IMPLICATIONS OF ALTERNATIVE POLICIES FOR THE USE OF PERMANENT CONTROLS AND SUPPLEMENTAL CONTROL SYSTEMS (SCS)

18 NOV 1974

IMPLICATIONS OF ALTERNATIVE POLICIES FOR THE USE OF PERMANENT CONTROLS AND SUPPLEMENTAL CONTROL SYSTEMS (SCS)

Conclusions

EPA in cooperation with other agencies has analyzed the implications of alternative policies concerning the use of permanent controls (i.e. use of low sulfur coal or scrubbers) or supplemental control systems (SCS). The principal findings of this study are:

- o Compliance with permanent controls by 1980 (Option 1 or current EPA policy) would increase the utility industry's capital requirements between 1974 and 1980 by $5.5 billion (or by 4.6%).
- o Between 18 and 70 plants (18,000-53,000 megawatts) could use SCS to meet ambient air quality standards for sulfur dioxide (SO_2).
- o Delaying the date of compliance with permanent controls for plants that could use SCS (Options 2 and 3) shifts between $.5 and $1.6 billion of the capital expenditure burden for existing sources from the 1974-80 period to the 1980-85 period.
- o Permitting the indefinite use of SCS (Option 4) would reduce the utility industry's capital requirements by $.5 to $1.6 billion between 1974 and 1985. If these figures were discounted to present worth using a 7% discount rate, the savings would be $.3 to $.9 billion.
- o The utility industry is projected to spend $120 billion (1974 dollars) between 1974 and 1980 and $260 billion between 1974 and 1985 in the absence of environmental regulations. Expenditures

for SO_2 control will increase the industry's capital requirements over the next 10 years between 2.1% (Option 4) and 2.7% (Option 1).

o Under Options 1, 2 and 3 expenditures for SO_2 control will increase the average consumer's electricity bill approximately 4.7% in 1985. Allowing the indefinite use of SCS (Option 4) would reduce the expected price increase to between 3.8 and 4.4%. However, since 90% of the candidate plants for SCS are located in four electric reliability areas, greater price increases will be experienced in some areas and less in others.

Background

The Clean Air Act establishes national ambient air quality standards to protect public health and secondary air quality standards to protect other values such as property and vegetation. In 1972, the States submitted implementation plans (SIP's) which included constant emission limitations to insure the attainment and maintenance of ambient air quality standards. The act established a deadline for compliance for stationary sources by mid-1975, with extensions possible through State initiative up to mid-1977.

To achieve the statutory compliance dates, more stack gas scrubbers, other control technology and low sulfur fuel would be required than will be available. According to studies by EPA, FEA and the Bureau of Mines, the original State Implementation Plans (SIP's) would, in theory, have precluded the burning of 220 million tons of current coal production by 1975. However, through EPA's "Clean Fuels Policy," States have been urged to reduce limitations that were more stringent than necessary to protect public health. As a result, the deficit has been reduced to 185 million tons and changes currently in progress should reduce this deficit further to 130 million tons. Furthermore, EPA has pursued a policy of administratively extending compliance dates to assure that coal can continue to be burned.

While there is general agreement that plants coming on line after 1975 should meet new source performance standards, there is considerable disagreement over the extent to which permanent controls (i.e., use of low sulfur coal or scrubbers) should be used in existing plants to meet the objectives of the Clean Air Act. FEA and other agencies have argued that the use of supplemental control systems (SCS) should be allowed indefinitely where they can reliably meet ambient air quality standards. SCS is considerably cheaper than permanent controls. On the other hand, SCS does not appreciably reduce the total amount of sulfur emitted into the air. EPA indicates that there is accumulating evidence that sulfates--complex sulfur compounds which are formed from sulfur dioxide--cause adverse health effects. Because SCS will not reduce the total emissions of sulfur dioxide, EPA believes that it would only be marginally successful in reducing health damages from sulfates.

Alternative Policies

For the purposes of the analysis, coal burning power plants have been divided into three categories: new sources (i.e., post-1975), existing plants where SCS is feasible and enforceable and existing plants where SCS is not feasible and enforceable.* The analysis assumes that new sources will conform with new source performance standards.

- Option 1 (current EPA policy)
  - o All existing plants use permanent controls by 1980

- Option 2
  - o Existing plants where SCS is not feasible and enforceable use permanent controls by 1980

---

*Appendix A summarizes the methodology used to estimate the numbers of plants where SCS might be feasible and enforceable.

- o Existing plants where SCS is feasible and enforceable use SCS as an interim control strategy and install permanent controls by 1983

- Option 3
  - o Same as Option 2 except that existing plants where SCS is feasible and enforceable install permanent controls by 1985.

