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SUMMARY REPORT ON MODELING ANALYSIS OF POWER PLANTS FOR FUEL CONVERSION

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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SUMMARY REPORT ON MODELING ANALYSIS OF POWER PLANTS FOR FUEL CONVERSION

by

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ABSTRACT

This report presents a summary of the air quality modeling analysis for the selected power plants. Selected units within specific plants were considered candidates for fuel conversion from oil- to coal-firing as a result of the oil shortage and energy crisis of 1973-1974. A study was conducted to evaluate the impact these candidate conversions would have on ambient sulfur dioxide and particulate concentrations. The study is intended to add to the overall analysis of the individual plants being conducted by EPA, but not by itself to define precise problems associated with the conversion or to develop exact solutions.

In considering whether conversions would allow attainment of primary standards, no allowance was made for contributions from sources other than power plants. Furthermore, no consideration was given to the provisions of the Energy Supply and Environmental Coordination Act (ESECA, 1974), which requires other limiting conditions (e.g., Primary Standard Conditions.) Thus, a more complete analysis in terms of ESECA requirements might significantly alter the total amount of coal which could be substituted.

A brief synopsis of the background for this study is presented in the introduction to this report. This is followed by a description of the analysis procedure and a presentation of the summary results.

Of the 63 power plants modeled for 1972 base case operations, SO_2 emissions from approximately 7 plants resulted in concentrations which exceeded the primary 24-hour SO_2 standard at nominal load, exclusive of other background source contributions. Similarly, concentrations from approximately 10 plants were predicted to exceed the standard by themselves under maximum load operation. Fuel switch strategies under both nominal and maximum load operations indicated that emissions from approximately 16 of the candidate plants for conversion would alone produce 24-hour SO_2 concentrations which exceed the primary standard. It should be noted that possible conversion combinations were examined at 43 of the 63

power plants and that the additional 20 power plants were included for possible significant interaction.

Emissions from none of the plants produced concentrations which alone exceeded the primary 24-hour particulate standard for 1972 operations under either nominal or maximum load. Under fuel switch alternatives for both nominal and maximum load operation, 7 of the plants considered for conversion exceeded the primary 24-hour particulate standard by themselves. No annual standards were exceeded by any of the 63 plants alone.

The study is intended only to add to the overall analysis of the specific plants being conducted by EPA. Decisions on final evaluations based on the material presented in the separate reports pertaining to specific plants should consider the data, assumptions, and procedures used in this analysis, as well as a variety of important factors not considered in this study.

ACKNOWLEDGEMENTS

The summary results presented in this report for a modeling analysis of power plants for fuel conversion are based on studies performed by EPA and Walden Research Division of Abcor, Inc. An earlier analysis of 8 AQCRs was conducted by the Monitoring and Data Analysis Division of the Office of Air Quality Planning and Standards, Office of Air and Waste Management. This was followed by a similar analysis of 43 AQCRs conducted by Walden, sponsored jointly by MDAD and by Strategies and Air Standards Division, OAQPS, OAWM [1]. These earlier studies were performed with a projected low-sulfur coal deficit in mind and did not address the prospect of fuel conversions.

The EPA project officer for this latest analysis was C.E. Mears, and the Walden project manager was P. Morgenstern, assisted by Dr. L. Morgenstern. The project was aided by the cooperation and assistance provided by D.H. Barrett and R.F. Lee of MDAD and by J.L. McGinnity of SASD. The technical staff at Walden who contributed significantly to this project are: F. Banta, R. Buerschaper, P. Cole, L. Fereshetian, S. Goward, P. Horowitz, B. Kemerer, G. MacWilliam, E. Rich, J. Sacco, and R. Stockdale.

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I. INTRODUCTION

This summary report covers an air quality modeling analysis of a number of power plants which were considered candidates for fuel conversion from oil- to coal-firing as a result of the oil shortage and energy crisis of 1973-1974. The purpose of the study was to evaluate the impact on ambient sulfur dioxide and particulate concentrations if selected units within specific plants were converted to coal. The study was intended to add to the overall analysis of the given plants being conducted by EPA, but not by itself to define precise problems or to develop exact solutions.

This report summarizes the results obtained from an analysis of 63 power plants located in the 17 eastern Air Quality Control Regions (AQCRs) listed in Table 1. The study results are presented by the Group numbers shown in Table 1. It should be noted that not all power plants in each AQCR were considered in this analysis. The 63 power plants considered are listed by AQCR in Tables 2a-e and include those 43 examined for possible conversion and those 20 included for possible interaction. A summary of the generating units which are candidates for conversion at the plants is included in Tables 2a-e.

The procedure applied in the analysis examined two basic situations: (1) 1972 operations and (2) with specified fuel substitutions for selected units at certain plants. A single-source model was used to calculate both annual and 24-hour SO_2 and particulate concentrations from each power plant. Where interactions of concentration levels between adjacent power plants are significant, supplementary modeling calculations were used to account for the joint impact of two or more facilities. No contribution of SO_2 or particulate was included for other types of sources in the area of the power plants. These contributions could be very significant.

Any decisions based on the material presented in this report pertaining to individual plants should fully consider the input data available for the model, the assumptions on which the model is based, and the procedures followed in conducting the analysis. The final evaluation for a given plant should consider all relevant data on the plant and must recognize the inherent limitations resulting from the data and procedures used in this modeling effort. Other factors which should, if possible, be considered include contributions of other sources, projected growth for the region, measured air quality data, known downwash or fumigation problems, unique topographic features, nearby land use patterns and population distributions, more specific operational data for the plant, impact of units new since 1972, meteorological studies specific for the area, and additional studies or findings by other investigators. Only a full consideration of all these data will lead to a balanced and reasonable decision.

This study was performed prior to the enactment of the Energy Supply and Environmental Coordination Act of 1974 (ESECA). ESECA places a number of environmental and other constraints on possible conversions. None of these constraints was considered in this study. Definitive evaluations required by ESECA could significantly alter the results obtained herein. However, this study has served to demonstrate that selective conversions to coal could be made, with appropriate environmental safeguards, and that such conversions could have a significant impact on the oil shortage.

II. METHOD OF ANALYSIS

An overview of the method of analysis is presented by the flow diagram in Figure 1. This chart shows the relationship among three major task elements and indicates further subtask components within each of these.

A. SOURCE INPUT DATA

Source data required as input to the diffusion models include SO_2 and particulate emission rate, stack height and diameter, stack gas exit velocity, and stack gas temperature. Furthermore, the change in load demand with time of year is also input to the models.

