	Orlando	Florida	460	3.50	Limestone	1	Combustion Engineering	5/1987
C.H. Stanton									
Oxford Energy Co. ^d	1	Lackawanna	New York	33	NA ^f	Lime	3	GE Environmental Services	0/1992
Exeter Energy Project	1	Sterling	Connecticut	30	1.75 ^f	Lime	2	Vendor not selected	0/1991
Modesto Energy Project	1	Westley	California	14	1.75 ^f	Lime	1	GE Environmental Services	10/1987
Pacific Power & Light Dave Johnston	4	Glenrock	Wyoming	330	0.50	Lime/spray drying	1	GE Environmental Services	2/1985
Jim Bridger	1	Rock Springs	Wyoming	508	0.56	Sodium carbonate	2	Babcock & Wilcox	6/1990
Jim Bridger	2	Rock Springs	Wyoming	508	0.56	Sodium carbonate	1	Babcock & Wilcox	6/1986
Jim Bridger	3	Rock Springs	Wyoming	508	0.56	Sodium carbonate	1	Babcock & Wilcox	6/1988
Jim Bridger	4	Rock Springs	Wyoming	508	0.56	Sodium carbonate	1	Air Correction Division, UOP	9/1979
Wyodak	1	Joliet	Wyoming	320	0.55	Lime/spray drying	1	Joy Mfg./Niro Atomizer	9/1986
Pennsylvania Power Bruce Mansfield	1	Shippingport	Pennsylvania	835	4.70	Lime	1	GE Environmental Services	12/1975
Bruce Mansfield	2	Shippingport	Pennsylvania	835	4.70	Lime	1	GE Environmental Services	7/1977
Bruce Mansfield	3	Shippingport	Pennsylvania	835	4.75	Lime	1	M.W. Kellogg	6/1980
Philadelphia Electric Cromby	1	Phoenixville	Pennsylvania	188	1.70	Magnesium oxide	1	United Engineers	10/1982
Eddystone	1	Eddystone	Pennsylvania	354	1.70	Magnesium oxide	1	United Engineers	9/1982
Eddystone	2	Eddystone	Pennsylvania	354	1.70	Magnesium oxide	1	United Engineers	11/1982
Plains Electric G & T Plains Escalante	1	Prewitt	New Mexico	233	0.80	Limestone	1	Combustion Engineering	11/1984

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status	System supplier	Initial start-up date
Platte River Power Authority Rawhide	1	Wellington	Colorado	278	0.29	Lime/spray drying	1	Joy Mfg./Miro Atomizer	12/1983
Public Service Indiana Gibson	5	Princeton	Indiana	667	4.40	Limestone	1	M.W. Kellogg	10/1982
Public Service of Colorado Arapahoe	4	Denver	Colorado	112	NA	Sodium bicarbonate/ dry injection	2	Public Service of Colorado	12/1991
Cherokee	1	Denver	Colorado	100	NA	Sodium bicarbonate/ dry injection	2	Public Service of Colorado	12/1991
Cherokee	2	Denver	Colorado	110	NA	Sodium bicarbonate/ dry injection	2	Public Service of Colorado	12/1991
Cherokee	3	Denver	Colorado	150	NA	Sodium bicarbonate/ dry injection	2	Public Service of Colorado	12/1991
Cherokee	4	Denver	Colorado	375	0.65	Sodium bicarbonate/ dry injection	1	Public Service of Colorado	4/1989
Pawnee	2	Brush	Colorado	500	0.35	Sodium bicarbonate/ dry injection	6	Public Service of Colorado	0/1994
Valmont	5	Denver	Colorado	166	NA	Sodium bicarbonate/ dry injection	2	Public Service of Colorado	12/1990
Public Service of New Mexico San Juan	1	Waterflow	New Mexico	361	0.80	Wellman Lord	1	Davy McKee	4/1978
San Juan	2	Waterflow	New Mexico	350	0.80	Wellman Lord	1	Davy McKee	8/1978
San Juan	3	Waterflow	New Mexico	544	0.80	Wellman Lord	1	Davy McKee	12/1979
San Juan	4	Waterflow	New Mexico	544	0.80	Wellman Lord	1	Davy McKee	5/1982
Public Service of Oklahoma Oklahoma	1	Tulsa	Oklahoma	600	NA	Process not selected	6	Vendor not selected	0/2001
Inola	2	Tulsa	Oklahoma	600	NA	Process not selected	6	Vendor not selected	0/2007
Salt River Project Coronado	1	St. Johns	Arizona	400	1.00	Limestone	1	M.W. Kellogg	11/1979
Coronado	2	St. Johns	Arizona	400	1.00	Limestone	1	M.W. Kellogg	7/1980
Coronado	3	St. Johns	Arizona	400	0.60	Limestone	2	SPR/M.W. Kellogg	0/2004
San Antonio Public Service J.K. Spruce	1	San Antonio	Texas	535	0.35	Limestone	2	Combustion Engineering	5/1992
J.K. Spruce	2	San Antonio	Texas	535	0.35	Limestone	3	Combustion Engineering	5/1998