- Option 4
  - o Same as Option 2 except that SCS can be used indefinitely by existing plants where it is feasible and enforceable.

Analysis

1. Requirements for Scrubbers

An analytical study of existing power plants indicates that between 18 and 70 plants (18,000-53,000 megawatts) could be rated as SCS candidates.* Assuming that 50% of these plants would use scrubbers to comply with constant emission limitations, Table 1 summarizes the impact of different options for the phasing in of permanent controls on the demand for scrubbers:

Table 1
Cumulative Requirements for Scrubbers (thous. megawatts**)

Scenario	1980	1983	1985
1	83	99	111
2	56-74	99	111
3	56-74	72-90	111
4	56-74	72-90	84-102

*Appendix A describes the methodology used to derive these estimates.

**Appendix B explains the estimates for both new and existing plants.

Under the Energy Supply and Environmental Coordination Act (ESECA), 24,000 MW of capacity are expected to convert from oil to coal. The above estimates for 1980, 1983, and 1985 assume that 14,000 MW of this capacity will require scrubbers and the remaining 10,000 will meet requirements by using low sulfur coal. In addition, the estimates for 1980, 1983 and 1985 assume that 23,000 39,000 and 51,000 megawatts will require scrubbers to meet new source performance standards.

The analysis assumes complete achievement of EPA's Clean Fuels Policy which would allow the burning of 90 million tons of current high sulfur coal production through revision of SIP's that are more stringent than needed to attain primary standards. Failure to achieve this goal would increase the requirement for scrubbers and potential savings attributable to each of the Options 2 through 4 since some States might be willing to accept interim SCS while being unwilling to revise SIP limitations. Assuming a very conservative 30 million tons shortfall, approximately 8,000 megawatts of additional scrubber capacity would be required.

2. Incremental Investment for SO_2 Control

The utility industry is projected to spend $120 billion (1974 dollars) between 1974 and 1980 and $260 billion between 1974 and 1985 in the absence of environmental regulations.* The incremental capital requirements for SO_2 control for new and existing plants are shown in the following table:

---

*Estimates are based on Temple, Barker, and Sloane Inc.'s work for the Technical Advisory Committee on Finance to the National Power Survey.

Table 2
Cumulative Capital Investment for SO_2 Control
for New and Existing Plants
(billion 1974 dollars)

Option	1980 $Bil.	1983 $Bil.	1985 $Bil.
1	$5.5	$6.3	$7.0
2	3.9-5.0	6.4-6.6	7.1-7.3*
3	3.9-5.0	4.7-5.8	7.1-7.3*
4	3.9-5.0	4.7-5.8	5.4-6.5

The estimates of total expenditures provide a basis for evaluating the implications of the alternative policies for financing requirements. In addition, the following table shows the expenditures only for existing plants:

Table 3
Cumulative Capital Investment for SO_2 Control
for Existing Plants
(billion 1974 dollars)

Option	1980 $Bil.	1983 $Bil.	1985 $Bil.
1	$4.2	$4.2	$4.2
2	2.6-3.7	4.3-4.5	4.3-4.5
3	2.6-3.7	2.6-3.7	4.3-4.5
4	2.6-3.7	2.6-3.7	2.6-3.7

---

* Options 2 and 3 cost more than Option 1 because a number of existing utilities will build tall stacks by 1977 and then install permanent controls by 1983 or 1985. Appendix C summarizes the results for new and existing plants.

As indicated in Table 2 the cumulative capital investment for SO_2 control through 1985 will range from $5.4 to $7.3 billion or from 2.1 to 2.8% of the industry's projected capital expenditures during this period. The principal impact of the Options 2 and 3 is to delay capital expenditures during this period. The principal impact of the Options 2 and 3 is to delay capital expenditures while Option 4 would reduce total expenditures. Moreover, because the reduced expenditures will be concentrated in existing utilities and since 90% of these plants are located in four reliability regions, the regional impacts of the options could vary considerably.

Permitting the indefinite use of SCS (Option 4) would reduce the utility industry's capital requirements by $.5 to $1.6 billion between 1974 and 1985. If these figures were discounted to present worth using a 7% discount rate, the savings would be $.3 to $.9 billion.

Failure to achieve EPA's full goal of 90 million tons of SIP revisions would increase capital requirements of Options 1, 2 and 3. Assuming a conservative estimate of a 30 million ton shortfall, this increase in cumulative capital requirements by 1985 would be about $0.5 billion.

