GENERAL DISCUSSION OF PART 2

INTRODUCTION

The Clean Air Act and subsequent guidelines for the preparation of implementation plans promulgate national ambient air quality standards and the methodologies by which the State must show that it will attain and maintain such standards. The deadline for compliance is approximately July 3, 1975, although provisions are made for the Governor to request and justify limited extensions. This proposal Part 2, in conjunction with the previously submitted Parts 1 and 3 of regulations for the control of air pollution, is designed to attain both primary and secondary national air quality standards by July 1, 1975. Furthermore sufficient stringency has been incorporated in the design of emission control standards to support the possibility that these proposals, as they apply to existing air contaminant emissions sources, will need not be revised prior to 1980 and hopefully thereafter.

The national ambient air quality standards and those promulgated by the old Illinois Air Pollution Control Board are shown in Table 1. With the exception of the Illinois Sulfur Dioxide Standard and the national hydrocarbon standards, we are able to propose effective and reasonable emission control standards for stationary emission sources so that in conjunction with national emission standards for motor vehicles, the ambient air quality standards in Table 1 can be attained by July 1, 1975 throughout the State. Attainment in Chicago of the Illinois sulfur dioxide standard of 40 micrograms per cubic meter which is 1/2 the national, health-oriented primary standard and 2/3 the national, secondary, welfare-oriented standard cannot be attained with present day resources and technology short of a total ban on the use of coal throughout the region. The eventual development of coal gasification techniques would alter this situation considerably.

The national hydrocarbon standard is set at approximately 30% of the present non-methane hydrocarbon levels in the Chicago and St. Louis regions. Since the Clean Air Act has preempted state control of emissions from post 1968 vehicles and since such emissions constitute over 60% of

TABLE 1
AMBIENT AIR QUALITY STANDARDS

Particulates (micrograms/cu.meter)	Federal Primary	Federal Secondary	Illinois Standard
annual geometric mean	75	60	75
max. 24-hr. conc.	260	150	260
Sulfur oxides			
(micrograms/cu.meter) annual arith. aver.	80[b] (.03 ppm)	60[c] (.02 ppm)	40[d] (.015 ppm)
max. 24-hr. conc.[a]	365 (1.4 ppm)	260 (.1 ppm)	450 (.17 ppm)
max. 3-hr. conc.[a]	---	1,300 (.5 ppm)	---
max. 1-hr. conc.	---	---	1120 (.42 ppm)
Carbon Monoxide			
(milligrams/cu.meter) max. 8-hr. conc.[a]	10 (9 ppm)	10	---
max. 1-hr. conc.[a]	40 (35 ppm)	40	---
Photochemical oxidants			
(micrograms/cu.meter) one-hr. max.[a]	160 (.08 ppm)	160	---
Hydrocarbons			
(micrograms/cu. meter) max. 3-hr. conc.[a] 6-9 am	160 (.24 ppm)	160	---
Nitrogen oxides			
(micrograms/cu. meter) annual arith. aver.	100 (.05 ppm)	100	---

a. Not to be exceeded more than once a year

b. Corresponds to an annual geometric mean of approximately 70 ug/m^3.

c. Corresponds to an annual geometric mean of approximately 52 ug/m^3.

d. Annual geometric mean.

all hydrocarbon emissions, the application of reasonably available control techniques for hydrocarbon emissions from stationary sources coupled with the federal vehicle controls is not sufficient to attain the national hydrocarbon standard. This eventuality was recognized in the Guidelines for the Preparation of Implementation Plans published in the Federal Register which in effect eliminated the requirement for attainment of the national hydrocarbon standard by stating that reduction of hydrocarbons as necessary to attain the national ambient air quality standard for photochemical oxidants will be considered to also have attained the national hydrocarbon standard. Proposed reductions in hydrocarbon emissions contained herein represent the maximum degree of control which is reasonably available and, when coupled with the federal vehicle controls, will meet this latter requirement.

The design of these proposed emission control regulations has entailed a number of critical steps which together insure the effectiveness and reasonableness of the regulations: Inventory of emissions; forecasts of industrial and population growth; measurements of air quality; assessment of control technology; analyses which forecast the air quality likely to result from the imposition of such emission control strategies; and the resources (fuels, hardware, dollars, etc.) necessary to implement such emission control strategies.

The Federal EPA, in consultation with the Agency, has divided the State into eleven air quality control regions as shown in Figure 1. The Federal Guidelines for the Preparation of Implementation Plans allow that emission control standards can be designed on a "worst region" basis whereby analyses are performed to show that such standards are adequate for the most polluted portion of the State and thereby are deemed sufficient for the remainder of the State.

In order to obtain a more reasonable solution to the pollution problems in Illinois, the Agency and its consultants have considered essentially three types of regions: The highly industralized Major Metropolitan Areas (MMAs) of Chicago and St. Louis; moderately sized MMAs typified in their maturity by the Peoria Region, and rural areas defined as those counties outside MMAs (see Table A of Rule 201 for specification of MMAs).

The regulations have been designed with further stratification to distinguish between existing and new sources and in between various types of sources in order to account for their relative contributions to air pollution and relative ease of control.

The proposed regulations are uniform for new sources throughout the State in keeping with the principle that excessive proliferation of new sources in areas with presently acceptable air quality should not be encouraged by creating artificial economic incentives.

The result of these many stratifications, summarized in Table 2, is certainly a more complicated set of regulations than would be the case if uniform state-wide controls were imposed; however, this problem-oriented approach facilitates the design of emission standards which will achieve the desired ambient air quality goals with minimum, all be it considerable, demand on the resources of the State.

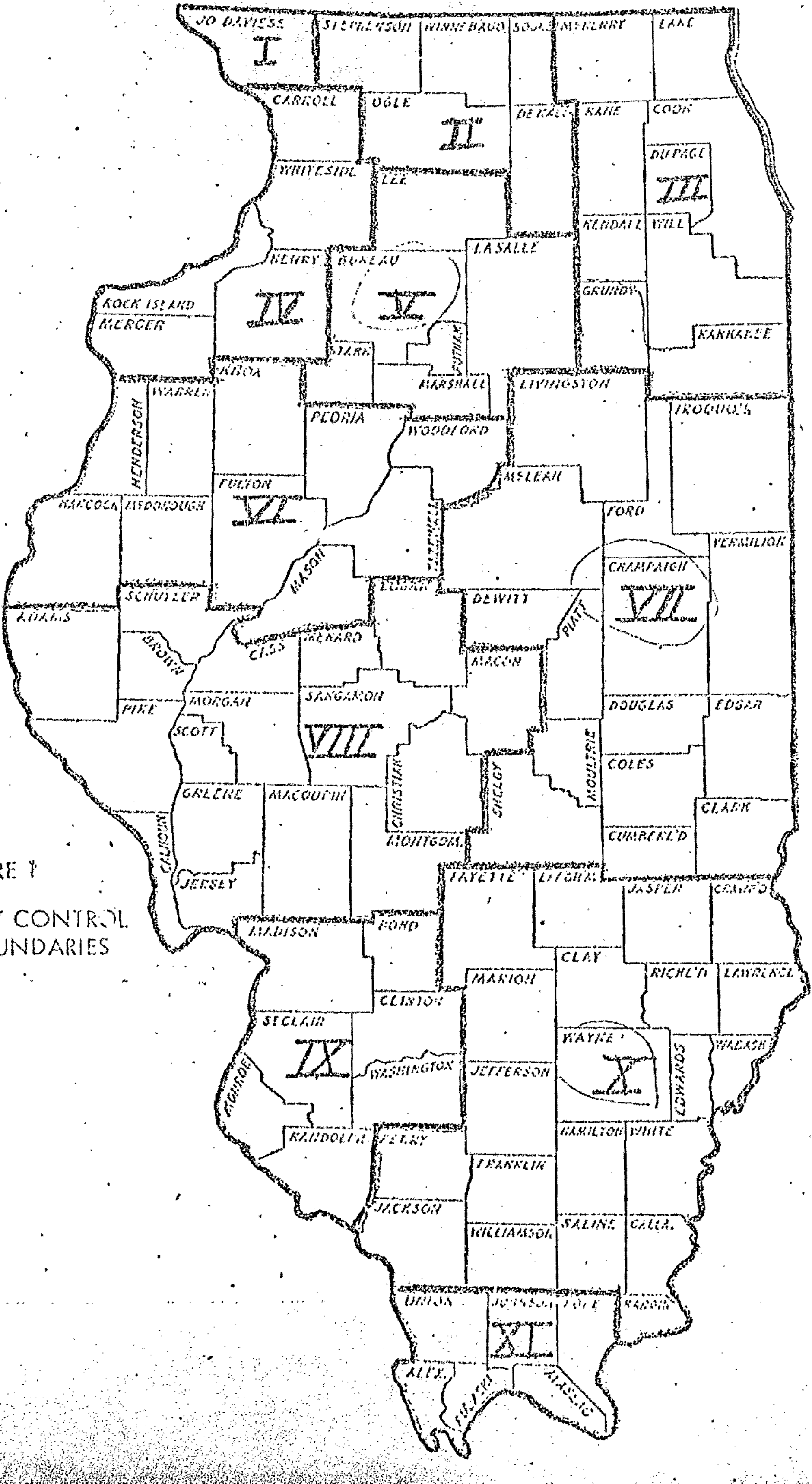

FIGURE 1

AIR QUALITY CONTROL REGION BOUNDARIES

TABLE 2

SUMMARY OF SULFUR DIOXIDE AND PARTICULATE EMISSION STANDARDS

Source Classification	Subclassification	Sulfur Dioxide Emissions			Particulate Emissions	
		Coal	Oil	Process	Allowable Emissions	Visual
All Fuel Combustion Emission Sources	New ≥ 250 MMB/hr	1.8 lb/MMB*	0.7 lb/MMB*		0.05 lb/MMB	Ringelmann 1.5
	New < 250 MMB/hr	1.8 lb/MMB*	0.7 lb/MMB*		0.1 lb/MMB	
	Existing in all MMAs					
	Existing Elsewhere	6.0 lb/MMB*				
Process Emission Sources	New or Certain Existing			1500 ppm	DAPC Table 2.1 +	Ringelmann 1.5
	Existing presently in compliance with Table 2.2			1500 ppm	Mod. Bay Area Table 2.2 +	
Incinerators	New Residential and Commercial Buildings				0.1 grains per SCF +	Ringelmann 1.5
	Existing Residential and Commercial Buildings				0.2 grains per SCF +	
	Municipal, Industrial & Commercial Incinerator Estmts.				0.05 grains per SCF +	

+ Also subject to Rules 203(d) and 203(g).

*Maximum Emission of $20,000\left(\frac{H_s}{300}\right)^2$ lb/hr at any site, regardless of any other regulation. (Rule 204(d)).

MMB = million btu

Rule 202 - VISUAL EMISSIONS.

In contrast to present regulations, process emission as well as incineration and fuel combustion emissions are subject to visual standards. Except for limited periods, Ringelmann and opacity limits of 1.5 and 30% respectively are applicable to all emission sources.

Rule 202(b) streamlines procedures for determining violations of the visual emission standards.

Rule 203 - PARTICULATE EMISSION STANDARDS AND LIMITATIONS.

Table 2 summarizes the particulate emission standard applicable to each source classification. In contrast to standards for sulfur oxides, no geographical distinctions have been made for the particulate standards.

Rule 203(a) applies to all new process emission sources and to all existing process emission sources which do not presently meet the limits of the more lenient Rule 203(b). This latter rule is the present Rule 3-3.111 (Bay Area Table) with an upper emission limit of 70 pound particulate per hour. By this approach, most existing process sources which have in good faith made process modifications or installed control equipment adequate to meet the present Rule 3-3.111 will be spared the additional economic burden of further control. However, those process emission sources which, by virtue of negligence or special exceptions in the present regulations, would require a control program to meet Rule 203(b), must according to Rule 203(c) of this proposal meet the more stringent Rule 203(a).

Rule 203(a) is similar to and very slightly more stringent than the most recent Pollution Control Board proposal published in Newsletters 12 and 17. In comparison with the process weight rate table published in the August 14 issue of Federal Register, Table 2.1 of the proposed regulations is more stringent for small and intermediate sources and more lenient for large sources. The Agency and its consultants have conducted a study of the technical feasibility and economic reasonableness of Rule 203(a) as it effects thirteen major industrial classifications including steel manufacture, gray iron foundries, cement manufacture, and asphalt batching. There is little question that Rule 203(a), with exceptions noted in Rule 203(e), is technically and economically feasible. Following the methods of Babcock as presented to the Pollution Control Board during the Chicago Implementation Plan hearings, economic reasonableness was evaluated by comparing the annualized cost of control to the value of the product. This ratio ran as high as 3% but in general was of the order of 1%.