Annual reports to the Federal Power Commission on Steam-Electric Plant Air and Water Control Data (FPC Form 67) provide the basic reference for compilation of this source input data. Reports on operations for the year 1972 were the most recent currently available, while complete design information for individual boiler and stack units was reported in 1969, with any modifications shown in subsequent reporting periods. A compilation of the operations and design information was transcribed into computer format for processing.

A number of plants analyzed currently utilize both oil and natural gas as fuels. Modeling of these plants for 1972 operations under nominal load was based on the reported annual consumption of these fuels. However, analysis of maximum load operation was based on 100% utilization of fuel oil.

It should be emphasized that the modeling was based on only 1972 operations. The impact of any new units after 1972 was not included in this analysis due to lack of sufficient data. Information on new units planned through 1976 is included in the footnotes to Table 2a-e.

The modeling analysis for those plants with units considered candidates for conversion to coal was based on switching both oil and natural gas consumption for those units. Wherever appropriate, collection efficiencies from installed particulate collection equipment were applied in calculating stack emissions.

Fuel quality parameters (percent sulfur and percent ash) for the coal which the plant might be required to burn were estimated by EPA from data on current and projected supplies. Walden estimated coal heat content based on an average of 12,500 BTU/pound. For existing pollution control devices within the plant, a control efficiency was provided by EPA after considering design and test data, recent history of use, and estimations from local agencies and the power companies. In so doing, it was recognized that an electrostatic precipitator which has not been in use, or which has been used in conjunction with an oil-fired boiler, will operate at an efficiency significantly less than the design efficiency for an extended period of time.

The conversion of oil to coal annual fuel use was obtained either by design or by BTU equivalent. If both the design firing rate for coal and oil were available they were ratioed to the actual 1972 oil use. However, if the design firing rate of coal was not given, the fuel use was converted on a BTU equivalent basis, with the assumed coal heating value of 12,500 BTU/pound. Fuel conversion on a design basis was preferred because the annual coal equivalent determined would not exceed that for which the plant was designed, which it conceivably could if considered solely on a BTU equivalent basis.

B. METEOROLOGICAL DATA

For an individual plant analysis, the meteorological data assembled consist of (1) hourly surface weather observations in standard card image format, and (2) twice daily mixing height tabulations. The year 1964 was selected for the analysis because it is the only one which satisfies the dual requirement of hourly surface data, and wind direction azimuth recorded to the nearest 10 degree sector.

The surface and upper air data are preprocessed by a computer program. Among the different functions performed by this routine are:

- Screening of all data for completeness
- Determination of hourly stability classification
- Interpolation of twice daily mixing height data to hourly values

The output of this preprocessing operation yields a set of meteorological data for input to the modeling analysis.

C. SITE DATA

A principal site factor which can influence the impact on ground-level concentrations from power plant operations is the topography of the surrounding terrain. Isolated elevated terrain features such as nearby hills or bluffs can be severely impacted by plume transport along selected azimuth directions. In other locations, the power plant may be located in a valley with elevated terrain surrounding the plant site. Under certain conditions, lateral plume dispersion may be restricted by the valley walls.

The location of the power plant relative to urban areas also can influence the impact of plant operations on ambient concentration levels. Consequently, specification of the urban/rural characterization of the plant site location is an input parameter to the modeling analysis.

In order to assess both of these site factors, the plant location was identified on appropriate scale topographic maps of the area. The UTM coordinates of the plant location are used for this purpose. Significant terrain features in the vicinity of this site were considered in the modeling analysis. For those plant sites where elevated terrain was present in the vicinity, the modeling analysis considered this topographic factor by the application of a terrain adjustment procedure described in Appendix A.

The topography at other plants also showed the surrounding terrain at higher elevations than those of the plants. Moreover, the calculated plume height from at least one stack at these plants was lower than the surrounding terrain. The analysis considered this factor by the application of a special model designed to evaluate ground-level concentrations for the case of elevated receptor sites in valley locations (see Appendix A). The scope of the analysis conducted with this model was designed to determine representative maximum concentration levels. Because plume dispersion from power plants located in valley sites constitutes a complex interaction of source factors, terrain factors, and meteorological factors, a more exhaustive and detailed analysis of the specific power plant sites is desirable prior to finalizing the evaluation of these plants.

Because of extreme building heights in the Manhattan area, a special building height adjustment was also used for some of the plants in the New York City area. The effect of the skyscrapers considered that the air intake ducts are located on every tenth floor. Based on an average skyscraper height of 30 floors and ten feet per floor, the special analysis was modeled with a 300-foot building height adjustment.

The geographic proximity of several plant sites provided the potential for significant interaction of ground-level concentrations to occur. This factor was also considered during detailed analysis of maximum concentration levels in the vicinity of these sites.

D. DISPERSION MODELING

The procedure for modeling analysis of power plant operations consists of the application of a sequence of atmospheric diffusion models, as illustrated in Figure 1.

A single-source model was used to calculate both annual and 24-hour maximum particulate and SO_2 concentrations from 48 power plants in this study.

This model was developed recently by the Meteorology Laboratory (NERC, RTP) of EPA. It employs a Gaussian plume formulation and Brigg's plume rise equation and uses hourly observations of meteorological conditions. A further description of the model is included in Appendix A. * As applied herein, the model calculates estimated 24-hour average concentrations at a preselected field of receptors for each day of the year. The annual average concentration for each receptor is also calculated. Where interactions between the power plants are significant, supplementary calculations are made to account for this factor.

Some 35 of these 48 plants had surrounding terrain considered to have a significant effect on predicted concentrations. A terrain model, described in Appendix A, considered the difference between the plant elevation and the elevation at each receptor for 31 plants in Groups I-IV. Plants treated with this model in Groups I-IV only are designated by the letter "E" on Tables 2a-d. The four plants in AQCR 42 which were treated with an average terrain adjustment procedure are designated on Table 2e by the symbol"TA". This average terrain adjustment procedure is also described in Appendix A. Plants with no designation on this same table were treated with the flat version of the single-source model.

The model used to estimate short-term concentrations for 15 plants is one previously developed by EPA for application to sources located in complex terrain. The general features of this model are also described in Appendix A. Plants examined with this model are designated by the letter "V" on Tables 2a-e.

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* A number of significant modifications were performed by Walden to increase computation efficiency and application flexibility.