3. Incremental Annual Cost for SO_2 Control

In the absence of environmental regulations, the utility of industry's annual revenues are projected to increase from $30 billion in 1973 to $65 billion in 1980 and $85 billion in 1985. The incremental annual cost for SO_2 control for new and existing plants is summarized below:

Table 4

Annual Cost of SO_2 Control for New and Existing Plants
(billion 1974 dollars)

Option	1980 $Bil.	1983 $Bil.	1985 $Bil.
1	$2.6	$3.4	$4.0
2	1.8-2.3	3.4	4.0
3	1.8-2.3	2.6-3.1	4.0
4	1.8-2.3	2.6-3.1	3.2-3.7

Annual costs only for existing plants are shown in Table 5.

Table 5
Annual Cost of SO_2 Control for Existing Plants
(billion 1974 dollars)

Option	1980 $Bil.	1983 $Bil.	1985 $Bil.
1	$1.5	$1.5	$1.5
2	.7-1.2	1.5	1.5
3	.7-1.2	.7-1.2	1.5
4	.7-1.2	.7-1.2	.7-1.2

As indicated in the above tables, compliance with constant emission limitations by 1980 (Option 1) would increase the industry's total annual costs in 1985 by $4.0 billion which would increase the average consumer's electricity bill in 1980 by about 4.7%. Permitting the indefinite use of SCS (Option 4) would reduce the industry's costs in 1985 by about 300 to 800 million dollars. However, since 90% of the candidate plants for SCS are located in four electric reliability areas, the price increase will be higher in some regions and lower in others. If EPA's clean fuels policy is not as effective as currently anticipated, another 200 million dollars in annual savings possibly could be attained under Option 4.

APPENDIX A

SCS CANDIDATE POWER PLANT STUDY

SUMMARY AND FINDINGS

An analysis was made of 112 coal burning power plants (79,581 MW) to determine their potential for the application of supplementary control systems (SCS) to meet sulfur dioxide (SO) primary ambient air quality standards. Essentially all coal burning power plants considered to require further control of SO_2 emissions to meet primary standards are included in this study. It should be emphasized, however, that these plants were identified only for analytical purposed and inclusion or exclusion does not reflect a regulatory decision. The analysis is intended to be used solely for the purpose of estimatingthe magnitude of the problem.

Emissions from the 94 plants (see table 1) that EPA has identified as actual or potential violators of the primary air quality standards were tabulated and compared with total SO_2 emissions within a specified geographical area surrounding the plant (defined as the liability area* to permit an assessment oof the degree to which power plant emissions might affect ground level concentrations of SO_2. In general, the higher the power plant emissions are in comparison with total emissions, the greater the potential for using SCS to meet primary standards during periods of adverse meteorological conditions. Plants whose emissions are 90% or greater of the total are considered good candidates for SCS. Plants whose emissions comprise less than 50% to 70% of the total are considered poor SCS candidates because the aggregate emissions from other sources limit the ability of the plant to control emissions as required to meet primary standards.

The following table summarizes the findings from this analysis:

Plant Emissions of SO_2 (Percent of total in liability area)	No. of Plants	Capacity MW	Capacity %
> 90%	18	17,738	25
70-89	20	13,895	20
50-69	14	11,922	17
50	42	26,309	38
TOTAL	94	69,864	100

Based on a review of a prior FEA study of the potential plants for SCS, ** an addition 18 plants (9717 MW) that are not burning conforming coal were identified. These plants are listed in Table 2 and maybe candidates for SCS. Their inclusion as SCS candidates is based on their location in areas with population densities under 1,000 persons per square mile. If these relatively rural locations are dominated by power plant emissions, they may be good SCS candidates. However, a detailed analysis of emissions is required to make this determination.

*The following sections explain the methodology for defining the liability area.

** The Clean Fuels Deficit - A Clean Air Act Problem, Federal Energy Administration, August, 1974.

Based on the above findings the following tentative conclusions can be made:

- a low estimate of the potential for SCS would be the 18 plants in table 1 (17,738 MW) that accounted for over 90% of the emissions of SO_2 in the surrounding liability area.

- A high estimate of the potential for SCS would be the 52 plants in table 1 (43,555 MW) that account for over 50% of the emissions of SO_2 in the surrounding liability area plus the 18 plants (9717) in table 2 - that are located in counties with population densities under 1,000 persons per square mile. It should be emphasized that a detailed analysis of most of these plants would be required to verify their ability to meet primary standards with SCS.

The above conclusions are intended to be used only for analytical purposes and do not constitute a regulatory decision concerning the use of SCS.

STUDY METHODOLOGY

1. Basic Approach

A list of plants was developed to include all coal burning plants which are considered to require additional emission control to meet primary ambient air quality standards for SO_2. Next, a liability area was defined within which emissions from each SCS candidate plant could result in a violation of primary standards. Detailed emission data were drawn from the EPA NEDS emission file to define area source emissions and all significant point source emissions within the liability area. These data were tabulated and summarized. An assessment was then made based on plant emissions compared with total area emissions to determine the potential of each plant for use of SCS.