Although Rule 203(g) is written in terms of "maximum allowable particulate emissions," it in effect imposes a stack height requirement on all new large incinerators and all new process emission sources. Rule 203(g) (3) reduces to Rule 202(g) (2) for the case of a single stack. Stack height requirements for fuel combustion emission sources are embodied in a similar rule (Rule 204(d)) governing "maximum allowable sulfur dioxide emissions." Three basic guidelines have been employed in designing Rule 203(g):

- The maximum 24-hour average ground-level particulate concentration must be less than the federal standard of 150 $\mu g/m^3$. This corresponds to a 1-hour average of approximately 300 $\mu g/m^3$.
- Proper stack design calls for the stack height to be at least 2.5 times the height of the tallest nearby building, including any upon which the stack is mounted.
- Proper stack design calls for the average exit velocity of the exhaust gasses to be 1.5 times the design wind speed. If the exit velocity is less than 1.5 times the design wind speed, aerodynamic downwash is likely to occur.

Air contaminant emissions from fuel combustion are major contributors to the excessive particulate, sulfur dioxide, and nitrogen dioxide levels in Major Metropolitan Areas. The quantity of pollutants (e.g. from large electric utilities) and the geometry of the sources (e.g. concentrated, space-heating sources without adequate smoke stacks) are considerations in the design of effective and reasonable control strategies. Where the control strategy for sulfur dioxide encourages the shift from solid to liquid fuels, that strategy must also be considered as a particulate control strategy. The emission standards for these two pollutant classes have therefore been developed with this consideration in mind.

The particulate emission standard from fuel combustion emission sources, Rule 203(h) coincides with "reasonably available control technology" as proposed by the Federal EPA (Federal Register, 36, No.67, April 7, 1971, P 6692). The 0.1 pound per million BTU limit applies to all existing fuel combustion sources and all new coal combustion sources with rated heat inputs of less than 250 million BTU per hour.

than 250 million BTU per hour. This standard can be met by control efficiencies of less than 99% on dry bottom pulverized coal boilers and by control efficiencies of less than 94% for cyclone types. This regulation is significantly more stringent than the present APS-1, but many responsible electric utilities have recognized the availability of more effective control equipment and installed devices which will meet Rule 203(h)(1).

Rule 203(h)(2) is compatible with the new source particulate emission standards for fuel combustion emission sources with rated heat inputs greater than 250 million BTU's per hour. The numbers differ from the Federal Register (Federal Register, 36, 159, August 17, 1971, P 15706) in that this proposed standard for measuring particulate emissions (Rule 203(k) is the traditional ASME method of determining dust concentration in gas streams rather than the newly proposed Federal EPA method.

Rule 202(h) also considers emissions from fuel combustion emission sources utilizing at one time both solid and liquid fuels.

Rule 203(h)(1) limits emissions from most fuel combustion emission sources to 0.1 pounds per million BTU. For residential and commercial buildings and certain manufacturing concerns located in urban areas, space limitations and probably economic consideration will necessitate shifting of fuel from coal to either gas or oil. The Agency and its consultants have evaluated the implications of such wholesale fuel conversions in terms of resultant levels of particulates and sulfur dioxide and required hardware and fuel resources. Analyses indicate consistently that only through such particulate limitations on sources situated in densely populated, highly industrialized, urban areas can the national primary ambient air quality standard be achieved. Furthermore, by virtue of the unacceptable aerodynamics of short stacks associated with such sources, such buildings in and of themselves can be frequently the cause of excessive short-term ambient air levels of particulates and sulfur dioxide.

Rule 203(h)(1) is, in essence, a total ban on the use of solid fuel in residential and commercial buildings. A controversial element in the proposed regulations is the essential ban on the use of coal in residential and commercial buildings in urban areas. Researchers at Argonne and at the Mitre Corporation have consistently emphasized that major reductions in the emissions of particulate matter and sulfur dioxide from such sources are essential to the attainment of the Federal and State Ambient Air Quality Standards in Chicago and other urban areas. Therefore, during the hearings before the Pollution Control Board in early 1971 on the Chicago Implementation Plan, the Board and its consultants proposed such stringent controls. Fuel availability, originally a pivotal issue, is no longer considered a serious problem. However the observation that conversions and possibly higher fuel costs may be translated into higher rents, often for those segments of the urban population which can least afford such rent increases, remains valid. The Agency urges the Federal Congress, the State Legislature, and the Chicago City Council to consider assistance in the form of direct subsidies, loan guarantees, or tax incentives to relieve the possible burden that these necessary fuel conversions may have upon the home owner and apartment renter. Furthermore, the Agency welcomes any proposals which can demonstrate that the Federal Air Quality Standards can be achieved and maintained (with consideration for regional growth) by alternate means. Personnel from the Region V office of the Federal EPA have expressed a willingness to evaluate on short notice such alternate plans as to their adequacy in terms of the provisions of the Clean Air Act. In this regard, the Agency urges that any such plans be submitted in writing to both the Board and the Agency within two weeks of the publication of this proposal.

The original proposal proposal by the Pollution Control Board called for a ban on the use of solid fuel in certain fuel combustion emission sources situated in critical suare miles within Chicago. Subsequent studies at Argonne suggested a three phase implementation of a region-wide ban on the use of solid fuels in residential and commercial buildings in order to maximize the improvement in air quality per unit of natural gas. Testimony by Mr. J. Thomas of Peoples Gas Light and Coke Company (PGLC) at the hearings on the proposed particulate and sulfur dioxide emission standards in (continued on page 11)

Chicago, emphasized that the Illinois Commerce Commission establishes criteria for responding to the backlog of requests for gas connections. The Agency therefore suggests an arrangement be made with the ICC to permit PGLC to direct available connections to critical areas rather than make that requirement an integral part of these regulations.

Incinerator standards (Rule 203(f) are expressed here in grains per standard cubic foot of exhaust gas rather than in pounds of particulate matter per ton of refuse since weighing of refuse prior to incineration is generally impractical. Residential incinerators are required to meet 0.2 grains per standard cubic foot. Although the present State regulation allows 0.35 grains per standard cubic foot for such incinerators, permits have been approved by the State only for multiple chambered incinerators equipped with afterburners which, if properly operated, will easily comply with the proposal. This proposal is also compatible with the existing regulations throughout Cook County.

The Standard for new residential incinerators, 0.1 grains per standard cubic foot, is essentially the same as the Board's proposal R70-15. Available information on guaranteed incinerator performance indicates that this limit can be met without the installation of flue gas cleaning equipment. More stringent control of municipal, commercial, and industrial incinerators is required, up to 98.5% removal of particulate matter from exhaust gasses.

Rule 203(i) is designed to minimize the level of fugitive air contaminants, most notably dust, associated with material storage, handling, and transportation and with certain processes. By-product coke ovens are major sources of fugitive air contaminants. Because of the unique nature of the control problems associated with such operations, a separate rule, 203(j), has been proposed.

Rule 203(k) establishes the standard method for measuring particulate matter in a gas stream as the ASME power test code. The Federal EPA (Federal Register, 36, 159, August 17, 1971) has proposed a new source testing method for particulates. The crux of the Federal proposal is the requirement that condensible vapors be included in the measurement of particulate emission rates. The Agency feels that, if such condensible vapors constitute, by virtue of their chemical composition, a special air pollution hazard, they should be covered by separate regulations specific to that chemical species. For the general category "particulate matter," the ASME Power Test Code for determining dust concentration in a gas stream is recommended by the Agency for the following reasons:

- It is a standard method upon which an extensive history of emission factors and associated source and control equipment performance factors have been developed.
- Extensive planning such as large scale urban dispersion modeling studies have been done based on emission data developed via emission factors derived from tests conducted using this method.
- Many existing control regulations and regulations currently being evaluated for Implementation Plans are based on parameters derived through tests conducted eventually with this method.
- The inclusion of condensibles for determining allowable emissions from fuel combustion simply raises the emission rate and correspondingly the federal proposal for particulate emissions from fuel combustion (.2 lb./MMBTU) is much higher than that currently under evaluation by Illinois (.05 lb./MM BTU) as well as many other states. In other words, the Federal EPA has made the test tougher and slackened the standard. Equivalently Illinois proposes to maintain the ASME testing method with appropriately tighter emission standards.
- Finally, the Federal proposal will render obsolete much of the expensive stack testing equipment currently used by State and local agencies.

Rule 203(l) offers an extended compliance date for certain emission sources required to comply with the more stringent aspects of these proposals. It recognizes that sources which meet certain provisions of the present air pollution control regulations, most notably standards for fuel combustion,incineration and process emissions, have in general demonstrated good faith by voluntary compliance and therefore should be accorded a more lenient compliance schedule. This Rule is applicable to sources throughout the State, even in those areas which, prior to the passage of the Environmental Protection Act, were under the exclusive jurisdiction of local air pollution control agencies. Such agencies were required to promulgate and enforce regulations which were essentially equivalent to those of the State. Furthermore all emission sources throughout the State have been under the jurisdiction of the State and therefore subject to the present Air Pollution Control Rules and Regulations for the past fifteen months.

RESULTANT PARTICULATE LEVELS.

The emission standards of Rule 203 have been designed to achieve and maintain the ambient particulate air quality standards listed in Table 1. Short term (24-hour average) maxima are to be limited by a combination of emission standards and stack height requirements determined using standard dispersion equations (D.B. Turner, PHS Pub. No. 999-26, Rev. 1969) for single stacks. Regional air quality, which is influenced primarily by the regional meteorology and the magnitude and distribution of sources, has been analyzed at Argonne using the multiple-source dispersion model currently endorsed by the Federal EPA (see Argonne publication IIPP-2, December 1970). As mentioned in the introduction, three model regions have been studied: Chicago, St. Louis, and Peoria. The particulate emission standards proposed in Rule 203 are likely to achieve and maintain the federal secondary ambient air quality standard (60 ug/m^3) in each of these regions and therefore throughout the State.

Chicago Metropolitan Air Quality Control Region (CMAQCR).

Table 3 indicates for the past several years the annual average of the data obtained from all hi volume samplers operated by the City of Chicago and estimates by the Chicago Department of Environmental Control of annual emissions of particulate matter. Indications are that the suspended particulate average for 1971 will slightly exceed 100 $\mu g/m^3$.

TABLE 3
CHICAGO CITY-WIDE PARTICULATE LEVELS AND EMISSIONS

Year	Annual[a] Geometric Mean ($\mu g/m^3$)	Annual Particulate Emission (Tons/year)
1968	106	245,000[b]
1969	108	277,000[c]
1970	100	277,000[c]

a 20 sites

b From Federal EPA Inventory of the Chicago Region

c From Chicago DEC Federal Grant Application for FY 1971

Detailed emission figures are not available for the remainder of the Chicago region but the suspended particulate levels shown in Table 4 are similar to those in Table 3 in both magnitude and lack of significant downward trend.

TABLE 4
SUSPENDED PARTICULATE LEVELS OUTSIDE CHICAGO*

Year	Annual Geometric Mean ($\mu g/m^3$)
1968	108
1969	110
1970	100

* Approximately fifty sites (varies slightly from year to year) of which 24 are in Cook County outside Chicago city limits.

Figure 2 shows the profile of particulate levels throughout the CMAQCR based on 1968 air quality and emission data.

Figure 3 predicts the effect of applying Rule 203 to all major industries and utilities. The importance of controlling particulate emissions from the many small but densely packed fuel combustion sources is clearly demonstrated here and in Figure 4. The present Chicago and Cook County coal-sulfur restrictions encourage the shift to low-sulfur, low-ash fuels, but the availability of low sulfur coal has dulled this incentive.

Figures 5 and 6 show projections of particulate levels for 1975 and 1980. Growth has been estimated using land use patterns and historical trends for different classes of sources. The apparent violations of the secondary ambient air quality standard along the Illinois-Indiana border is primarily the responsibility of the Northwestern Indiana industrial complex. The dispersion model calculations (Figures 3-6) employ the Indiana regulations proposed in the implementation plan submitted to the Federal EPA last year. These regulations are currently under review using modeling methods and may be endowed with greater stringency in order to attain the federal standards.