Since only power plant operations were being modeled, it was not possible to perform a detailed calibration of the model using measured air quality data. The calculated values of concentration are considered to be reasonable estimates of anticipated concentrations using best available modeling techniques and readily available data.

E. MAXIMUM LOAD VERSUS NOMINAL LOAD OPERATIONS

Emission data input to the single-source model is based on average monthly operations for each month of the year. Of course, the level of power plant operations varies from day to day; however, the FPC data are only available on a monthly basis. A power plant could quite possibly operate at near maximum rated capacity for 24 hours, especially in an industrialized region. Such operations would not be apparent from the monthly data. If these operations were coincident with the days of highest predicted concentrations, the model's maximum predictions could be significantly low.

Therefore, the analysis investigated two situations, as follows:

Nominal Load Case - This presents maximum concentrations calculated by the model based upon average monthly emission rates.

Maximum Load Case - This case was calculated assuming the plant to be operating at 95% of rated capacity. Concentrations were predicted for the 20 highest concentration days under nominal load. A 10% safety factor was subsequently added to these predicted concentrations because the maximum load case involves a greater plume rise, and a somewhat higher concentration may therefore occur on a different day and at a different receptor.

Ground-level concentrations arising from nominal and maximum operating loads can be expected to differ, due to the joint effect of changes in emission rates, with corresponding changes in stack gas exit velocity and temperature. The specific interaction of these factors can produce higher concentrations under either nominal or maximum load conditions. Modeling of both cases provides a reasonable estimate of the range of possible values and permits identification of the maximum concentration case.

F. MAXIMUM CONCENTRATION CONTOUR MAPS

The contour maps included in the four group reports [2] were produced with the SYMAP [3] line printer graphics program, which graphically depicts spatially arranged quantitative information. An example contour map which connects all points having the same numeric value is shown in Figure 2. Isopleths are plotted by interpolation from the concentrations at an average of seven receptors. Small digits appear at the receptor locations and indicate the range of values at each receptor. The population densities were calculated from the 1970 Census [4] and xeroxed onto United Stated Geological Survey quadrangle maps which were microfilmed and adjusted to proper scale.

It should be noted that all 24-hour values represent the worst day for any particular receptor; the map does not represent any single day, but rather is a composite of all worst days. Also, it should be noted that these concentration contour maps were not available for the AQCR 42 study and will, therefore, not be found in that report.

III. DISCUSSION OF RESULTS

A summary of the 1972 power plant operations evaluated is presented in Tables 2a-e. Conversions were examined for 14 power plants in Group I; for 9 power plants in Group II; for 9 power plants in Group III; for 7 power plants in Group IV; and for 4 power plants in AQCR 42, as shown in Tables 2a-e.

It should be emphasized that these results include only consideration of power plant emissions. A complete analysis would also have to give consideration to other factors, which include contributions of other sources, projected growth for the region, measured air quality data, known downwash or fumigation problems, unique topographic features, nearby land use patterns and population distributions, more specific operational data for the plant, impact of units new since 1972, meteorological studies specific for the area, and additional studies or findings by other investigators.

It was estimated that, for 1972 operations, the primary 24-hour SO_2 standard was exceeded under nominal load operation by 7 plants and under maximum load operation by 10 plants. None of the plants exceeded the 24-hour particulate standard under 1972 operation. Of the 43 plants analyzed for conversion, 16 were calculated to exceed the 24-hour SO_2 standard under both nominal and maximum load operations. Seven of the 43 plants were estimated to exceed the 24-hour particulate standard under both nominal and maximum load operations. None of the plants was calculated to exceed the annual standards under either 1972 fuel use or fuel conversion strategies.

The total 1972 fuel use for the 63 plants examined is summarized in Table 3. Also shown is the potential reduction in fuel oil and natural gas annual consumption under fuel conversion options for the 26 plants where <u>no</u> standards under any load case were exceeded. Projected annual coal use at these plants would be about 19 million tons, while potential oil savings would be about 3 billion gallons per year, and potential natural gas savings about 5 billion cubic feet per year.

The power plants analyzed by application of the complex terrain model are reported only on the basis of predicted maximum 24-hour concentration. Short-period concentration levels are far more critical to maintaining ambient air quality standards than long-term average concentration levels in these situations.

Information on plant fuel use and operating parameters was included in the separate reports prepared during the study [2,5], along with the estimates of individual plant impact on air quality and interactions between plants. An outline of the tables included in these separate reports is included here in Appendix B. The five individual reports may be obtained from the Air Pollution Technical Information Center (MD #18), Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

IV. CONCLUSIONS

The analysis of the impact of SO_2 and particulate concentrations from the 63 power plants in the 17 eastern AQCRs concerned indicated the following broad conclusions:

- New coal use at the 26 (of 43) power plants considered for possible conversion where no standards were exceeded is approximately 19 million tons.
- Potential annual fuel oil savings at these plants would be approximately 3 billion gallons.
- Annual natural gas savings would be approximately 5 billion cubic feet.

The analysis has indicated that the partial conversion of selected east coast power plants would appear to offer a feasible alternative for partially alleviating the oil shortage of the east coast area. Further studies are required to determine appropriate environmental safeguards as required by ESECA.