2. Study Criterion

The geographical area in which the plant may significantly affect air quality is defined as the liability area. It is assumed that this area will vary with plant SO_2 emissions as follows:

SO_2 Tons/Hr	Radius (Miles) Defining Liability Area
16	7
24	10
32	15
40	20
48	25

The liability area is based on the worst case limited mixing meteorological conditions. Distances define the minimum area in which the 24 hour primary standard may be exceeded in flat terrain as a result of plant emissions. The basis for determining this liability area is discussed in Section 4.

2. Within the liability area, it is assumed that SO_2 emissions from other sources must be relatively low for a plant to be considered an SCS candidate. Otherwise, an SCS system may not reduce area emissions sufficient to meet NAAQS. Any plant whose SO_2 emissions were judged to be the controlling factor in meeting NAAQS within its liability area was considered a candidate for SCS. Plants whose emissions comprise 90% or more of the total in the liability area are considered to be the best candidates. Those with emissions of less than 50% to 70% of the total are considered poor candidates.

3. Assumptions

1. The assumptions relating plant size and coal sulfur content to liability area are shown in Figure 1. Plant specific factors not considered in this study include:

a. stack height (minimal influence for worse case limited mixing condition).

b. meteorology (considered in determination of liability area).

c. terrain

d. extent of current violations

e. SCS system considerations

f. ability of plant to curtail emissions in accordance with SCS requirements (i.e., load shedding or fuel switching).

g. emission changes within the liability area due to new sources, plant additions, or the addition of emission controls.

2. Factors such as the above can significantly influence the decision to use SCS for individual plants. The use of a "standardized" liability area is particularly subject to plant specific considerations and must be tailored for each SCS candidate plant in accordance with local meterological conditions, terrain, and the proximity and size of other sources. Plants are assumed to be responsible for meeting primary standards in their liability area.

4. Definition of SCS Liability Area

The minimum liability area as defined under the study criterion is based on air pollution concentration estimates of the likely impact of large isolated pollution sources. For a selected adverse atmospheric dispersion condition, it is assumed that the downwind distance at which the estimates do not exceed the 24-hour NAAQS is the minimum distance at which the source may present a hazard to health and welfare. This distance, taken in all directions from the source, then identifies the minimum liability area. Generally, at points within this area, there is a likelihood of periodically exceeding the NAAQS. Beyond this liability area, the pollutants are diluted to the extent that NAAQS should not be endangered. It should be noted that the liability area ultimately must be established on a plant-by-plant basis and must consider factors unique to each plant.

The selected adverse atmospheric dispersion condition is the limited mixing situation. This has been identified by both TVA[1] and EPA[2,3] as a critical condition for dispersion of effluents from tall stacks. This critical condition is simulated by using the "Point Model" described in Appendix A[4] to 40 CFR Part 51 in conjunction with appropriate graphs[5] for estimating atmospheric dispersion. The model is used to relate emissions, air quality, and downwind distances. The method described in Appendix A for obtaining 24-hour average concentrations is employed. This method assumes that the wind persists in one direction for 6 of the 24 hours. The calculated 6 hour value is divided by 4 to obtain a 24 hour average.

Wind speed and mixing height used in the model are 2.5 meters per second and 500 meters, respectively. These meteorological conditions are known to occur for periods of several hours on a significant number of days in many parts of the United States. For example, an initial review of available data indicates that these or equivalent poor dispersion conditions are likely to occur for 6 hours or longer on an average of 8-10 days per year in the mid-eastern United States.

For these meteorological conditions and the model specified above, emission rates ranging from 16 tons/hr to 48 tons/hr were considered. The greatest downwind distance at which concentration estimates exceeds the 24-hour NAAQS (based on a 6 hour calculated value of 4 times the 24-hour standard) is indicated in the table for selected emission rates.

1/ Carpenter, S.B., et al, 1971: Principle Plume Dispersion Models: TVA Power Plants. J. Air Poll. Control Assn., Vol. 22, No. 8, pp. 491-495.

2/ Pooler, F., and L.E. Niemeyer, 1970: Dispersion From Tall Stacks: An Evaluation. Paper No. ME-14D, presented at the Second International Clean Air Congress, December 6-11, 1970, Washington, D.C., 31 pp.

3/ Pooler, F., 1965: Potential Dispersion of Plumes From Large Power Plants. AP-16, Environmental Protection Agency, Washington, D.C., 13 pp.

4/ Environmental Protection Agency, 1971: Requirements for Preparation, Adoption, and Submittal of Implementation Plans. Federal Register, Vol. 36, No. 158, pp. 15486-15506.