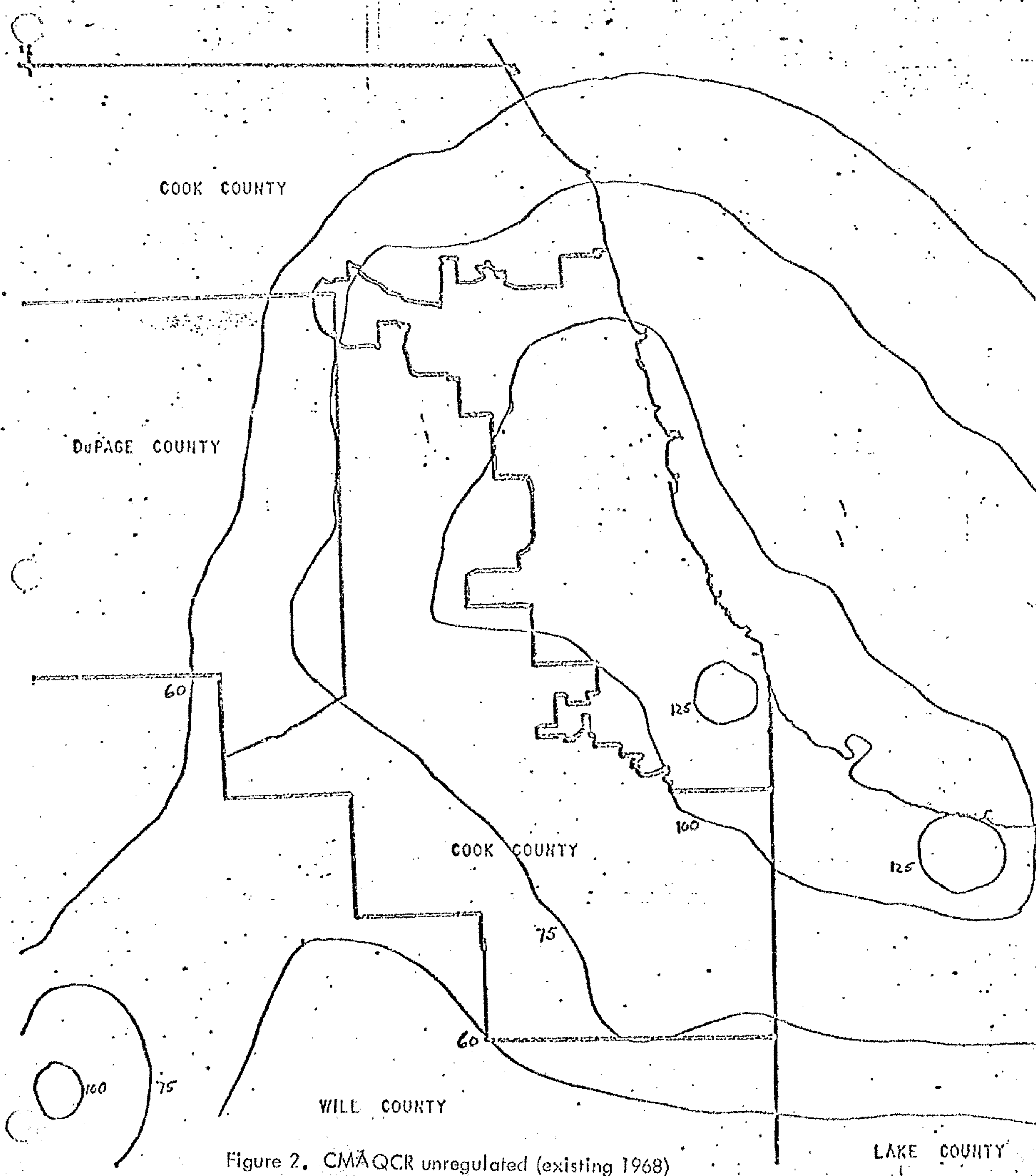

Figure 2. CMAQCR unregulated (existing 1968) particulate levels.
(Annual geometric means in $\mu g/m^3$).
Federal primary standard = 75 $\mu g/m^3$.
Federal secondary standard = 60 $\mu g/m^3$

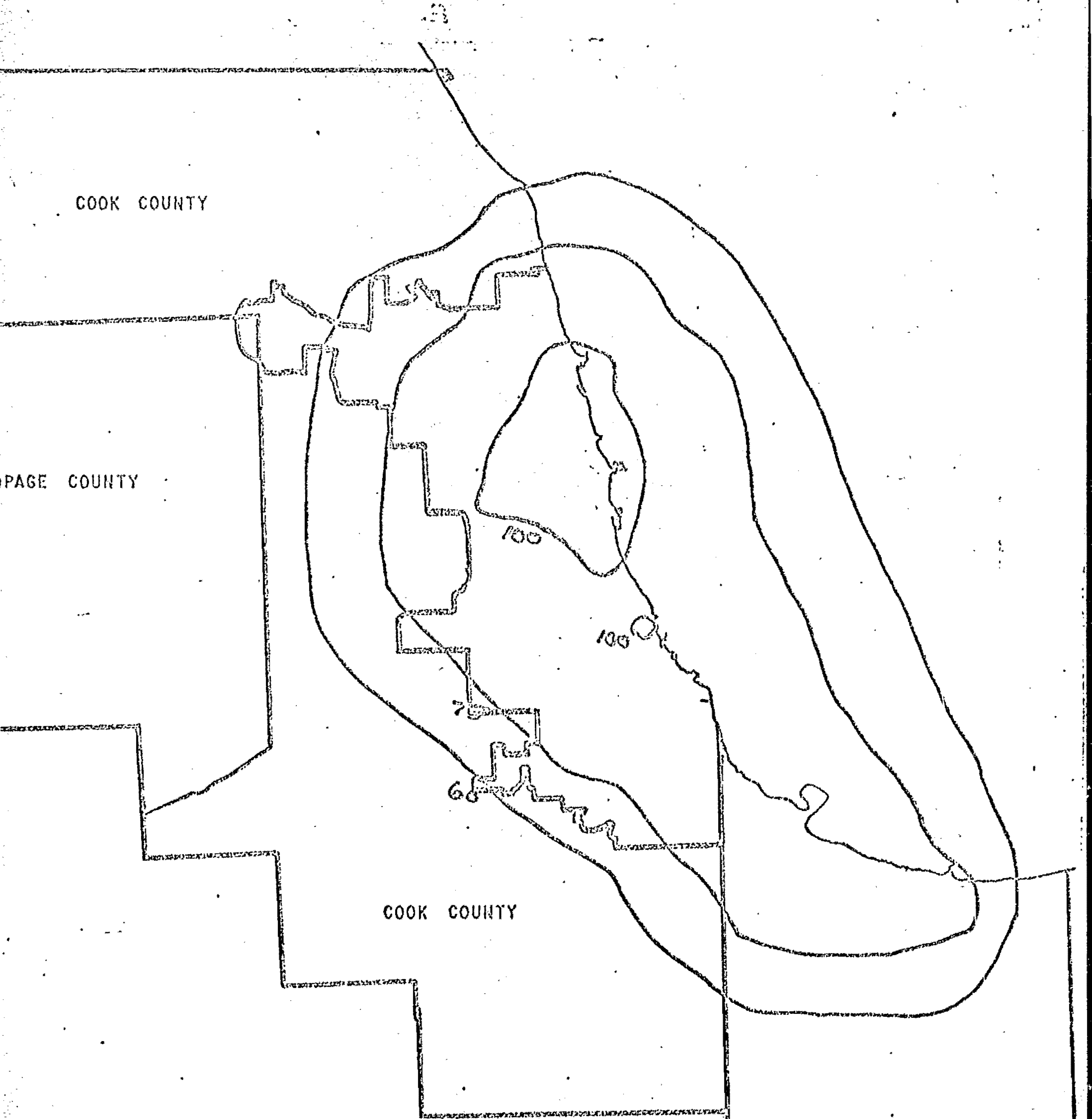

Figure 3. CMAQCR particulate levels with Rule 203 applied only to the largest 180 emitters. This represented 77% of regionwide particulate emissions in 1968. Most residential and commercial space heating sources are uncontrolled. (Annual geometric means, $\mu g/m3$).

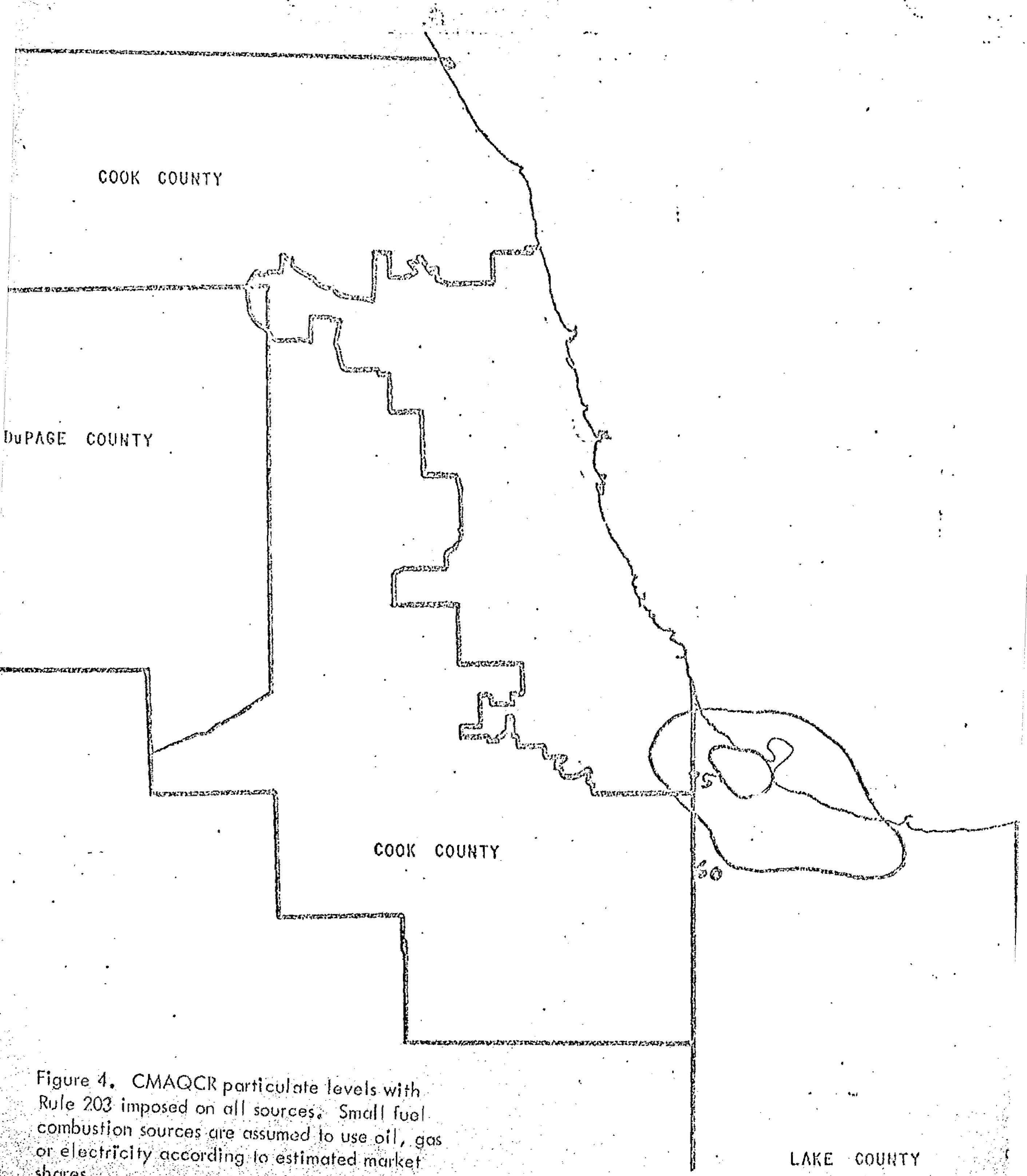

Figure 4. CMAQCR particulate levels with Rule 203 imposed on all sources. Small fuel combustion sources are assumed to use oil, gas or electricity according to estimated market shares.
(Annual geometric means $\mu g/m^3$)