(continued)

TABLE 3 (contInued)

Company plant name	Unit No.	City	State	Capac- ity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD b status	System supplier	Initial start-c up date
San Miguel Electric San Miguel	1	San Miguel	Texas	410	2.00	Limestone	1	Babcock & Wilcox	8/1981
Seminole Electric Seminole	1	Palatka	Florida	650	3.00	Limestone	1	Peabody Process Systems	5/1983
Seminole	2	Palatka	Florida	650	3.00	Limestone	1	Peabody Process Systems	9/1984
Sierra Pacific Power North Valmy	2	Valmy	Nevada	288	0.50	Line/spray drying	1	Rockwell International	5/1985
Thousand Springs	1	Wells	Nevada	250	NA	Process not selected	6	Vendor not selected	99/2050
Thousand Springs	2	Wells	Nevada	250	NA	Process not selected	6	Vendor not selected	99/2050
Thousand Springs	3	Wells	Nevada	250	NA	Process not selected	6	Vendor not selected	99/2050
Sikeston Board of Municipal Utilities Sikeston	1	Sikeston	Missouri	235	2.80	Limestone	1	Babcock & Wilcox	6/1981
South Carolina Public Service Cross	1	Cross	South Carolina	510	1.80	Limestone	3	Peabody Process Systems	0/1995
Cross	2	Cross	South Carolina	510	1.80	Limestone	1	Peabody Process Systems	10/1983
Pee Dee	1	Florence	South Carolina	550	NA	Limestone	6	Vendor not selected	0/2005
Pee Dee	2	Florence	South Carolina	550	NA	Limestone	6	Vendor not selected	0/2006
Winyah	2	Georgetown	South Carolina	315	1.08	Limestone	1	Vendor not selected	7/1977
Winyah	3	Georgetown	South Carolina	315	2.00	Limestone	1	Babcock & Wilcox	7/1980
Winyah	4	Georgetown	South Carolina	315	1.70	Limestone	1	American Air Filter	7/1981
South Mississippi Electric Power R.D. Morrow, Sr.	1	Purvis	Mississippi	215	1.50	Limestone	1	Enviroengineering, Riley Stoker	8/1978
R.D. Morrow, Sr.	2	Purvis	Mississippi	215	1.50	Limestone	1	Enviroengineering, Riley Stoker	6/1979
Southern Illinois Power Marion	4	Marion	Illinois	184	4.40	Limestone	1	Babcock & Wilcox	4/1979
Southern Indiana Gas & Electric A.B. Brown	1	West Franklin	Indiana	265	4.50	Dual alkali	1	FMC	3/1979
A.B. Brown	2	West Franklin	Indiana	265	4.50	Dual alkali	1	FMC	2/1986
Southwestern Electric Power Doleet Hills	1	Mansfield	Louisiana	720	0.70	Limestone	1	Air Correction Division, UOP	12/1985
Henry W. Pirkey	1	Hallsville	Texas	720	0.80	Limestone	1	Air Correction Division, UOP	12/1984
Walker Co.	1	Huntsville	Texas	720	1.49	Process not selected	6	Vendor not selected	0/2005
Walker Co.	2	Huntsville	Texas	720	1.49	Process not selected	6	Vendor not selected	99/2050