5/ Turner, D.C., 1970: Workbook of Atmospheric Dispersion Estimates. AP-26, Environmental Protection Agency, Washington, D.C. 84 pp.

TABLE 1

CANDIDATE PLANTS FOR SCS IDENTIFIED BY EPA

State	Plant	MW	% of SO_2 Emissions	Liability Radius Miles
Alabama	Widows Creek	1,978	98%	25
Florida	Gannon	1,270	54%	15
	Big Bend	892	32%	10
Illinois	Dixon	119	79%	7
–	Grand Tower	180	89%	7
✓	Meridosia	35[illegible]	94%	7
✓	Coffeen	1,005	91%	15
	Edwards	769	52%	10
	Wallace	305	33%	7
	Joliet	1,787	61%	25
✓	Kincaid	1,319	95%	20
	Powerton	2,100	44%	25
	Waukegan	933	57%	7
	Will County	1,269	58%	10
	Wood River	650	50%	7
✓	Dallman	160	90%	7
	Lakeside	146	79%	7
	Venice	474	19%	7
Indiana	Michigan City	738	76%	7
✓	Clifty Creek	1,304	97%	20
	State Line	972	14%	7
	Tanners Creek	1,100	47%	25
	Stout	834	42%	10
	Baily	610	72%	10
	Mitchell	529	14%	7
	Dresser	150	49%	7
	Edwardsport	14[illegible]	79%	7
	Wabash River	963	69%	10
	Cully	403	28%	7
	Warrick	733	80%	10
	Petersburg	724	71%	10

State	Plant	MW	% of SO_2 Emissions	Liability Radius Miles
Kentucky	Coleman	521	95%	15
	Cane Run	1,017	30%	15
	Paddys Run	338	5%	7
	Mill Creek	321 ('75)	64%	7
	Green River	263	94%	7
	Paradise	2,558	91%	25
	Shawnee	1,750	57%	25
Maryland	Chalk Point	728	83%	7
	Dickerson	586	89%	7
Michigan	Eckert	386	74%	7
	Connors Creek	540	33%	7
–	Marysville	230	83%	7
	Pennsalt	37	2%	7
	River Rouge	933	26%	10
	St. Clair	1,995	82%	25
	Trenton Channel	1,076	56%	10
	Wyandotte No.	51	1%	7
	Ericsson	160	27%	7
	Histersky	171	3%	7
–	Cobb	510	89%	7
Minnesota	Black Dog	487	37%	
Missouri	Meramec	923	98%	7
	Souix	1,100	33%	10
	Labadie	2,417	71%	25
Ohio	Lake Road	160	3%	7
	Cardinal	1,230	22%	25
	Cleveland Municipal	209	3%	7
	Ashtabula	456	55%	10
	East Lake	1,257	43%	20

Number of Plants

Freq Dist >

90%	80%	70%	60%	50%
9	7	8	2	9
9	16	24	26	35

[Region V]
Indiv
Total

{9 SCS plants
84 potential SCS plants}

Ohio → 4 plants SCS
2 potential SCS

TABLE 1

Page 2

State	Plant	MW	% of SO_2 Emissions	Liability Radius Miles
Ohio	Lake Shore	514	37%	7
	Conesville	1,276	70%	25
	Picway	231	57%	7
	Poston	232	95%	7
	Gorge	83	13%	7
	Burger	544	89%	10
	Sammis	2,304	39%	25
	Muskingum River	1,530	45%	10
	Philo	500	94%	10
	Tidd	226	8%	7
	Kyger Creek	1,086	99%	15
	Piqua	55	57%	7
	Miami Fort	393	50%	7
	Beckjord	1,221	84%	20
	Stuart	1,831	99%	10
Penn.	Elrama	510	46%	7
	Phillips	411	25%	7
	Cheswick	565	34%	7
	Crawford	117	1%	7
	Seward	268	34%	7
Penn.	New Castle	426	75%	10
	Cromby	418	22%	7
	Eddystone	707	34%	7
	Mitchell	449	14%	7
	Springdale	416	12%	7
Tenn.	Johnsonville	1,486	90%	25
	Kingston	1,700	94%	20
	Watts Bar	240	98%	7
Virginia	Potomac River	515	13%	7
W. Va.	Willow Island	215	89%	7
	Albright	273	95%	7
	Rivesville	175	16%	7
Wisconsin	N. Oak Creek	500	45%	10
	S. Oak Creek	1,192	2%	7