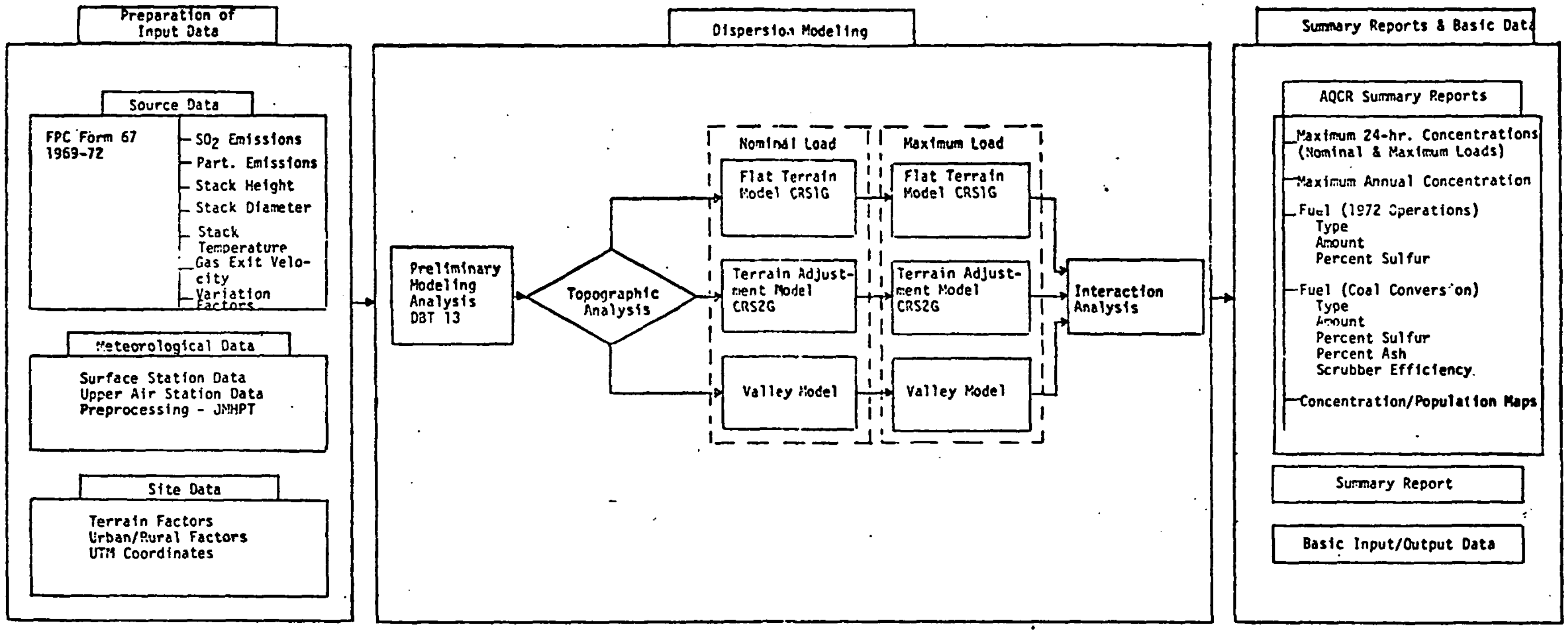

Figure 1. Power Plant Analysis Procedure

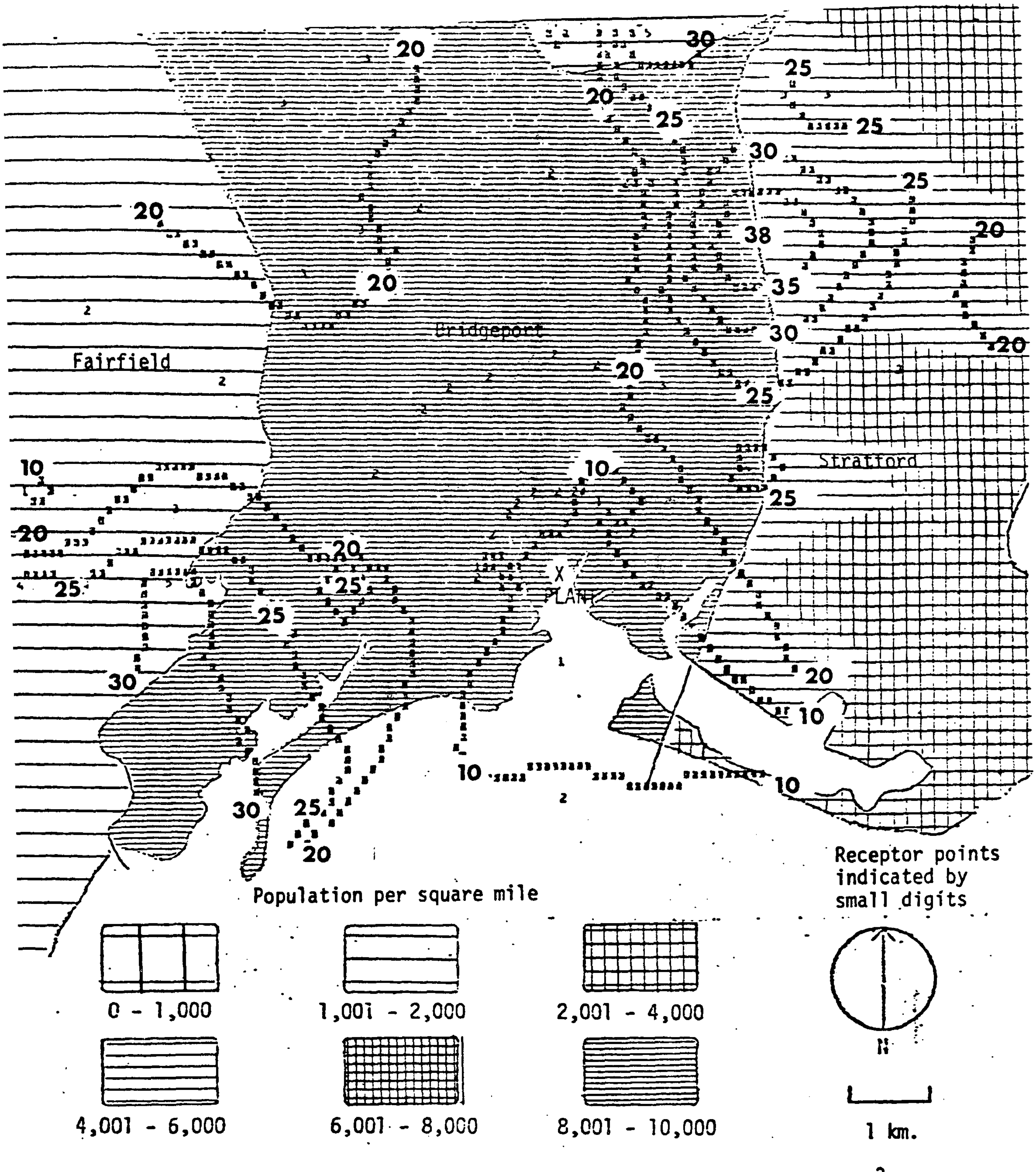

Figure 2. Modeling Analysis of Maximum 24-hour SO_2 Concentrations ($\mu g/m^3$) For Example Plant Under 1972 Operations - Nominal Load

TABLE 1

LISTING OF AQCRs ANALYZED BY WALDEN*

AQCR Name	Number	Group Number
New Jersey-New York-Connecticut	43	I
New Jersey	150	I
Hudson Valley	161	I
Metropolitan Philadelphia	45	II
National Capital	47	III
West Central Florida	52	III
Eastern Shore	114	III
Southern Maryland	116	III
Southern Central Plain	170	III
State Capital	225	III
Hampton Roads	223	III
New Hampshire-Maine	107	IV
Metropolitan Boston	119	IV
Metropolitan Providence	120	IV
Merrimack Valley-Southern New Hampshire	121	IV
Eastern Connecticut	41	IV
Hartford-New Hampshire-Springfield	42	AQCR 42 report

* Not all power plants in each AQCR were analyzed. See Table 2 for those included herein. Other plants are being examined in a subsequent modeling effort by Walden for EPA.