(contInued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capac- ity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD b status	System supplier	Initial start- up date
Southwestern Public Service									
South Plains	1	Idalou	Texas	572	NA	Process not selected	6	Vendor not selected	99/2050
Springfield Water, Light & Power									
Dallman	3	Springfield	Illinois	192	3.30	Limestone	1	Research-Cottrell	10/1980
Sunflower Electric									
Holcomb	1	Holcomb	Kansas	319	1.00	Lime/spray drying	1	Joy Mfg./Niro Atomizer	7/1983
Tampa Electric									
Big Bend	4	Tampa	Florida	455	3.50	Limestone	1	Research-Cottrell	12/1984
Tennessee Valley Authority									
Paradise	1	Paradise	Kentucky	704	3.20	Limestone	1	GE Environmental Services	5/1983
Paradise	2	Paradise	Kentucky	704	3.20	Limestone	1	GE Environmental Services	7/1983
Shamnee	9	Paducah	Kentucky	10	4.00	Lime/spray drying	1	EPRI/IWA/Ontario Hydro	3/1987
Widows Creek	7	Bridgeport	Alabama	575	4.00	Limestone	1	Combustion Engineering	3/1981
Widows Creek	8	Stevenson	Alabama	550	4.00	Limestone	1	Tennessee Valley Authority	5/1977
Texas Municipal Power Agency									
Gibbons Creek	1	Carlos	Texas	443	1.06	Limestone	1	Combustion Engineering	11/1982
Texas Utilities									
Forest Grove	1	Athens	Texas	750	2.10	Limestone	6	Vendor not selected	99/2050
Martin Lake	1	Tatum	Texas	793	0.90	Limestone	1	Research-Cottrell	4/1977
Martin Lake	2	Tatum	Texas	793	0.90	Limestone	1	Research-Cottrell	5/1978
Martin Lake	3	Tatum	Texas	793	0.90	Limestone	1	Research-Cottrell	2/1979
Monticello	3	Mt. Pleasant	Texas	793	1.50	Limestone	1	GE Environmental Services	5/1978
Sandow	4	Rockdale	Texas	595	1.60	Limestone	1	Combustion Engineering	12/1980
Twin Oak	1	Bremond	Texas	750	1.60	Limestone	3	Vendor not selected	0/1994
Twin Oak	2	Bremond	Texas	750	0.70	Limestone	3	Vendor not selected	0/1995
United Power Association									
Stanton	10	Stanton	North Dakota	60	0.77	Lime/spray drying	1	Research-Cottrell	7/1982
Utah Power & Light									
Hunter	1	Castle Dale	Utah	430	0.60	Lime	1	GE Environmental Services	3/1979
Hunter	2	Castle Dale	Utah	430	0.60	Lime	1	GE Environmental Services	6/1980
Hunter	3	Castle Dale	Utah	424	0.60	Limestone	1	GE Environmental Services	4/1983
Huntington	1	Huntington	Utah	426	0.55	Lime	1	GE Environmental Services	5/1978
Naughton	3	Kemmerer	Wyoming	346	0.55	Sodium carbonate	1	Air Correction Division	9/1981

(continued)

TABLE 3 (continued)

Company plant name	Unit No.	City	State	Capacity, MW (gross)	Fuel design, percent sulfur	FGD process	FGD status ^b	System supplier	Initial start-up date ^c
Washington Water Power									
Creston Coal	1	Creston	Washington	570	NA	Limestone	6	Vendor not selected	99/2050
Creston Coal	2	Creston	Washington	570	NA	Limestone	6	Vendor not selected	99/2050
Creston Coal	3	Creston	Washington	570	NA	Limestone	6	Vendor not selected	99/2050
Creston Coal	4	Creston	Washington	570	NA	Limestone	6	Vendor not selected	99/2050
West Penn Power Mitchell	3	Courtney	Pennsylvania	296	3.00	Lime	1	GE Environmental Services	8/1982
West Texas Utilities									
Oklaunion	1	Oklaunion	Texas	720	0.40	Limestone	1	GE Environmental Services	11/1986
Oklaunion	2	Oklaunion	Texas	720	0.40	Process not selected	6	Vendor not selected	99/2050
White Pine County									
White Pine Power Project	1	Ely	Nevada	820	0.60	Process not selected	6	Vendor not selected	99/2050
White Pine Power Project	2	Ely	Nevada	820	0.60	Process not selected	6	Vendor not selected	99/2050
Wisconsin Electric Power									
Port Washington	1	Port Washington	Wisconsin	80	NA	Process not selected	6	Vendor not selected	0/1994
Port Washington	4	Port Washington	Wisconsin	80	NA	Process not selected	6	Vendor not selected	0/1994

^a Coal, unless otherwise stated. The sulfur content listed is the design sulfur content. See Section 2 of the FGD Survey Report for the average sulfur content of the fuel as burned.