Table . 2

ADDITIONAL CANDIDATE SCS POWER PLANTS
IDENTIFIED BY EPA AND FEA*

TVA Plants	States	MW
Colbert A & B	Alabama	1396
Allen	Tennessee	990
		2386

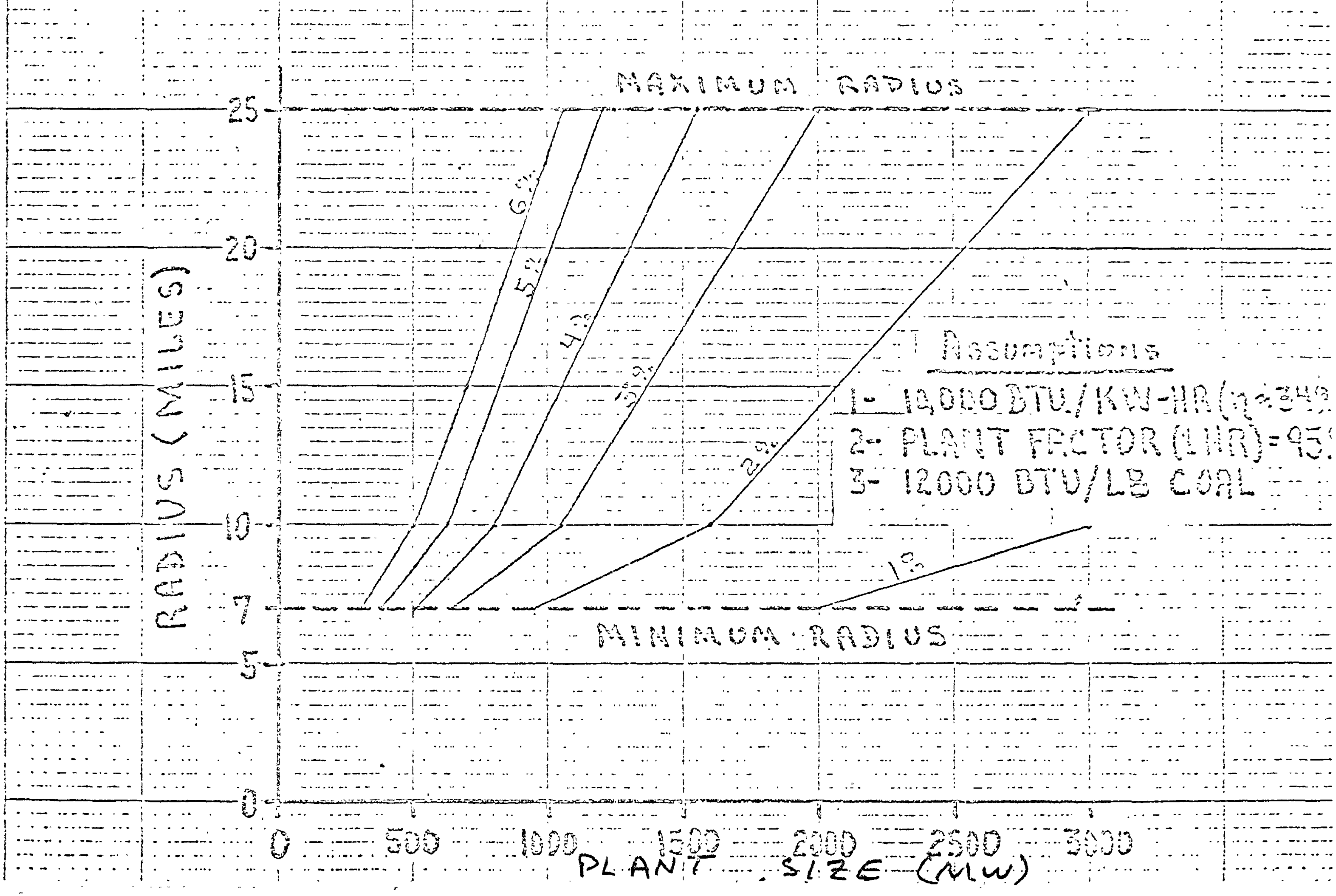
Plants < 100 MW	States	MW
✓ Marion	Illinois	99
✓ Logansport	Indiana	74
✓ Ames #2	Iowa	68
✓ J. DeYoung	Michigan	77
Louis & Clark	Montana	50
✓ Hamilton	Ohio	84
Holtwood	Pennsylvania	75
Hunlock	Pennsylvania	93
Henderson	Kentucky	51
		671

Other Plants	States	MW
Delaware City	Delaware	130
Hammond	Georgia	953
Morgantown	Maryland	1451
Gardner	Nevada	227
Mohave	Nevada	1520
Four Corners	New Mexico	2270
✓ No. Vine St.	Ohio	109
		6660
TOTAL - 18 PLANTS		9717

*The basis for considering these plants as SCS candidates is their location in areas with a population density less than 1000 persons per square mile. An analysis of SO_2 emissions within the vicinity of most of these plants has not yet been made.