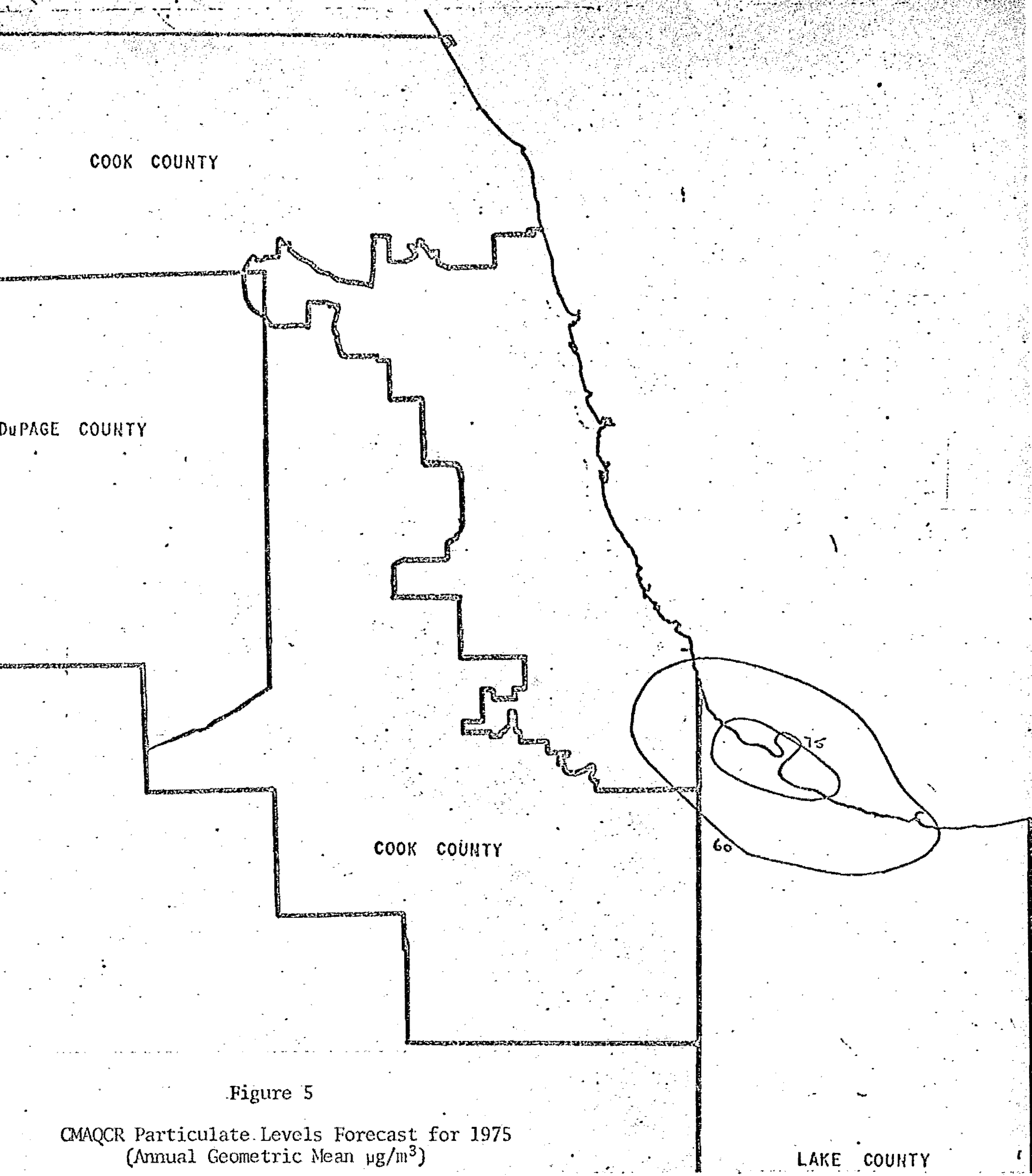

Figure 5

CMAQCR Particulate Levels Forecast for 1975
(Annual Geometric Mean $\mu g/m^3$)

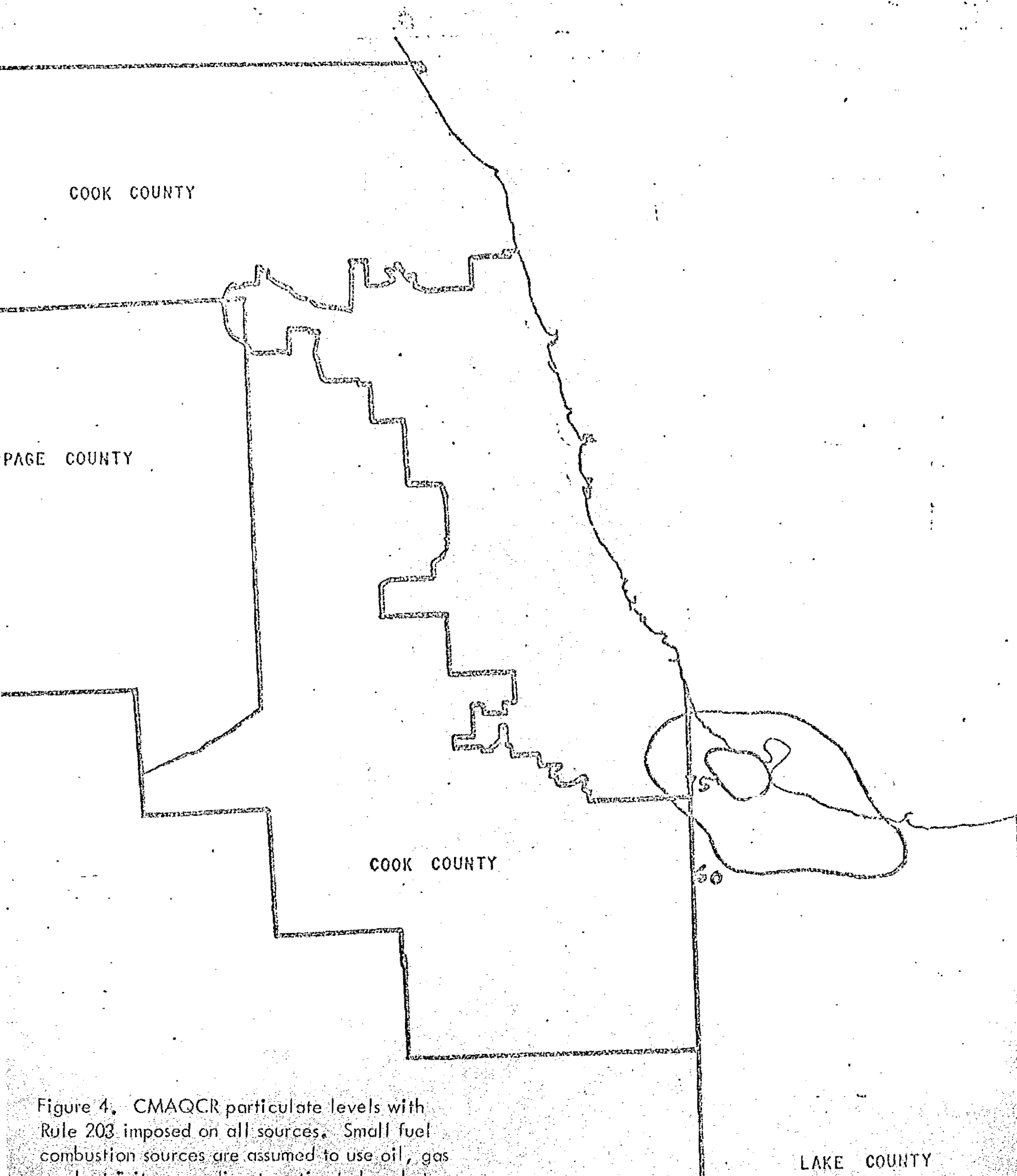

Figure 4. CMAQCR particulate levels with Rule 203 imposed on all sources. Small fuel combustion sources are assumed to use oil, gas or electricity according to estimated market shares.

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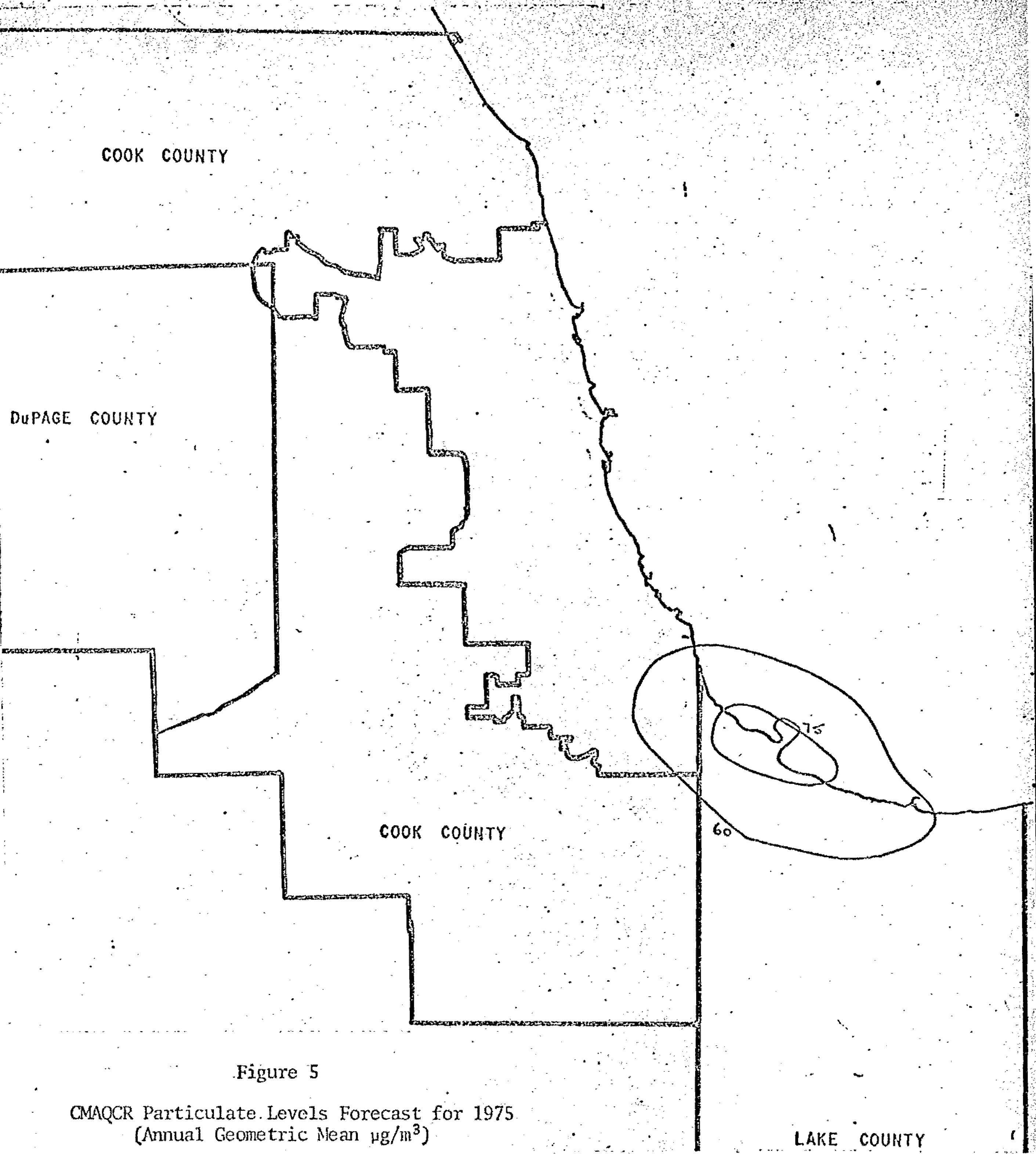

Figure 5

CMAQCR Particulate Levels Forecast for 1975
(Annual Geometric Mean μg/m³)

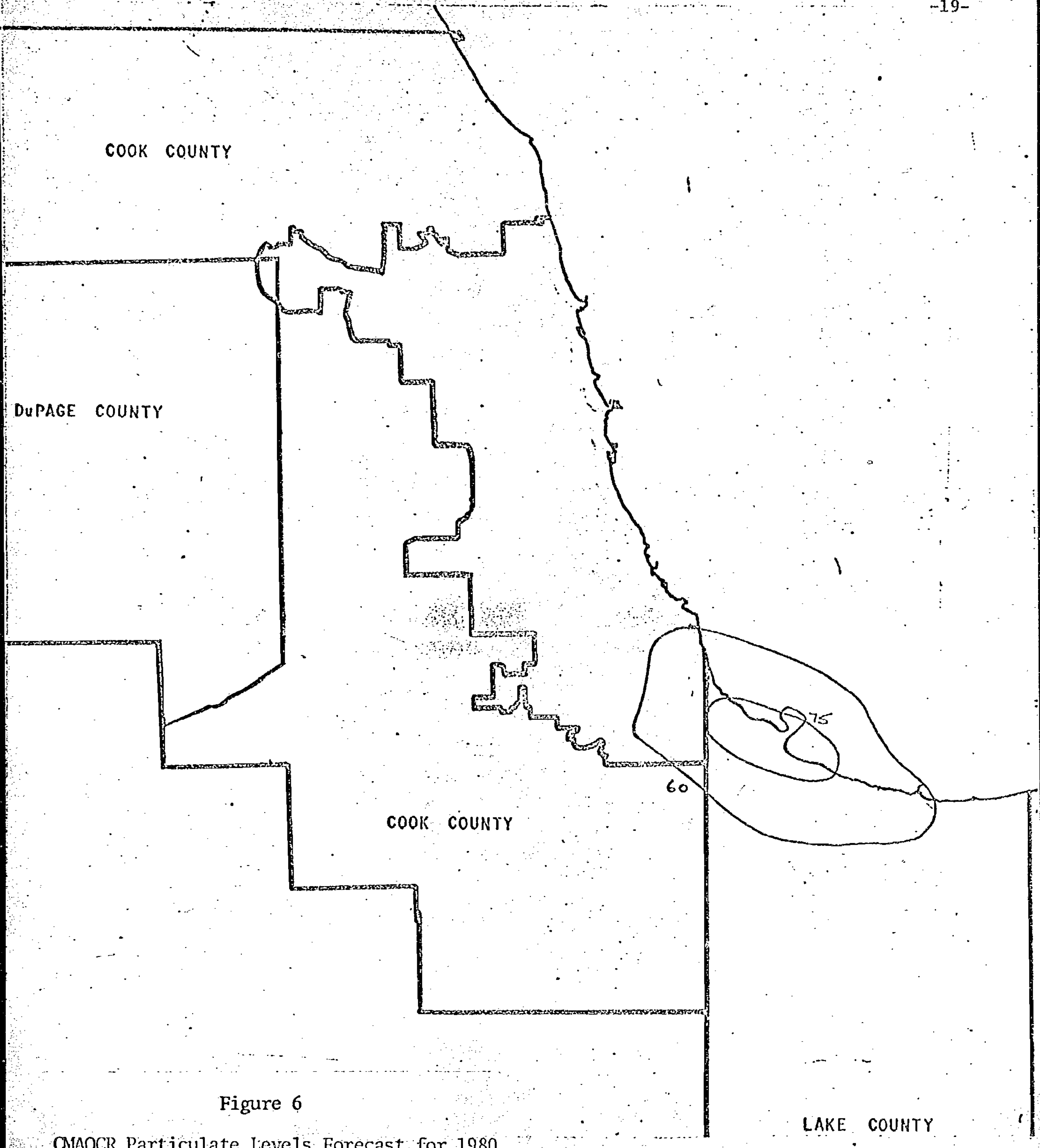

Figure 6

CMAQCR Particulate Levels Forecast for 1980
(Annual Geometric Mean μg/m^3)