TABLE 2 a

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP I

AQCR #	Company/Plant*	City/State	Oil Use: Amount(**) (10^3 bbl)	Oil Use: Sulfur (%)	Coal Use: Amount(**) (10^3 ton)	Coal Use: Sulfur (%)	Coal Use: Ash (%)	Control Efficiency (%)
43	United Illuminating Company							
	Bridgeport Harbor "E" 1972 Operations	Bridgeport, Ct.	6,603	0.6	--	--	--	--
	Steel Point "E" 1972 Operations	Bridgeport, Ct.	1,556	0.6	--	--	--	--
	Orange & Rockland Utilities, Inc.							
	Lovett "V"	Tomkins Cove/NY						
	1972 Operations		3,363	0.7	--	--	--	--
	Switch Units 4,5		524	0.7	664	3.1	15	90
	Bowline "V" 1972 Operations***	Haverstraw/NY	2,012	0.4	--	--	--	--
	Long Island Lighting Company							
	Barrett	Island Park/NY						
	1972 Operations		3,399	0.9	--	--	--	--
	Switch Unit 10		1,728	0.9	350	2.5	15	80
	Far Rockaway	Far Rockaway/NY						
	1972 Operations		929	0.5	--	--	--	--
	Switch Unit 40		--	--	209	3.0	15	80

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

*** This does not include consideration of a new 621 MW unit projected for 1974 and a new 600 MW unit projected for 1976.

TABLE 2 a

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP I
(continued)

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
43	Long Island Lighting Company							
	Port Jefferson "E"	Port Jefferson/NY						
	1972 Operations		4,405	2.4	--	--	--	--
	Switch Units 30,40		653	2.4	782	3.0	15	85
	Public Service Electric & Gas Company							
	Bergen	Sayreville/NJ						
	1972 Operations		4,297	0.3	--	--	--	--
	Switch Units 1,2		--	--	1,253	2.0	15	90
	Jersey Central Power & Light							
	Sayreville "E"	Sayreville/NJ						
	1972 Operations		3,381	0.3	--	--	--	--
	Switch Units 7,8		862	0.3	649	1.5	15	none
	Werner "E"	South Amboy/NJ						
	1972 Operations		1,012	0.3	--	--	--	--
	Switch Unit 4		313	0.3	163	3.0	10	85
	Consolidated Edison of New York, Inc.							
	Ravenswood	Queens/NY						
	1972 Operations		12,904	0.4	--	--	--	--
	Switch Unit 30N, 30S		6,410	0.4	1,551	3.0	15	99

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 2a

SUMMARY OF ANNUAL POWER PLANT OPERATIONS
GROUP I
(continued)

AQCR #	Company/Plant*	City/State	Oil Use Amount (**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
43	Consolidated Edison of New York, Inc.							
	Astoria	Queens/NY						
	1972 Operations***		8,997	0.4	--	--	--	--
	Switch Units 10,20,30,40,50		--	--	2,177	2.5	10	97
	74th Street	Manhattan/NY						
	1972 Operations		982	0.3	--	--	--	--
	Waterside	Manhattan/NY						
	1972 Operations		2,494	0.5	--	--	--	--
	Arthur Kill	Staten Island/NY						
	1972 Operations		6,197	0.4	--	--	--	--
	Switch Unit 30		3,190	0.4	710	3.0	15	95
	Connecticut Light & Power Company							
	Norwalk Harbor "E"	Norwalk/Ct.						
	1972 Operations		3,073	0.8	--	--	--	--
	Switch Units 1,2		--	--	717	2.5	15	95
150	Atlantic City Electric Company							
	England	Beesley Point/NJ						
	1972 Operations****		2,835	0.8	--	--	--	--
	Switch Units 1,2		--	--	661	2.8	10	85
	Missouri Ave.	Atlantic City/NJ						
	1972 Operations		--	--	147	0.6	5.6	86

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

*** This does not include consideration of new 800 MW unit projected for 1974.

**** This does not include consideration of a new 160 MW unit projected for 1974.

TABLE 2 a

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP I
(continued)

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
161	Niagara Mohawk Power Company							
	Albany "V"	Albany/ NY						
	1972 Operations		4,197	2.4	--	--	--	--
	Switch Units 1,2,3,4		--	--	1,036	3.0	15	30
	Central Hudson Gas & Electric Corp.							
	Danskammer "V"	Roseton/NY						
	1972 Operations		5,169	1.5	--	--	--	--
	Switch Units 1,2,3,4		--	--	1,236	3.0	15	90

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 2 b

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP II

AQCR #	Company/Plant *	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
45	Delmarva Power & Light Company							
	Edge Moor "V"	Edge Moor/Delaware						
	1972 Operations***		3,421	0.7	--	--	--	--
	Switch Units 1,2,3,4		--	--	766	2.5	12	65,63,57,95
	Delaware City "E"	Delaware City/Delaware						
	1972 Operations		1,282	3.7	355******	6.8	0.3	75,75,99
	Public Service Electric & Gas Co.							
	Burlington "E"	Burlington/NJ						
	1972 Operations		4,426	0.3	--	--	--	--
	Switch Stacks 5,6,7		174	0.3	1,085	210	15	85,90
	Mercer "E"	Trenton/NJ						
	1972 Operations		--	--	936	1.4	11	99
	Atlantic City Electric Company							
	Deepwater	Pennsgrove/NJ						
	1972 Operations****		4,073	0.3	--	--	--	--
	Switch Units 1,8		2,779	0.3	420	3.0	15	90,85
	Philadelphia Electric Company							
	Barbadoes "E"	Norristown/Penn						
	1972 Operations*****		1,406	0.6	--	--	--	--
	Switch Units 31,41		2	0.6	389	2.5	10	94
	Cromby "V"	Cromby/Penn						
	1972 Operations		2,895	0.5	363	2.5	9.1	90
	Switch Units 1,2		--	--	1,047	2.3	10	90

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

*** This does not include consideration of a new 378 MW unit projected for 1973. Includes 1,263 x 10^6 cu.ft. natural gas.