FIGURE 1.

LIABILITY RADIUS vs PLANT SIZE & SULFUR CONTENT



APPENDIX B

TABLE B1 - CURRENT AND PROJECTED CONSUMPTION OF COAL BY ELECTRIC UTILITIES (million tons/yr.) 1/

	73	75	77	80	83	85
- Consumption by existing coal plants	388	466	466	466	466	466
- Consumption by new plants 2/	-	-	60	175	298	391
- Consumption by existing plants that convert from oil or gas to coal 3/	-	5	15	60	60	60
	388	471	541	751	824	917

1/ Projections are based on the most likely demand projections by the Technical Advisory Committee on Finance to the National Power Survey and on data reported under FPC in Docket R-362, April 1, 1974.

2/ New plants are defined as those plants coming on line after 1975. It was also assumed that all fossil plants coming on line after 1977 would burn coal as their principal fuel

3/ Schedule for conversion was based on EPA's preliminary analysis of the environmental requirements of the Energy Supply and Environmental Coordination Act of 1974. It was assumed that plants that could use low sulfar coal would need until 1977 or 1980 to obtain the coal and upgrade the efficiency of particulate control. The remaining plants would install scrubbers by 1980.

TABLE [illegible] - SUMMARY OF EPA'S ANALYSIS OF THE PROJECTED STATUS OF THE ELECTRIC UTILITY INDUSTRY'S COMPLIANCE WITH SO_2 REGULATIONS IN 1975, 1977 & 1980

	75	77	[illegible]
- Utility coal consumption in 1975 (millions tons/yr)			
* Existing coal burning plants	466	466	[illegible]
* Conversion of existing oil or gas plants	5	25	60
Total Consumption in 1975	471	491	526
- Projected method of compliance (million tons/yr)			
* Currently in compliance with SIP's	200 1/	186 3/	186 3/
* Will be in compliance based on (SIP) revisions 2/	58	58	58
* Low and medium sulfur coal	45	95	110
* Washed coal	5	15	15
* Blending	35	35	40
* Scrubbers	13	56	117
Sub-Total	351	445	526
- Projected tonnage that will not be in compliance with emission regulations	120	46	—

1/ Includes [illegible] million tons of coal that has recently come into compliance as a result of SIP revisions for the following states: Alabama, Tennessee, South Carolina, and Colorado.

2/ Projected additional tonnage that will be in compliance after the approval of plan revisions that have been (or will be) [illegible] for Georgia, Indiana, Michigan, Ohio, Pennsylvania, and Illinois.

3/ An additional 14 million tons of current coal production will probably not be in compliance when Kentucky's SIP's are enforced in 1977.

TABLE B3 - PROJECTED DEMAND FOR SCRUBBERS BY EXISTING PLANTS (Thousand megawatts)

Cummulative Demand for Scrubbers (thousand megawatts) 1/

Option	75	77	80 5/	83 5/	85 5/
1 2/	7	32	60	60	60
2 3/	7	28	33-51	60	60
3 3/	7	28	33-51	33-51	60
4 4/	7	28	33-51	33-51	33-51

1/ The high end of the range assumes that SCS is reliable and enforceable at 18 plants which have a total capacity of 18,000 megawatts. The low end of the range assumes that SCS is reliable and enforceable at 70 plants which have a total capacity of 53,000 megawatts. For both estimates it was assumed that if SCS was not allowed as a permanent strategy 50% of the plants would install scrubbers and 50% would use low sulfur coal.

2/ Under option 1 it was assumed that the 144 million tons of existing coal that would not be in compliance with the current or projected SIP's and the 138 million tons that will be demanded between 1973 and 1985 would comply with constant emission limitations by 1980 by utilizing the following methods of compliance:

- low and medium sulfur coal	110	(39%)
- washed coal	15	(5%)
- blending	40	(14%)
- scrubbers	117	(42%)
Total	282	(100%)

3/ Under options 2 and 3 it was assumed that plants would comply with constant emission limitations by 1983 or 1985 using the same methods of compliance as outlined in option 1. However, in the interim, ICS and tall stacks would be used by approximately 18-70 plants which would consume 36-106 million tons per year. It was also assumed that in 1983 or 1985 50% of these plants would install scrubbers and 50% would use low sulfur coal.

4/ Same as footnote-3 except that ICS and tall stacks could be used indefinitely.

5/ Under the Energy Supply & Environmental Coordination Act (ESECA) 24,000 MW of capacity are expected to convert from oil to coal. The above estimates for 1980, 1983, and 1985 assume that 14,000 MW of this capacity will require scrubbers while the remaining 10,000 will meet requirements by using low sulfur coal.