Peoria Metropolitan Air Quality Control Region (PMAQCR)

The analysis of the effect of particulate control strategies in the PMAQCR was performed using a 1970 emission inventory. Figures 7 and 8 show current and anticipated particulate levels. Compliance with the federal secondary standard is achieved. Forecasts of particulate levels for 1975 and 1980 are not yet completed, but initial estimates for the next decade of the growth in emissions in the PMAQCR indicate that Rule 203, if properly enforced, will maintain the desired air quality levels.

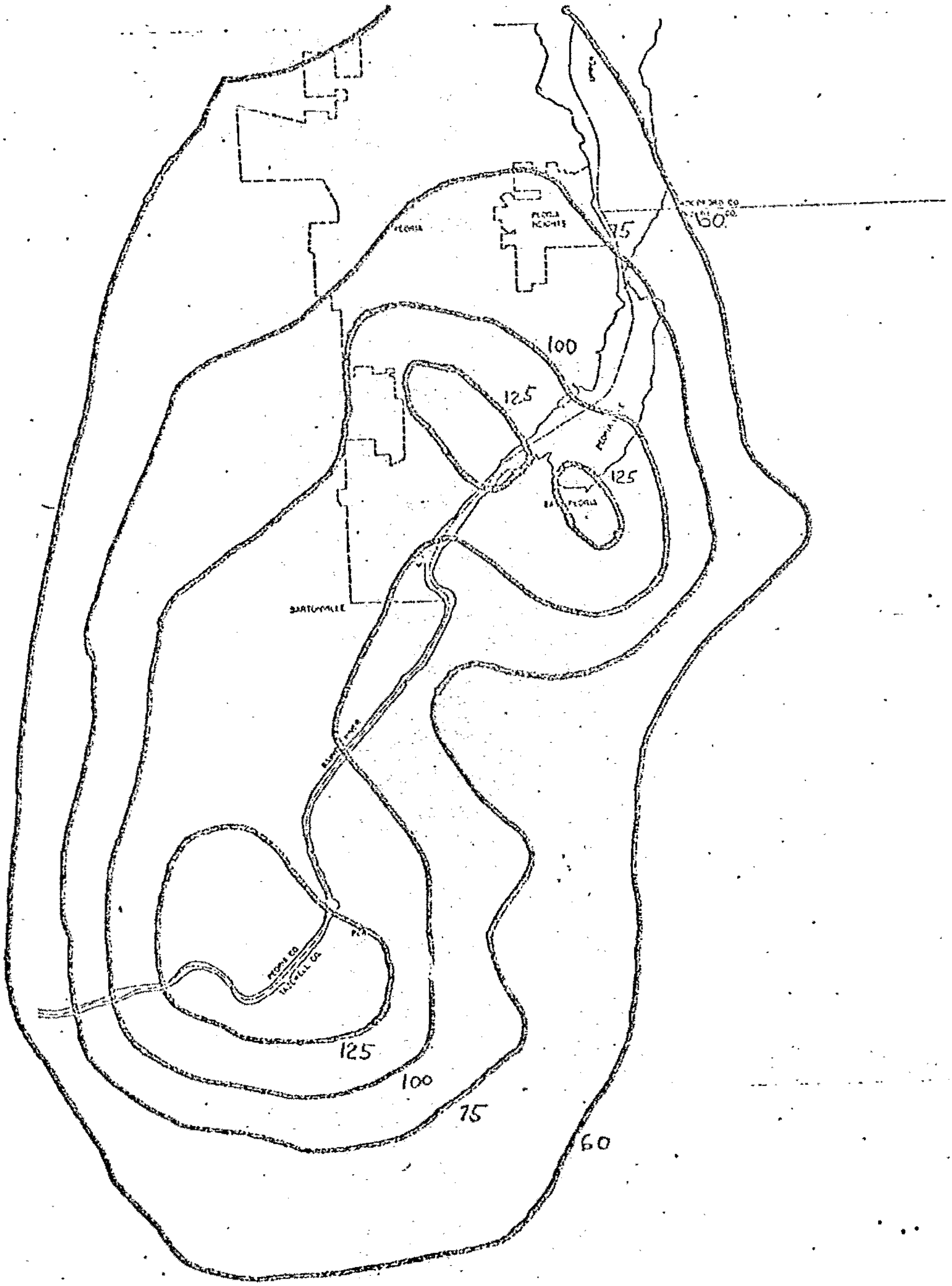

Figure 7. PMAQCR particulate levels in 1970.

(Annual geometric means, $\mu g/m^3$).

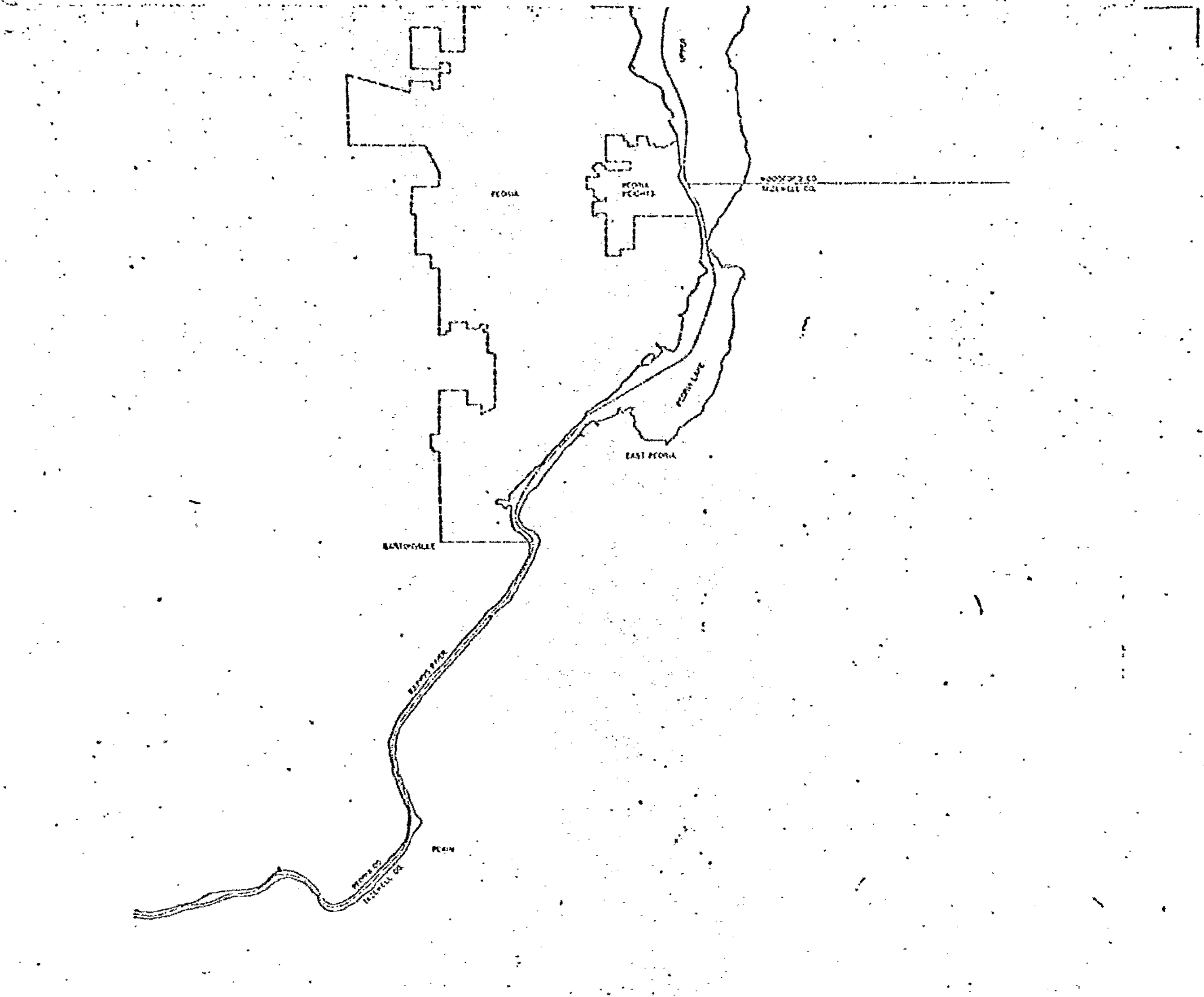

Figure 8. PMAQCR particulate levels are all below federal secondary ambient air quality standard of 60 $\mu g/m^3$ when Rule 203 is applied.

St. Louis Metropolitan Air Quality Control Region (SLMAQCR)

Analyses for the SLMAQCR were based on the 1968 emission inventory compiled by the federal government.

Table 4 shows the gradual downward trend in ambient air concentrations of particulate matter in and around the St. Louis area. These concentrations however are well above acceptable levels. Figure 9 shows profiles of particulate levels for 1968. The application of Rule 203 results in the isopleth map in Figure 10. The calculations assume that Rule 203(b), the less stringent process weight rate table, applies to all existing sources whereas, in effect, a significant (but presently unknown) number of these existing sources will be required to meet the more demanding schedule in Rule 203(a). Thus the resulting air quality will be somewhere between Figure 10 and Figure 11 in which all existing process sources are subject to the most stringent regulation.

Estimates for the growth in emissions in the SLMAQCR have been made and indicate significantly less of a problem than for Chicago for which the forecasts are quite satisfactory. Nevertheless, dispersion model runs will be made to forecast pollution levels in the SLMAQCR in 1975 and 1980.