**** Includes 2,835 x 10^6 cu.ft. natural gas.

***** Includes 1,803 x 10^6 cu.ft. natural gas.

****** Petroleum coke.

TABLE 2 b

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP II
(continued)

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
45	Philadelphia Electric Company							
	Chester "V"	Chester/Penn						
	1972 Operations****		1,311	0.6	--	--	---	--
	Switch Units 18,20		--	--	374	3.0	10	80
	Eddystone "V"	Eddystone/Penn						
	1972 Operations***		56	0.5	1,478	2.0	8.4	98,99
	Schuylkill "E"	Philadelphia/Penn						
	1972 Operations		4,257	0.7	--	--	--	--
	Southwark "E"	Philadelphia/Penn						
	1972 Operations		4,678	0.7	--	--	--	--
	Switch Units 11,12,21,22		--	--	1,214	3.0	10	40,25,35,45
	Delaware "E"	Philadelphia/Penn						
	1972 Operations		2,939	0.6	--	--	--	--
	Switch Units 71,81		49	0.6	687	3.0	10	95
	Richmond "E"	Philadelphia/Penn						
	1972 Operations		4,775	0.6	--	--	--	--
	Switch Units 63,64		2,283	0.6	650	3.0	10	75

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

*** This does not include consideration of a new 400 MW unit projected for 1974 and another 400 MW unit projected for 1975.

**** Includes 794 x 10^6 cu.ft. natural gas.

TABLE 2c

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP III

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Ash (%)	Control Efficiency (%)
47	Virginia Electric & Power Co.							
	Possum Point*** "E"	Dumfries/Virginia						
	1972 Operations		5,048	2.3	--	--	--	--
	Switch Units 1-4		--	--	1,162	2.3	13	80
225	Chesterfield "E"	Chester/Virginia						
	1972 Operations		13,508	2.3	--	--	--	--
	Switch Units 5,6		4,892	2.3	2,037	2.5	15	90
	Switch Units 3,4,5,6		2,006	2.3	2,723	2.5	15	90
	12th Street "E"	Richmond/Virginia						
	1972 Operations		246	0.2	--	--	--	--
223	Yorktown "E" ****	Yorktown/Virginia						
	1972 Operations		--	--	814	2.0	6.1	98,84
	Switch Stack 1		--	--	832	2.0	15	98,85
47	Potomac Electric Power Company							
	Potomac River "E"	Alexandria/Virginia						
	1972 Operations		37	0.1	967	0.9	9.3	98,98,95,98,98
	Buzzard Point "E"	Washington/D.C.						
	1972 Operations		1,069	0.9	--	--	--	--
	Switch Units 1-6		--	--	260	3.0	15	99

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

*** This does not include consideration of a new 845 MW unit projected for 1976.

**** Includes 523 x 10^6 cu.ft. natural gas.

TABLE 2c

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP III
(continued)

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
47	Potomac Electric Power Company							
	Benning "V"	Washington/D.C.						
	1972 Operations		3,556	0.9	176	0.8	9.1	0,93,93,96, 98.4,0,0
	Chalk Point*** "E"	Aquasco/Maryland						
	1972 Operations		--	--	1,297	1.7	12.4	99.6,98.6
	Switch Units 1,2		--	--	1,297	2.3	15	95
	Dickerson "V"	Dickerson/Maryland						
	1972 Operations****		--	--	1,290	1.8	13	97.5
116	Morgantown "E"	Newburg/Maryland						
	1972 Operations		7,636	1.9	614	2.1	14.2	99,99
	Switch Units 1,2		--	--	2,441	3.0	15	90
	Delmarva Power & Light Company of Md.							
114	Vienna	Vienna/Maryland						
	1972 Operations		1,591	0.2	--	--	--	--
	Switch Units 5,6,7		1,006	0.2	111	3.0	15	0
	Carolina Power and Light Company							
170	Sutton "E" *****	New Hanover/N.C.						
	1972 Operations		3,458	2.1	172	1.1	12.7	80
	Switch Units 1,2,3		--	--	971	2.5	15	80,98

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

*** This does not include consideration of a new 630 MW unit projected for 1974.

**** This does not include consideration of a new 850 MW unit projected for 1974, and a new 850 MW unit projected for 1977.

***** Includes 1,199 x 10^6 cu.ft. natural gas.

TABLE 2 c

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP III

(continued)

AQCR #	Company/Plant*	City/State	Oil Use		Coal Use			Control Efficiency (%)
			Amount (**) (10^3 bbl)	Sulfur (%)	Amount(**) (10^3 ton)	Sulfur (%)	Ash (%)	
52	Florida Power Company							
	Crystal River	Citrus/Florida						
	1972 Operations		7,900	2.3	--	--	--	--
	Switch Units 1,2		--	--	2,072	4.0	11	0,90

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 2 d

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP IV

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Ash (%)	Control Efficiency (%)
107	Central Maine Power Company							
	Mason "E"	Wiscasset/Maine						
	1972 Operations		1,763	2.1	--	--	--	--
	Switch Units 3,4		819	2.1	202	2.5	15	80
119	New England Power Company							
	Salem Harbor "E"	Salem/Massachusetts						
	1972 Operations		7,987	0.7	--	--	--	--
	Switch Units 1,2,3		4,694	0.7	757	2.5	15	95
120	Narragansett Electric Company							
	South Street "E"	Providence/R.I.						
	1972 Operations		1,351	0.9	--	--	--	--
	Switch Stack 12		293	0.9	260	2.0	20	90
	New Bedford Gas & Edison Light Co.							
	Cannon Street "E"	New Bedford/Massachusetts						
	1972 Operations		954	0.9	--	--	--	--
	Narragansett Electric Company							
	Manchester Street "E"	Providence/R.I.						
	1972 Operations		1,108	0.9	--	--	--	--
	New England Power Company							
	Brayton Point Station "E"	Somerset/Massachusetts						
	1972 Operations		10,890	0.8	--	--	--	--
	Switch Unit 3		5,093	0.8	1,431	1.5	15	98
	Switch Unit 3		5,093	0.8	1,431	2.5	15	98
	Switch Units 1,2,3		--	--	2,688	2.5	15	98

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 2d

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

GROUP IV
(continued)