TABLE B4 - PROJECTED DEMAND FOR LOW SULFUR COAL AND SCRUBBERS BY NEW PLANTS

Period	Low Sulfur Coal ** (million tons/yr)	Scrubbers ** (million tons/yr)	(Thous. megawatts)	Total Consumption (million tons)
76-77	40	20	8	60
78-80	77	38	15	115
81-83	82	41	16	123
84-85	62	31	12	93
Total	261	130	51	391

* Projections are based on the most likely demand projects by the Technical Advisory Committee on Finance to the National Power Survey and on data reported under FPC Docket R-362, April 1, 1974.

** It was assumed that 2/3 of the plants would use low sulfur coal (predominately western low sulfur coal) and 1/3 of the plants would use scrubbers.

TABLE B5 - TOTAL DEMAND FOR SCRUBBERS BY NEW AND EXISTING PLANTS*

Cummulative Demand for Scrubbers (thous. megawatts)

Option	75	77	80	83	85
1	7	40	83	99	111
2	7	27-36	56-74	99	111
3	7	27-36	56-74	72-90	111
4	7	27-36	56-74	72-90	83-102

*Numbers in this table were derived by adding the numbers in tables 3 and 4.

APPENDIX C

TABLE C1 - COST ESTIMATES USED IN CALCULATING THE ECONOMIC IMPACT OF SO_2 REGULATIONS

The estimated shown in the following table were used to calculate the cost of complying with SO_2 regulations for each scenario.

Method of Compliance	Capital ($/kw)	Annual Cost* $/ton	Annual Cost* ¢/million BTU
	Incremental Cost (1974 dollars)		
- Low sulfur coal			
Existing Plants	-	$ 7.60	33
New Plants	-	$ 6.20	27
- Washed Coal			
Existing Plants	-	$ 4.50	20
- Blending			
Existing Plants	-	$ .25	1
- Scrubbers			
Existing Plants	$70	$9.20	40
New Plants	$55	$6.90	30
- ICS and Tall Stacks			
Existing Plants	$ 5	$.75	3

*Includes incremental fuel gas O&M costs, depreciation, taxes, and return on investment

TABLE C2 - SUMMARY OF THE CAPITAL REQUIREMENTS OF ALTERNATIVE SCHEDULES FOR COMPLYING WITH SO_2 REGULATIONS

- Required Cummulative Investment (billion 1974 dollars)*

Option	80	83	85
1			
- Existing plants	4.2	4.2	4.2
- New plants	1.3	2.1	2.8
- Total	5.5	6.3	7.0
2			
- Existing plants	2.6 - 3.7	4.3 - 4.5	4.3 - 4.5
- New plants	1.3	2.1	2.8
- Total	3.9 - 5.0	6.4 - 6.6	7.1 - 7.3
3			
- Existing plants	2.6 - 3.7	2.6 - 3.7	4.3 - 4.5
- New plants	1.3	2.1	2.8
- Total	3.9 - 5.0	4.7 - 5.8	7.1 - 7.3
4			
- Existing plants	2.6 - 3.7	2.6 - 3.7	2.6 - 3.7
- New plants	1.3	2.1	2.8
- Total	3.9 - 5.0	4.7 - 5.8	5.4 - 6.5

*Options 2 and 3 cost more than option 1 in 1983 and 1985 because the plants which use SCS build tall stacks by 1977 and then install permanent controls by 1983 or 1985

TABLE C3 - SUMMARY OF THE ANNUAL COST OF ALTERNATIVE SCHEDULES FOR COMPLYING WITH SO_2 REGULATIONS*

Option	Annual Cost (billion 1974 dollars)*		
	80	83	85
1			
- Existing plants	1.5	1.5	1.5
- New plants	1.1	1.9	2.5
- Total	2.6	3.4	4.0
2			
- Existing plants	.7 - 1.2	1.5	1.5
- New plants	1.1	1.9	2.5
- Total	1.8 - 2.3	3.4	4.0
3			
- Existing plants	.7 - 1.2	.7 - 1.2	1.5
- New plants	1.1	1.9	2.5
- Total	1.8 - 2.3	2.6 - 3.1	4.0
4			
- Existing plants	.7 - 1.2	.7 - 1.2	.7 - 1.2
- New plants	1.1	1.9	2.5
- Total	1.8 - 2.3	2.6 - 3.1	3.2 - 3.7

*Figures are estimates of the annual cost in 1977, 1980, 1983 and 1985. The estimates include incremental fuel and O&M costs, depreciation, taxes, and a return on investment. Options 2 and 3 cost more than option 1 in 1983 and 1985 because the existing plants which use SCS build tall stacks by 1977 and then install permanent controls by 1983 or 1985.