^b FGD status codes are defined as:

- 1 - Operation units.
- 2 - Units under construction.
- 3 - Planned - contract awarded.

4 - Planned, letter of intent signed.

5 - Planned, requesting/evaluating bids.

6 - Planned, considering only FGD systems for SO₂ compliance.

^c 99/indicates indefinitely deferred unit.

^d Nonutility generator that sells power to utilities.

^e NA = Not available.

^f Fuel for this unit is tires.

Figure 1. History of utility FGD status reports for operational, under construction, and planned FGD capacity - December 1970 through December 1989.¹

Figure 2 presents a comparison of actual coal-fired generating capacity and FGD capacity from 1975 through 1989 and projections thereafter through 1999.¹⁻¹² Although the retirement of older units is taken into account in these plots, such retirements affect only the overall coal-fired capacity rate because FGD-controlled capacity represents primarily new power generating capacity. This accounts for the slightly greater slope of the lower line, which depicts FGD-controlled capacity.

Current projections estimate the total power-generating capacity of the U.S. electric utility industry will be 773 GW by the end of 1999.¹² (This value reflects the loss resulting from the retirement of older units, which is considered to be approximately 4,394 MW by the end of 1999.¹²) Approximately 337 GW, or 44 percent of the 1999 total, is estimated to be coal-fired units. Table 4 presents a distribution of present (December 1989) and future (December 1999) power generation sources.

It is interesting to note that the breakdown for the actual power produced by these sources during the past year (Table 5)¹³ differs appreciably, especially for coal- and oil-fired sources, from the power generating capacity shown in Table 4. This is due to the effect of the changing economy on the operation of various types of power-plants and also on the fact that coal and nuclear plants tend to be base loaded and other types tend to serve as intermediate or peak loading units.

Based on known commitments of utilities to FGD (as presented in Table 1) and other coal-fired generating capacity expected to be required to incorporate FGD (Figure 2), current and projected percentages of electrical generating capacity controlled by FGD are shown in Table 6. The utility FGD survey includes 13 non-utility units that contribute all or part of the power they produce to the utility grid.

Cogeneration and independent power producing facilities are becoming a larger factor of electrical energy production partially as a result of legislation requiring utilities to purchase power whenever possible and the high cost of constructing new units.

Currently the capacity of non-utility units is over 14,588 MW¹⁴ (approximately 2.1 percent^{12,14} of the total in the United States). By 1999, this capacity is expected to increase to 33,009 MW¹⁴ (approximately 4.3 percent^{12,14} of the 1999 capacity). Non-utility units are expected to produce 4.0 percent of the electricity in 1990 and 6.4 percent in 1999.¹⁴

Table 7 presents data on the planned additions to the electric generating units of non-utility power producers compared with utility additions for the next five years. As shown, the non-utility producers will account for as much as 48 percent of the new capacity in 1990 and will be from 30 to 66 percent of the additional capacity in the following years.

Figure 2. Actual and projected coal-fired generating capacity and FGD capacity, 1989.¹⁻¹²

**TABLE 4. POWER GENERATION SOURCES: PRESENT AND FUTURE
(U.S. DOE, Inventory of Power Plants, 1989)¹²**

	Coal	Nuclear	Oil	Hydro	Gas	Other	Total generating capacity, generator nameplate, GW ^a
December 1989	44%	14%	12%	12%	17%	1%	731
December 1999	44%	14%	11%	12%	18%	1%	773

^a Generator nameplate capacity: The rating assigned by the generator manufacturer and appearing on the generator's nameplate.

**TABLE 5. POWER PRODUCTION BY SOURCE
(U.S. DOE, Electric Power Monthly, February 1991)¹³**

	Coal	Nuclear	Oil	Hydro	Gas	Other	Total energy generated, GWh
January-December 1989	56%	19%	6%	9%	10%	0	2,784,304

**TABLE 6. FGD-CONTROLLED GENERATING CAPACITY: PRESENT AND FUTURE
(FGDIS, U.S. DOE Inventory of Power Plants, 1989)^{1,12}**

	Coal-fired generating capacity controlled by FGD, %	Total generating capacity controlled by FGD, %
December 1989 ^a	21.1	9.3
December 1999	24.9	10.9

^a The December 1989 FGD total controlled capacity figures are based on reports by utilities. The figures used for the total generating capacity and the December 1999 coal-fired generating capacity are based on December 1989 DOE-projected generator nameplate figures.