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
120	Montaup Electric Company							
	Somerset Station "E"	Somerset/Massachusetts						
	1972 Operations		3,359	0.7	--	--	---	--
	Switch Units 7,8		1,493	0.7	463	2.5	15	85
121	Public Service Company of New Hampshire							
	Schiller "E"	Portsmouth/N.H.						
	1972 Operations		1,709	1.9	--	--	--	--
	Switch Units 4,5		616	1.9	283	2.5	15	90
41	Connecticut Light & Power Company							
	Montville "V"	Uncasville/Conn						
	1972 Operations		4,548	0.9	--	--	--	--
	Switch Units 1,2,5		2,964	0.9	380	3.0	15	80

* "E" indicates terrain model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 2e

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

AQCR # 42

AQCR #	Company/Plant*	City/State	Oil Use Amount(**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount(**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
42	Hartford Electric Light Company							
	South Meadow "TA"	Hartford/Conn						
	1972 Operations		1,934	0.8	--	--	--	--
	Holyoke Water Power Company							
	Riverside "V"	Holyoke/Massachusetts						
	1972 Operations		347	1.0	--	--	--	--
	United Aluminating Company							
	English"TA"	New Haven/Conn						
	1972 Operations		1,456	0.8	--	--	--	--
	City of Holyoke Gas & Electric Dept.							
	Holyoke "V"	Holyoke/Massachusetts						
	1972 Operations		381	0.9	--	--	--	--
	Connecticut Light & Power Company							
	Devon "TA"	Milford/Conn						
	1972 Operations		4,252	0.6	--	--	--	--
	Switch Units 7,8		2,637	0.6	500	2.5	15	90
	Hartford Electric & Light Company							
	Middletown "V"	Middletown/Conn						
	1972 Operations		4.159	0.8	--	--	--	--
	Switch Units 1,2		2,229	0.8	469	2.5	15	90
	Holyoke Water Power Company							
	Mt. Tom "V"	Holyoke/Massachusetts						
	1972 Operations		1,481	0.9	--	--	--	--
	Switch Unit 1		--	--	365	2.5	15	85

* "TA" indicates terrain adjustment model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 2e

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

AQCR # 42

(continued)

AQCR #	Company/Plant *	City/State	Oil Use Amount (**) (10^3 bbl)	Oil Use Sulfur (%)	Coal Use Amount (**) (10^3 ton)	Coal Use Sulfur (%)	Coal Use Ash (%)	Control Efficiency (%)
42	Western Mass. Electric Company							
	West Springfield "TA"	West Springfield/Mass						
	1972 Operations		1,711	1.0	--	--	--	--
	Switch Units 1,2,3		--	--	557	2.5	15	90
	Switch Unit 3		884	1.0	360	2.5	15	95

* "TA" indicates terrain adjustment model; "V" indicates valley model; no notation indicates flat model.

** Total plant fuel use for either 1972 operations or fuel switch indicated. For plants with units designated as convertible, coal use includes any burned in 1972 plus that resulting from conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 3

SUMMARY OF RESULTS

1972 Power Plant Operations			
No. of Plants Analyzed	Annual Amount Coal (10^3 tons)	Annual Amount Fuel Oil (10^3 gals)	Annual Amount Natural Gas (10^6 ft.^{3})
63	8,609	8,684	14,694

Potential Reduction in Fuel Oil and Natural Gas Consumption Under Fuel Conversion Options		
Potential Number Plants Converted	Plants Not Exceeding SO_2 Standards	Plants Not Exceeding Particulate Standards
43	27	36*
New Coal Use Where No Standards Are Exceeded** (10^3 tons)	Potential Annual Oil Savings (10^6 gals)	Potential Natural Gas Savings (10^6 ft.^{3})
19,095	3,191	5,351

* Includes 26 of the 27 plants which do not exceed the SO_2 standard

** This occurs for 26 of the convertible power plants

REFERENCES

1. "Summary Report on Modeling Analysis of Power Plants for Compliance Extensions in 51 Air Quality Control Regions," Walden Research (Contract 68-02-0049), December 17, 1973, EPA Report Number EPA-450/3-75-060; available from National Technical Information Services, 5285 Port Royal Street, Springfield, Virginia 22161.

2. "Modeling Analysis of Power Plants for Fuel Conversion," Group I, APTIC #75448; Group II, APTIC #75449; Group III, APTIC #75450; Group IV, APTIC #75451; Walden Research, revised April 1975; available from National Technical Information Center, Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

3. Originally developed at the Harvard Laboratory for Computer Graphics, SYMAP is best documented in the SYMAP User's Reference Manual, Report No. 71-1, Department of Architecture, University of Illinois at Chicago Circle, Chicago, Illinois.

4. Characteristics of the Population, Volume I, Part A, Section 1, Table 31, "Land Area and Population of Places of 2,500 or More for the United States and Puerto Rico."

5. "Modeling Analysis of Power Plants for Fuel Conversion: Hartford-New Haven-Springfield AQCR #42," June 11, 1974, APTIC #75452.

6. Steam Factors, 1972 Edition, National Coal Association, Washington, D.C.

7. "Compilation of Air Pollutant Emission Factors," Second Edition, U.S. Department of Health, Education, and Welfare, PHS Pub. No. AP-42, April 1973.

8. Turner, D.B., "Workbook of Atmospheric Dispersion Estimates," U.S. Department of Health, Education, and Welfare, PHS Pub. No. 992-AP-25, Revised 1970.

9. Briggs, G.A., Plume Rise, U.S. AEC Critical Review Series TID-25075, National Technical Information Services, Springfield, Virginia, 1969.

10. Briggs, G.A., "Some Recent Analyses of Plume Rise Observations," Proceedings of the Second International Clean Air Congress, edited by H.M. Englund and W.T. Berry, Academic Press, New York, 1971, pp. 1029-1032.

11. Briggs, G.A., "Discussion on Chimney Plumes in Neutral and Stable Surroundings," Atmospheric Environment, 6, July 1972, pp. 507=510.

APPENDICES

APPENDIX A

DESCRIPTION OF THE MODELS

DESCRIPTION OF THE SINGLE SOURCE MODEL (CRS MOD)

The model used to estimate ambient concentrations for 48 of the plants, is one developed by the Meteorology Laboratory, EPA. This model is designed to estimate concentrations due to sources at a single location for averaging times of 1 hour, 24-hours, and 1 year, with emphasis on the 24-hour value.