TABLE 4

REGIONAL TRENDS – SUSPENDED PARTICULATES

HIGH VOLUME DATA

ug/m^3

SITE	1966	1967	1968	1969	1970
AREA: EAST ST. LOUIS					
Alton #1	136	116	112	117	93
Alton #2	110	130			
Belleville				88	94
Collinsville				96	86
Columbia				87	93
E. St. Louis #1	187	154	155	139	122
E. St. Louis #2		133			
E. St. Louis #3		133			
Edwardsville			114	87	91
Granite City #1	199	197	216	152	142
Granite City #2			214	281	
Granite City #3	161	182			207
Sauget		202			
Venice				141	135
Wood River #1	125	126	94	149	124
Wood River #2		115		183	128
Summary					
Average	153	149	152	138	120
Maximum	199	202	216	281	207
Minimum	110	115	114	87	86
No. of Sites	6	10	6	11	11

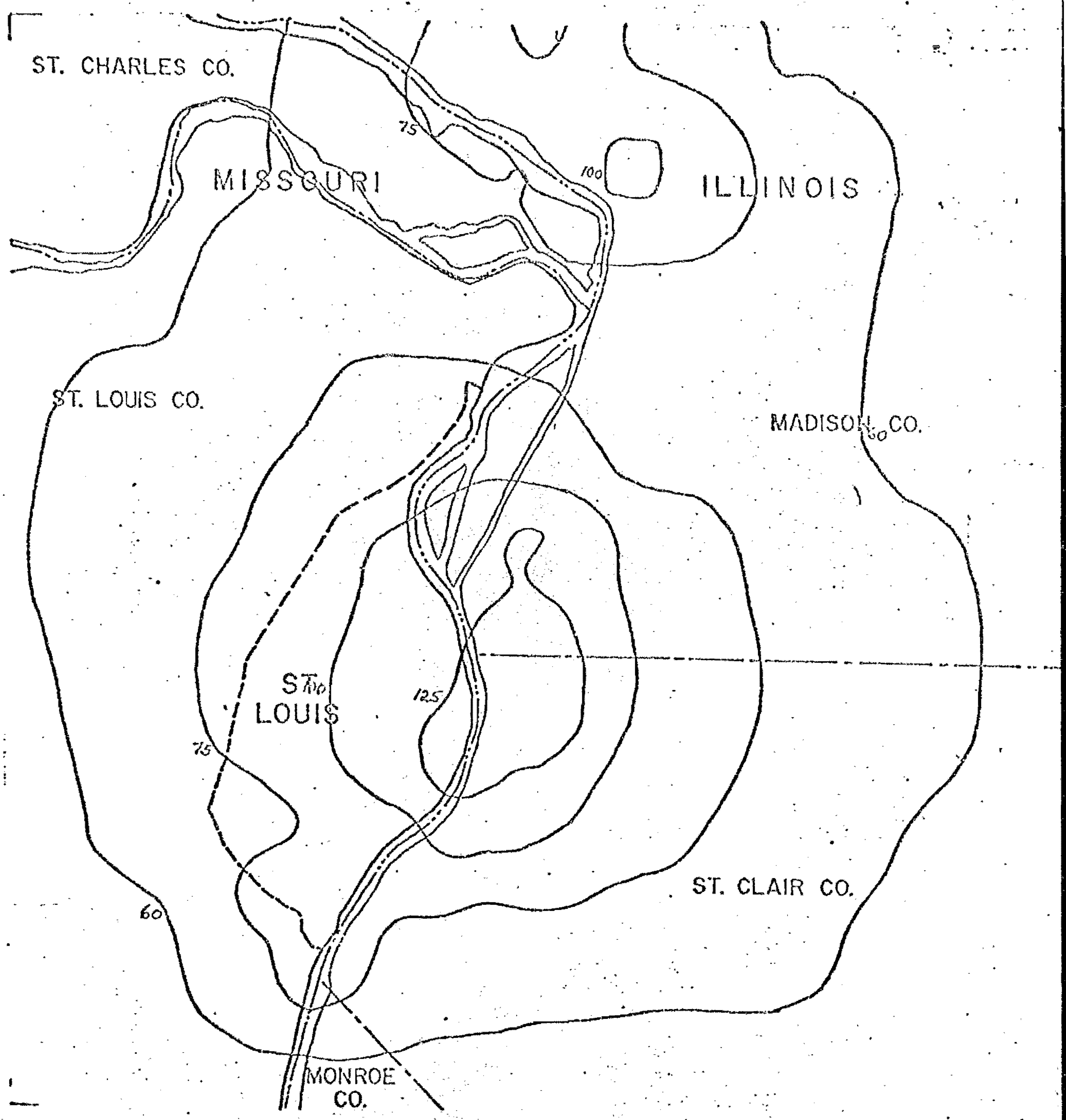

Figure 9. SLMAQCR particulate levels, 1968.
(Annual geometric means, $\mu g/m^3$).

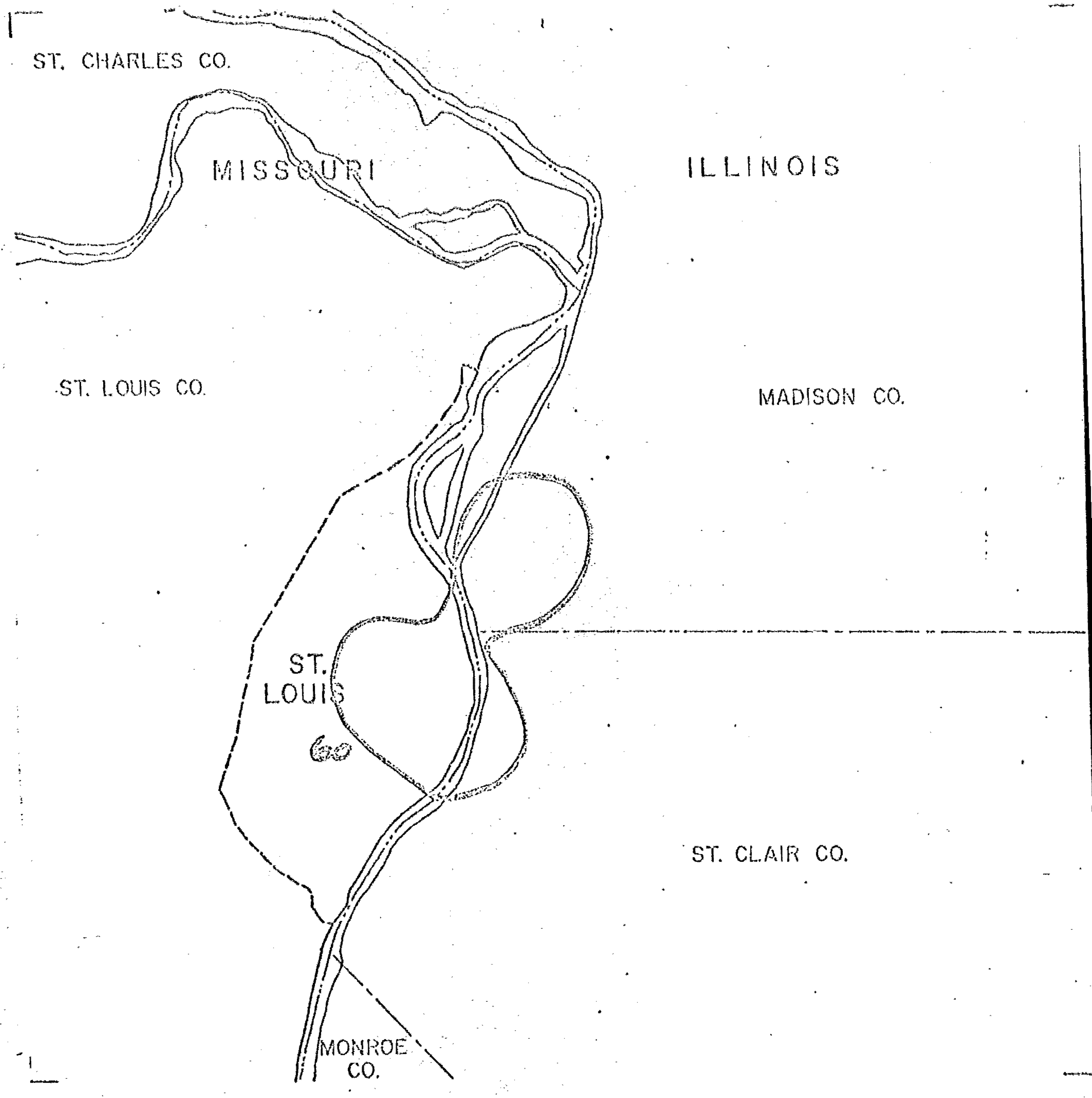

Figure 10. SLMAQCR particulate levels under Rule 203 with all existing process sources subject to Rule 203(b). (Annual geometric means, $\mu g/m^3$).

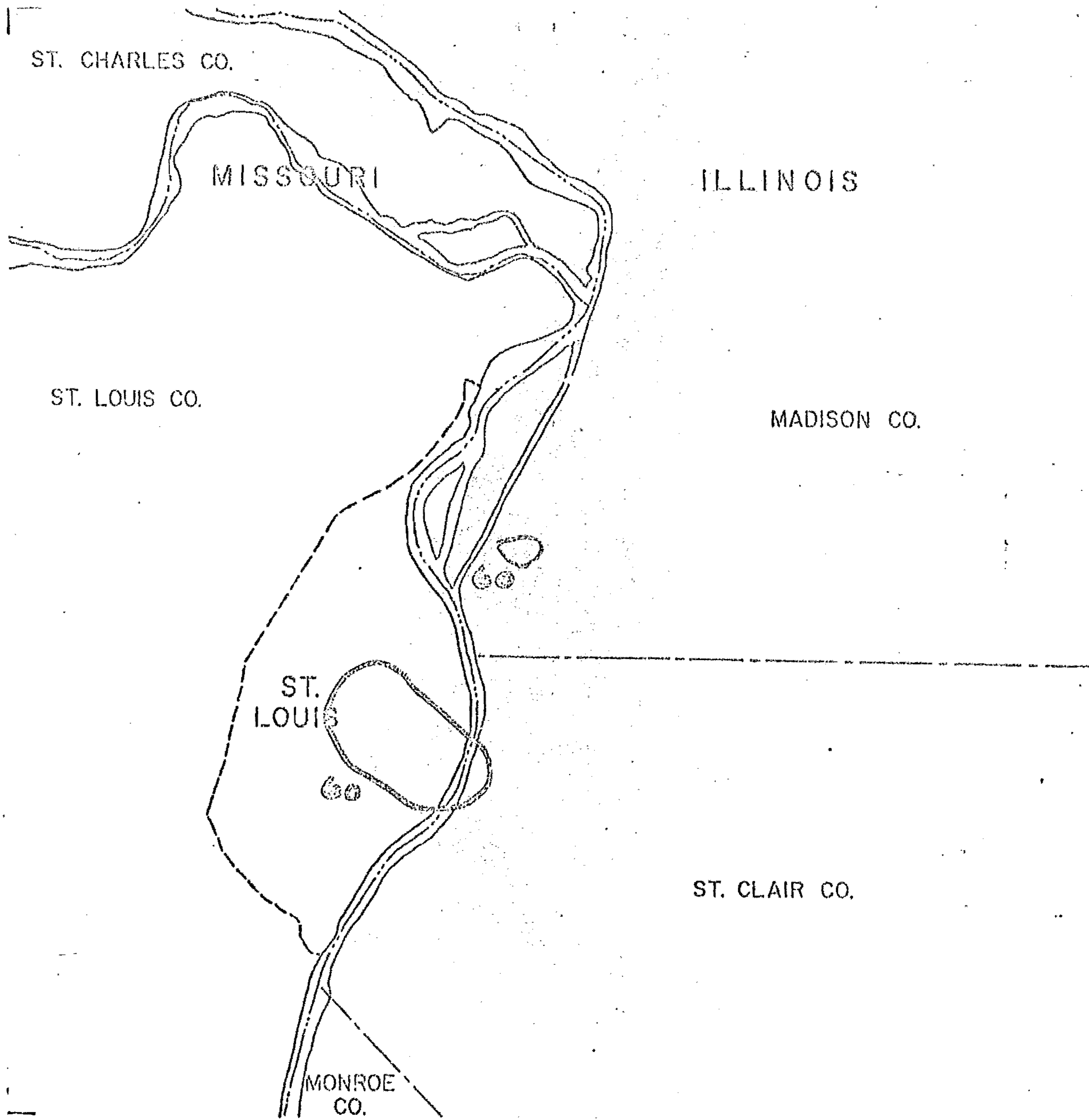

Figure 11. SLMAQCR particulate levels with all existing process sources subject to Rule 203(a).

(Annual geometric means, µg/m^3).

Rule 204 - SULFUR STANDARDS AND LIMITATIONS (PROPOSAL B).

Rule 204(a) limits the sulfur dioxide emissions from all coal combustion units to 1.8 pounds of sulfur dioxide per million BTU of actual heat input from those existing plants in Major Metropolitan Areas and for all new emission sources. The distinction between fuel combustion emission sources in MMAs and those outside, which are allowed 6.0 pounds of sulfur dioxide per million BTU of actual heat input according to Rule 204(b), recognizes that there are generally multiple sources within an MMA in contrast to comparatively isolated sources without. Thus the suitability of the regulation for MMAs has been ascertained via multiple source dispersion model calculations for Peoria, St. Louis and Chicago.

Compliance with Rule 204(a)(1) can be accomplished by retrofitting existing plants with sulfur dioxide removal systems or by converting the units to burn alternate, cleaner fuels. The limit of 1.8 pounds of sulfur dioxide per million BTU would require a sulfur dioxide removal system of at least 72.4% efficiency based on coal of 3.5% sulfur by weight and heat content of 11,000 BTU per pound. This required efficiency is less than manufacturers' guaranteed efficiencies on currently available flue gas sulfur removal systems. Should the decision be made to burn low sulfur coal, Rule 204(a)(1) would limit the sulfur content to 1% by weight for coal with a heating value of 11,000 BTU per pound. Oil combustion would be limited to .7 pounds sulfur dioxide per million BTU (approximately .7% sulfur by weight). The tighter standard for sulfur dioxide emissions from sources utilizing liquid fuels is based upon (1) the need for such controls in order to attain the ambient air quality standards and (2) the feasibility of oil desulfurization as an integral part of refinery operations.