**TABLE 7. CAPACITY ADDITIONS
OF UTILITIES VERSUS NON-UTILITY PRODUCERS^{12,14}**
(MW)^a

	Actual 1989	Projected				
		1990	1991	1992	1993	1994
Utilities	684,619	4141	6238	2460	2443	3218
Non-utility ^b	14,588	3786	2683	4692	3729	1994

^a Summer capability MW rating: the steady hourly output that generating equipment is expected to supply to system load, exclusive of auxiliary power, as demonstrated by testing at the time of summer peak demand.

^b Non-utility generators are facilities that are not owned exclusively by an electric utility that sells or is projected to sell electric energy and/or capacity to electric utilities.

Table 8 gives the percentage of each fuel type that will be added from 1990 to 1999. As shown, coal accounts for 18.5 percent (3692 MW) of these additions. FGD systems will be used by some of the coal-fired units as well as other fuels (e.g., tires, waste). Other coal units will use fluidized bed boilers or will burn low-sulfur coal.

TABLE 8. NON-UTILITY UNIT ADDITIONS BY FUEL TYPE¹⁴
(Courtesy of North American Electric Reliability Council)

Fuel type	1990-1999 Summer Megawatts (MW)	Percent of total planned capacity
Natural gas	4,239	21.2
Gas (other)	3,868	19.4
Coal	3,692	18.5
Refuse (solid waste)	1,163	5.8
Hydro	585	2.9
Wood/wood wastes	435	2.2
Solar	151	0.8
Geothermal	108	0.5
Fuel oil	61	0.3
wind	44	0.2
Other or unknown	5,619	28.2
TOTAL	19,965	100.0

Table 9 shows both the current (December 1989) and projected (after December 2000) breakdown of throwaway-product FGD systems versus saleable-product FGD systems as a percentage of the total known commitments to FGD. If the SO₂ or particulate removed from the flue gas is recovered in a usable or marketable form

(e.g., gypsum), the product is considered saleable. If the SO₂ or particulate is not recovered in a usable form, it is considered a throwaway product.

TABLE 9. SUMMARY OF FGD SYSTEMS BY PROCESS
(percentage of total MW)

Process	Byproduct	December 1989	Future	Future ^a
<u>Throwaway-product</u>				
Wet scrubbing				
Dual alkali		3.3	2.3	2.5
Lime		16.3	13.5	14.6
Lime/alkaline fly ash		7.0	4.9	5.2
Limestone		48.0	43.9	47.6
Limestone/alkaline fly ash		2.4	1.6	1.8
Sodium carbonate		4.0	3.3	3.6
Spray drying				
Lime		8.8	7.9	8.6
Sodium carbonate		0.7	0.5	0.5
Reagent type not selected		-	2.1	2.2
Dry injection				
Lime		0.2	0.1	0.1
Sodium carbonate		0.6	1.6	1.8
Reagent type not selected		-	0.2	0.2
Process not selected		-	2.2	2.4
<u>Saleable-product</u>				
Wet scrubbing				
Lime	Metals/fly ash/other	<0.1	<0.1	<0.1
Limestone	Gypsum	4.1	4.6	5.0
Magnesium oxide	Sulfuric	1.4	1.0	1.1
Wellman Lord	acid	3.1	2.1	2.3
	Sulfuric acid			
Spray drying				
Lime	Dry scrubber waste	-	0.3	0.3
Process undecided		-	7.8	-
TOTAL		100.0	100.0	100.0

^a The effect of those systems listed as "Process undecided" is removed.

HIGHLIGHTS: JANUARY-DECEMBER 1989

The following paragraphs highlight FGD system activities and availabilities during the period of January through December 1989.

Indeck Energy Services, Inc., reported that initial operations began on Turners Falls 1 in August 1989. This 19-MW (gross) unit located in Turners Falls, Massachusetts, has a dry lime injection FGD system supplied by General Electric Environmental Services, Inc. (GEESI) for SO₂ control and a fabric filter for particulate control.