This model is a Gaussian plume model using diffusion coefficients based on Turner (1970).* Concentrations are estimated for each hour of the year, based on the wind direction (in increments of 10 degrees), wind speed, mixing height, and Pasquill stability class. For the 1- and 24-hour values, it is assumed that the pollutant does not "decay" significantly between the source and the receptors because of the short travel time involved. Also, decay depends on a number of meteorological variables and might well be insignificant when the meteorological conditions occur which lead to highest SO_2 concentration.

Meteorological data for 1964 were used. The reasons for this choice are: (1) data from earlier years did not have sufficient resolution in the wind direction; and (2) data from subsequent years are readily available on magnetic tape only for every third hour.

Mixing height data were obtained from the twice-a-day upper air observations made at the most representative upper air station. Hourly mixing heights were estimated by the model using an objective interpolation scheme.

* Turner, D.B., "Workbook of Atmospheric Dispersion Estimates," U.S. Dept of H.E.W., PHS Publication No. 999-AP-25 (Rev. 1970).

The meteorological data selected as representative for the power plants in these regions were shown as in the table below:

Plant Name	Surface Wind and Stability Data	Mixing Height Data
Example Plant A	Bridgeport	JFK Airport
Example Plant B	JFK Airport	JFK Airport

To simulate the effect of elevated terrain in the vicinity of four plant sites in AQCR 42, a ground-plane displacement procedure was used in the modeling analysis. This procedure consists of adjusting (decreasing) the effective height of the plant stacks by an amount equal to the difference in elevation between the plant site and the average surrounding terrain. This "reduced" stack height is input to the diffusion model described above.

DESCRIPTION OF THE SINGLE SOURCE TERRAIN ADJUSTMENT MODEL (CRS TER)

To simulate the effect of elevated terrain in the vicinity of 31 of these 48 plants with terrain judged to have significant effect, the modeling analysis used a terrain adjustment procedure which considered the difference between the plant elevation and the elevation at each receptor. Ground elevations on 30° radials as well as points of maximum elevation were determined from U.S.G.S. quadrangle maps. The diffusion model then used the difference between the plant elevation and the receptor elevation to modify the effective stack height and thereby adjust the predicted concentrations.

DESCRIPTION OF THE VALLEY MODEL

The model used to estimate short-term concentrations for 15 additional plants in severe terrain is one developed previously by EPA for application to sources located in complex terrain (valley model). Elevations of the receptor sites are derived from contours on the U.S.G.S. quadrangle maps of the area. The model calculates a daily average concentration at these receptor locations based on a 10 meter nearest-approach point of the plume and an assumed persistence of meteorological conditions for 6 hours out of the 24 hours. During this period, the wind direction azimuth is considered to be confined to a 22.5 degree sector. This model assumes a stability class "E" (stable) condition and a wind speed of 2.5 m/sec.

APPENDIX B

EXAMPLE TABLES

The following tables are illustrative of the manner in which data are reported in the individual reports.

TABLE 1

LISTING OF POWER PLANTS EVALUATED

AQCR	Plant	City/State

TABLE 2

POWER PLANT CONVERTIBLE UNITS ANALYZED

Plant	Unit No.	% Sulfur Coal	% Ash Coal	Particulate Control Efficiency	Estimated Annual Coal Use* 10^3 Tons

* Additional coal use, over and above any 1972 usage, in designated units, assuming conversion of 1972 oil (and natural gas, if any) in those units on the basis of equivalent heat input.

TABLE 3

SUMMARY OF ANNUAL POWER PLANT OPERATIONS

Plant/Conversion	Oil Use: Amount (10^3 bbl)	Oil Use: Sulfur (%)	Coal Use: Amount(a) (10^3 ton)	Coal Use: Sulfur (%)	Coal Use: Ash (%)	Control Efficiency (%)

TABLE 4

SUMMARY OF POWER PLANT MODELING RESULTS

	Maximum 24-Hour Concentration ($\mu g/m^3$)				Maximum Annual Concentrations ($\mu g/m^3$)	
	SO_2		Particulates			
Plant/Conversion	Nominal Load	Maximum Load	Nominal Load	Maximum Load	SO_2	Particulates

TABLE 5

SUMMARY OF POWER PLANT INTERACTION CONTRIBUTIONS

Plant/Conversion	Maximum 24-Hour Concentration (μg/m³)				Maximum Annual Concentration (μg/m³)	
	SO_2		Particulates			
	Nominal Load	Maximum Load	Nominal Load	Maximum Load	SO_2	Particulates

APPENDIX B

SUMMARY OF MODELING INPUT DATA

					Emission Rates[a] (Tons/Day)				
						SO_2		Particulates	
Plant (Company)	Stack Number	Rated Capacity (10^6 Btu/hr.)	Stack Height (m)	Fuel Use Per year[b] (Coal = 10^3 tons Res. Oil = 10^3 gal. Nat. Gas = 10^6 ft.^{3})	Percent Sulfur	Maximum Load	Nominal Load	Maximum Load	Nominal Load

a. For the day for which calculated air quality is shown in Table 4.
b. Based on 1972 operations.

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7. AUTHOR(S)	**8. PERFORMING ORGANIZATION REPORT NO.**
Dr. L. Morgenstern	504
9. PERFORMING ORGANIZATION NAME AND ADDRESS	**10. PROGRAM ELEMENT NO.** / **11. CONTRACT/GRANT NO.**
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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report summarizes an air quality modeling analysis of a number of selected power plants. Selected units within specific plants were considered candidates for fuel conversion from oil to coal firing as a result of the oil shortage and energy crisis of 1973-1974. The purpose of this study is to evaluate the impact these candidate conversions would have on ambient sulfur dioxide and particulate concentrations.

In considering whether conversions would allow attainment of primary standards, no allowance was made for contributions from sources other than power plants. Furthermore, no consideration was given to the provisions of the Energy Supply and Environmental Coordination Act (ESECA, 1974), which requires other limiting conditions (e.g. Primary Standard Conditions). Thus, a more complete analysis in terms of ESECA requirements might significantly alter the total amount of coal which could be substituted.

The study is intended to add to the overall analysis of the individual plants being conducted by EPA, but not by itself to define precise problems or to develop exact solutions. Decisions on final evaluations based on the material presented in the five separate reports pertaining to specific plants should consider the data, assumptions, and procedures used in this analysis, as well as a variety of important factors not considered in this study.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
power plant modeling power plant variances SO_2 impact of power plants particulate impact of power plants coal-conversion of power plants dispersion modeling		

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