It is anticipated that virtually all residential and commercial space heating sources presently utilizing coal will convert to gas or low sulfur oil in order to comply with the particulate emission limits (Rule 203(h) discussed earlier.

Rule 204(d) is superimposed upon other sulfur dioxide emission standards to insure that the emissions from a single source or cluster of sources cannot violate the short term national ambient air quality standard of 1300 micorgrams per cubic meter (.5 ppm) for a three hour average not to be exceeded more than once per year. The equations in Rule 204(d)(1) are based upon recognized methods for calculating the peak concentrations from an elevated source with a buoyant plume. For an electric utility located outside of the 19 counties which comprise the MMAs, Rule 204(d) may impose restrictions on sulfur emissions which go significantly beyond the rather lenient standard of 6 pounds per million BTU in Rule 204(b). For example a 300 megawatt electric plant with a 300 ft. stack need only meet the 6 pound per million BTU limit which would permit the use of coal with a sulfur content of approximately 3%; whereas, the addition or existence of a second 300 megawatt electric unit at that site would require the overall emissions be reduced to a site-wide average emission of 3 pounds of sulfur dioxide per million BTU. This could be achieved by burning gas in the second unit, by burning oil in both, or by any combination of control and fuel selection. Rule 204(d)(2) is based on a similar concept but is oriented toward preventing unacceptable concentrations of sulfur dioxide emission sources owned by different persons.

As provided in the Clean Air Act, the Federal Environmental Protection Agency published performance standards for certain new emission sources in the Federal Register under Title 42 C.F.R. Part 466 in August 1971. For fossil fuel fired steam generating units with a capacity greater than, 250 million BTU per hour heat input, the proposal called for no more than 1.2 pounds of sulfur dioxide per million BTU heat input when solid fossil fuel is used. In contrast to this the Agency proposal calls for 1.8 pounds per million BTU for such new fuel combustion sources. The Federal figure would require control efficiencies of approximately 85% as contrasted to 72% for the Agency proposal. We are not convinced at this time that the higher of these two efficiencies can be attained by commercially available flue gas sulfur removal systems as claimed by the Federal EPA. The Agency has requested the Federal EPA to present its story at hearings in Illinois; however, the latest rumor is that the Federal EPA will raise its new source sulfur limitation. We are still trying to arrange for Federal testimony and if it is convincing, the Agency may amend its proposal for sulfur dioxide emissions from such large fuel combustion sources to conform with the Federal guidelines. It will be demonstrated further on that the substitution of the proposed federal standard will not significantly improve the air quality as forecasted for 1975 and 1980 in the Chicago Region.

Industrial processes are limited in Rule 204(e) to 1500 ppm sulfur dioxide. Sulfur recovery plants associated with refineries would require approximately 85% efficient exhaust gas cleaning equipment which is available for such concentrated gas streams. New sulfuric acid manufacturing processes are governed in Rule 204(e) by a process weight rate regulation of 6.5 pounds of sulfur dioxide per ton of acid produced (100% acid basis) since the two standard methods of acid production, chamber and contact processes, can be controlled to this limit in multistage systems of 99.5% conversion efficiencies; however, these alternate processes have widely differing air requirements and thus with the same efficiencies would have widely differing concentrations of sulfur dioxide in the exhaust gases. The limitation on the emission of sulfuric acid mist from processes manufacturing or using sulfuric acid has been set at .2 pounds per ton of acid produced or used (100% acid basis). This level of control is consistant with available control technology and with the federal new source performance standards.

RESULTANT SULFUR DIOXIDE LEVELS.

The emission standards of Rule 204 have been designed to achieve and maintain the ambient sulfur dioxide air quality standards listed in Table 1. Short term (3 hour average) maxima are to be limited by a combination of emission standards and stack height requirements determined using standard dispersion equations (D.B. Turner, PHS Pub. No. 999-AP-26, Rev. 1969) for single stacks. Regional air quality, which is influenced primarily by the regional meteorology and the magnitude and distribution of sources, has been analyzed at Argonne using the multiple-source dispersion model currently endorsed by the Federal EPA (see Argonne publication IIPP-2, December 1970). As mentioned in the introduction, three model regions have been studied: Chicago, St. Louis, and Peoria. The sulfur dioxide emission standards proposed in Rule 204 are likely to achieve and maintain the federal secondary ambient air quality standard (annual arithmetic mean, 60 ug/m^3; approximate annual geometric mean, 52 ug/m^3) in each of these regions and therefore throughout the State.

Chicago Metropolitan Air Quality Control Region (CMAQCR)

Sulfur dioxide data from individual sites and regional trends are listed in Table 5. Table 6 indicates for the past several years the annual average of all sulfur dioxide (West-Gaeke bubblers) samplers* operated by the City of Chicago and estimates by the Chicago Department of Environmental Control of annual emissions of sulfur dioxide. Indications are that the City-wide sulfur dioxide average for 1971 may be below .02 ppm due to the effect of the Chicago fuel-sulfur ordinance.

Figure 12 shows the profile of sulfur dioxide levels throughout the CMAQCR based on 1968 air quality and emission data.

Figure 13 predicts the effect of applying Rule 204 to only major sulfur dioxide emitters. The importance of controlling sulfur dioxide emissions from the many small but densely packed fuel combustion sources is clearly demonstrated here.

Figure 14 predicts the effect of applying the present Chicago fuel-sulfur ordinance throughout the CMAQCR. Compliance with the national secondary standard is likely but with little allowance for the anticipated growth in population and therefore in space heating sources.

A shift to 0.7% sulfur oil as required in Rule 204 and an essential ban on the use of coal in urban areas (by virtue of Rule 203(h)) leads to the predicted SO_2 profiles of Figure 15. Compliance with the national secondary standard is achieved but the Illinois standard of 40 ug/m^3 is exceeded over an appreciable portion of Chicago.

Figures 16 and 17 show projections of SO_2 levels for 1975 and 1980. Growth has been estimated using land use patterns and historical trends for different classes of sources. Figure 18 indicates that the 1980 forecast is not significantly affected by requiring that new fuel combustion sources larger than 250 million btu per hour meet the proposed federal standard of 1.2 pounds SO_2 per million btu instead of the 1.8 pounds per million btu requirement of Rule 204(a).

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* The Chicago Department of Environmental Control also operates 8 continuous SO_2 monitors, the results of which were not used in our analyses since they do not correlate with bubbler data or with emission data and since the bubblers employ a federally approved measurement method.

It is apparent that the 1980 SO_2 levels in a significant portion of Chicago may exceed the national secondary standard. The maximum SO_2 level in the central city area is less than 1.0 percent above the federal secondary standard. According to Argonne, this is within normal tolerances of the model. Furthermore, the calculations are based on a market split between .7% sulfur oil and sulfur-free gas of 54%-44% (2% electric heat). Recent announcements by the Peoples Gas Light and Coke Company that the gas availability picture has significantly improved imply that the actual market split in 1975 and 1980 may shift more heavily toward gas. For example, a split of 49% oil-49% gas (2% electric) would modify the 1980 SO_2 forecast so that the whole region with the exception of portions along the Indiana border which are dominated by Indiana sources, would be in compliance with the secondary standard. For these reasons, the Agency feels that the proposed strategy for SO_2 control in the CMAQCR will meet the requirements for an approvable implementation plan.

TABLE 5

REGIONAL TRENDS - SULFUR DIOXIDE

ARITHMETIC MEANS - PARTS PER MILLION

SITE	1966	1967	1968	1969	1970
REGION: CHICAGO					
Argo		.028	.058	.078	.070
Calumet City		.048	.043	.027	.038
Bedford Park #1			.053	.049	.027
Bedford Park #2			.033	.037	.026
Chicago Heights			.021	.041	.022
Cicero		.052	.040	.032	.006
Harvey		.031	.028	.020	.024
Hillside		.029	.028	.045	.028
Wilmette		.021	.026	.029	.024
McCook				.026	.040
oliet				.016	.011
aft	.032	.026	.018	.010	.021
akeview	.070	.053	.035	.030	.037
teinmetz	.028	.023	.017	.013	.023
ooley	.061	.027	.034	.029	.058
.S.A.	.072	.077	.061	.052	.050
rane	.069	.053	.025	.026	.040
stin	.087	.070	.045	.029	.047*
lly	.042	.033	.025	.029	.031
ndbloom	.050	.038	.030	.023	.022
de Park	.087	.072	.051	.041	.051
evenson	.045	.037	.032	.015	.027*
[illegible]	.053	.044	.026	.016	.006
[illegible]	.031	.024	.019	.005	.007

* continuous technique

TABLE 5 (continued)

SITE	1966	1967	1968	1969	1970
EGION: CHICAGO					
enger	.039	.026	.006	.013	.023
arver	.035	.028	.023	.027	.027
lay	.036	.024	.019	.026	.023
ullivan	.071	.060	.044	.042	.013
ale				.042	.036
ummary					
verage	.053	.040	.032	.030	.030
aximum	.087	.077	.061	.078	.070
inimum	.028	.021	.006	.013	.006
o. of Sites	17	23	26	29	29

TABLE 6

CHICAGO CITY-WIDE SULFUR DIOXIDE LEVELS AND EMISSIONS

Year	Annual Arithmetic Average (ppm) (a)	Annual Sulfur Dioxide Emission (Tons/year)
1968	.030 (a)	542,000 (d)
1969	.026 (b)	381,000 (c)
1970	.029 (c)	381,000 (c)

(a) 17 bubbler sites
(b) 18 bubbler sites
(c) 16 bubbler sites
(d) From Federal EPA inventory of the Chicago Region
(e) From Chicago DEC Federal Grant Application for FY 1971

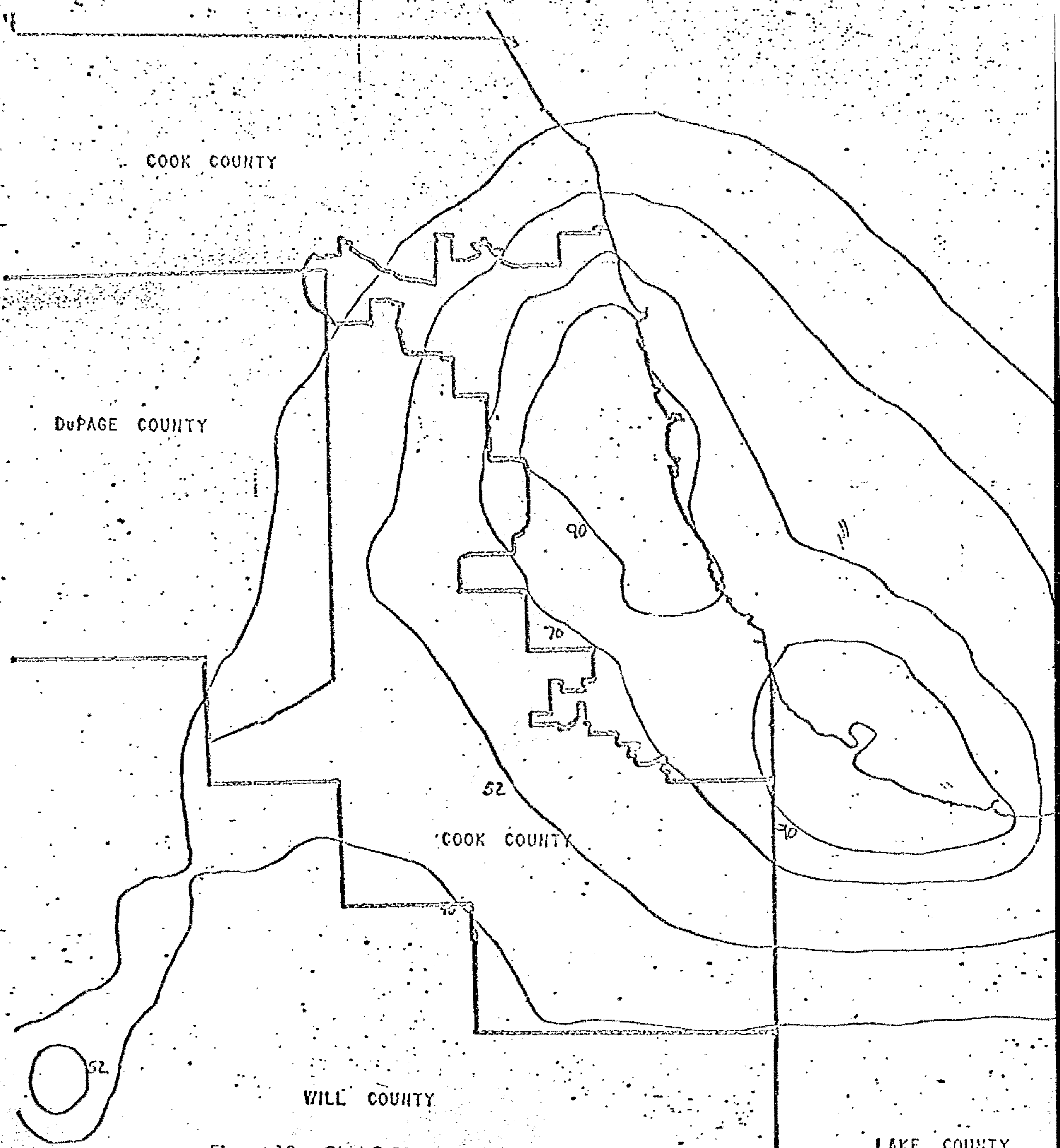

Figure 12. CMAQCR unregulated (existing 1968) sulfur dioxide levels.
(Annual geometric means, $\mu g/m^3$)
Federal primary standard, 70 $\mu g/m^3$
Federal secondary standard, 52 $\mu g/m^3$