Ohio Edison Company reported that initial testing began on the retrofitted Coolside FGD demonstration project on Edgewater 4. This 105-MW (gross) unit located in Lorain, Ohio, burns high-sulfur bituminous coal. The FGD process that is part of the U.S. Department Of Energy (DOE) Clean Coal Technology program utilizes dry hydrated lime for SO₂ capture. The hydrated lime and humidification water are injected into the flue gas stream via a humidification chamber downstream of the boiler. The Coolside FGD system, which is designed to capture 70 percent of the SO₂, commenced operations in July 1989.

Old Dominion Electric Cooperative reported that it has awarded contracts for the construction of two new units to be located in Clover, Virginia. These 424-MW (gross) units will be supplied by Combustion Engineering and will burn pulverized bituminous coal. Each unit will employ a Combustion Engineering wet limestone FGD system for SO₂ control and a fabric filter for particulate control.

Oxford Energy Company announced that construction began on the Exeter Energy Project 1 in Sterling, Connecticut. This 30-MW (gross) cogeneration facility will burn waste tires as fuel. The facility, capable of burning 1600 tires an hour, will utilize a wet lime FGD system for SO₂ control and a fabric filter for particulate control. Startup of Exeter Energy Project 1 is scheduled for 1991. The company also reported that a contract has been awarded to GEESI to supply a wet lime FGD system for SO₂ control for a new 33-MW (gross) tire-burning cogeneration facility to be located in Lackawanna, New York. The facility, named Erie Energy Project 1, is scheduled to commence operations in 1992.

Public Service Company of Colorado reported that initial operations of the retrofitted sodium bicarbonate dry injection FGD system on Cherokee Unit 4 commenced in April 1989. The FGD 350-MW (gross) unit was originally equipped with an ESP followed by a wet packed tower for primary particulate control. This equipment was replaced with a GEESI-supplied fabric filter preceded by a dry sodium bicarbonate injection system designed by the utility for particulate

and SO₂ control. The retrofit dry injection FGD system meets the EPA-required 20-percent-reduction-level equivalency for both Cherokee Units 1 and 4.

Texas Utilities Electric Company announced that it has awarded contracts for the construction of two new units (Twin Oak 1 and 2) in Bremond, Texas. The units will fire pulverized lignite coal and have a gross rating of 750 MW. Each unit will utilize a wet limestone FGD system supplied by GEESI for SO₂ control and an ESP for particulate control. Initial startups of the units are scheduled in 1994 and 1995, respectively.

Wisconsin Electric Power Company announced plans to retrofit dry duct injection FGD systems onto their Port Washington 1 and 4 units in Port Washington, Wisconsin. The pulverized bituminous-coal-fired units have a gross rating of 80 MW. The retrofit FGD systems are scheduled to be in service by 1994.

Table 10 lists the names of the utility systems that reported achieving operating availabilities of 90 percent or greater for the period January through December 1989.

**TABLE 10. UTILITY FGD SYSTEMS ACHIEVING
AVERAGE ANNUAL AVAILABILITIES OF 90 PERCENT
OR GREATER FOR 1989**

Utility	Unit
Alabama Electric	Lowman 2 Lowman 3
Associated Electric	Thomas Hill 3
Central Illinois Light	Duck Creek 1
Central Illinois Public Service	Newton 1
Columbus & Southern Ohio Electric	Conesville 5 Conesville 6
Hoosier Energy	Merom 2
Indianapolis Power & Light	Petersburg 3
Minnesota Power & Light	Clay Boswell 4
Muscatine Power and Water	Muscatine 9
Nevada Power	Reid Gardner 1 Reid Gardner 2 Reid Gardner 3 Reid Gardner 4
Orlando Utilities	C.H. Stanton 1
Public Service of Indiana	Gibson 5
Seminole Electric	Seminole 2
Sierra Pacific Power	North Valmy 2
South Carolina Public Service	Cross 2 Winyah 3 Winyah 4
Southern Illinois Power	Marion 4
Southern Indiana Gas & Electric	AB Brown 1 AB Brown 2
South Mississippi Electric	RD Morrow 1 RD Morrow 2
Sunflower Electric	Holcomb 1
Utah Power & Light	Naughton 3

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The complete report, entitled "Utility FGD Survey: January-December 1989," will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(703) 487-4650

For further information, contact:

James Kelly, U.S. Department of Energy
(202) 586-8420

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