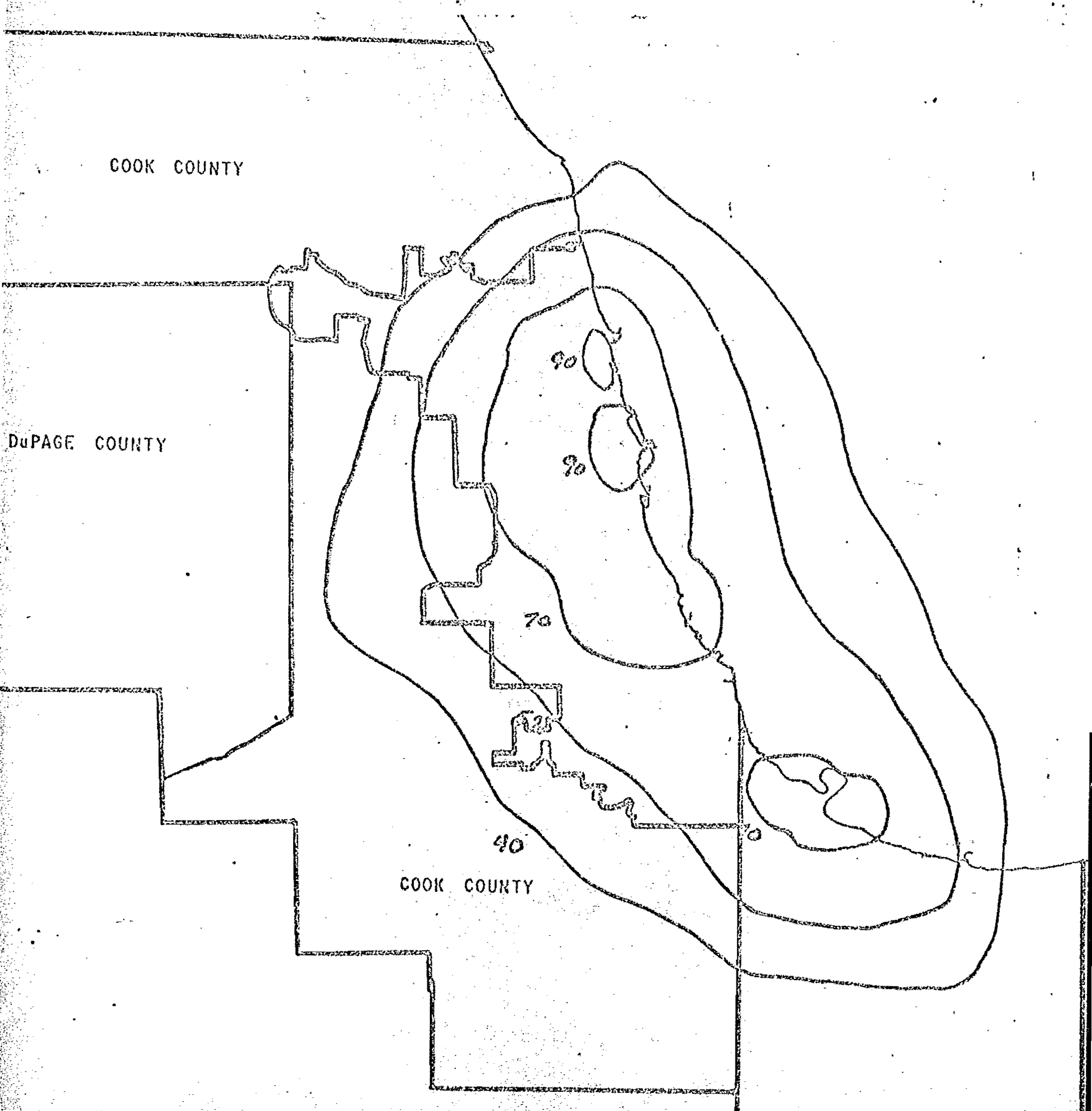

Figure 13. CMAQCR SO_2 levels with Rule 204 applied only to the largest 114 emitters. This represented 86% of regionwide SO_2 emissions in 1968.
(Annual geometric means, $\mu g/m^3$)

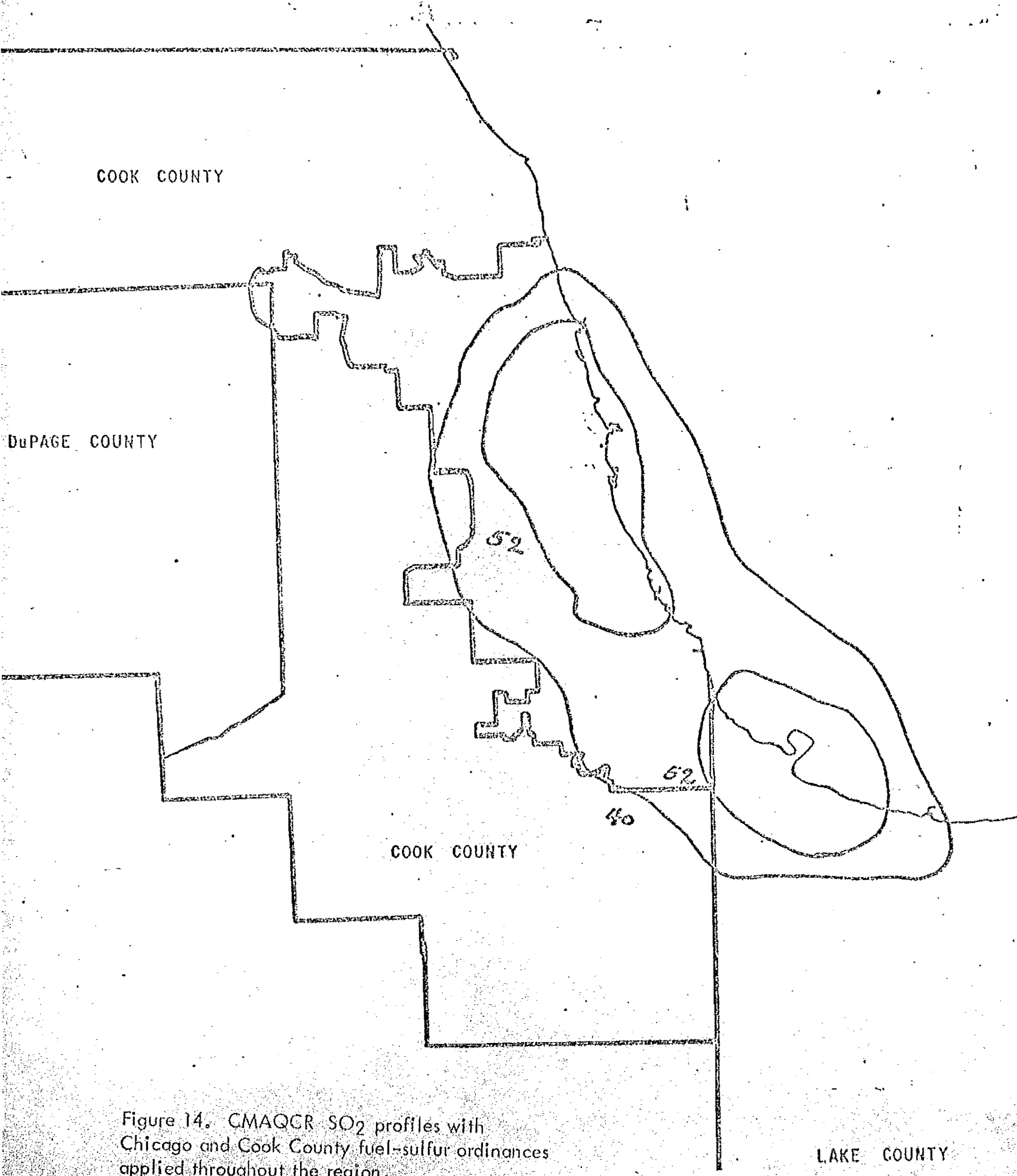

Figure 14. CMAQCR SO_2 profiles with Chicago and Cook County fuel-sulfur ordinances applied throughout the region. (Annual geometric means, $\mu g/m^3$)

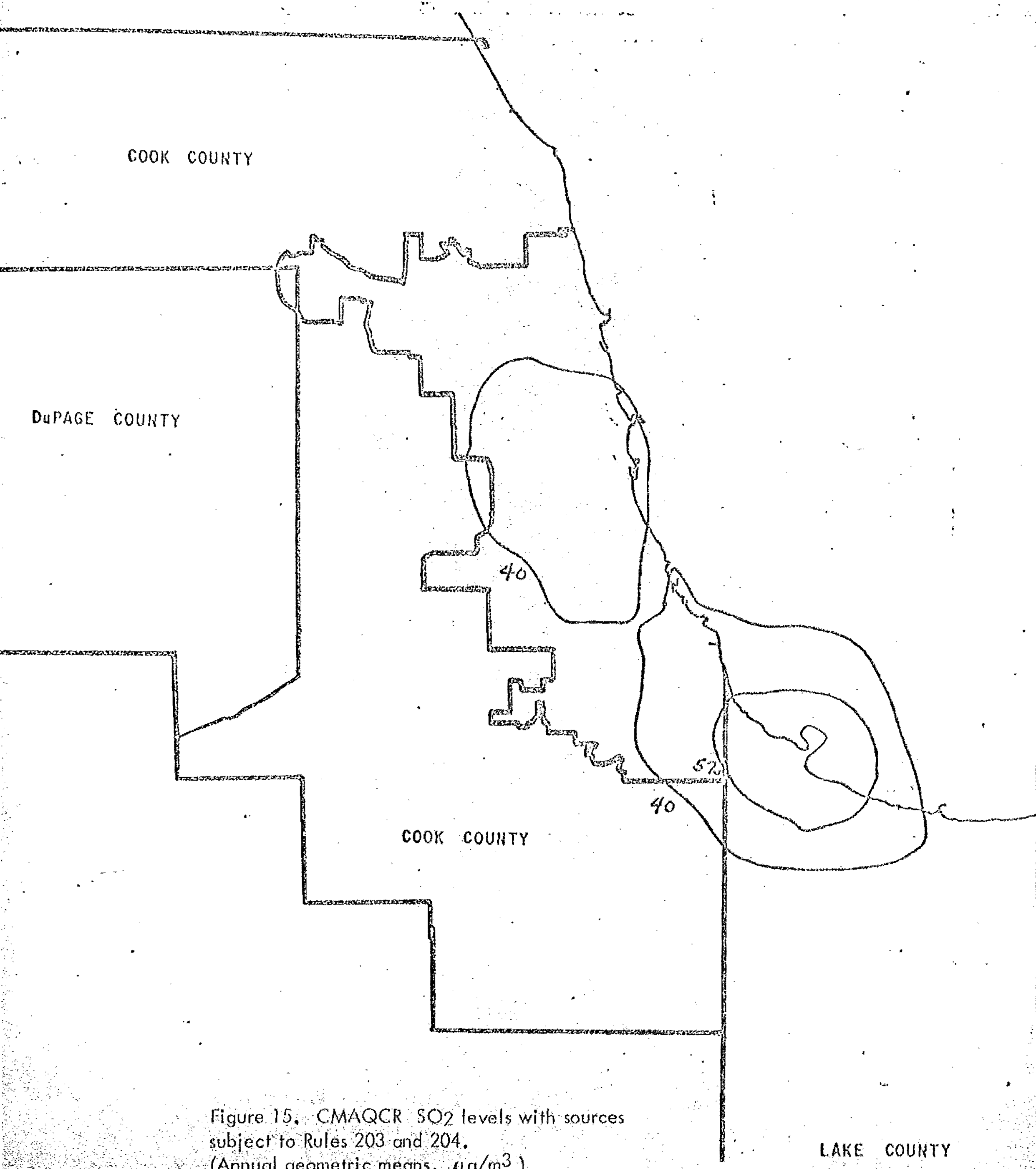

Figure 15. CMAQCR SO_2 levels with sources subject to Rules 203 and 204.
(Annual geometric means, $\mu g/m^3$)

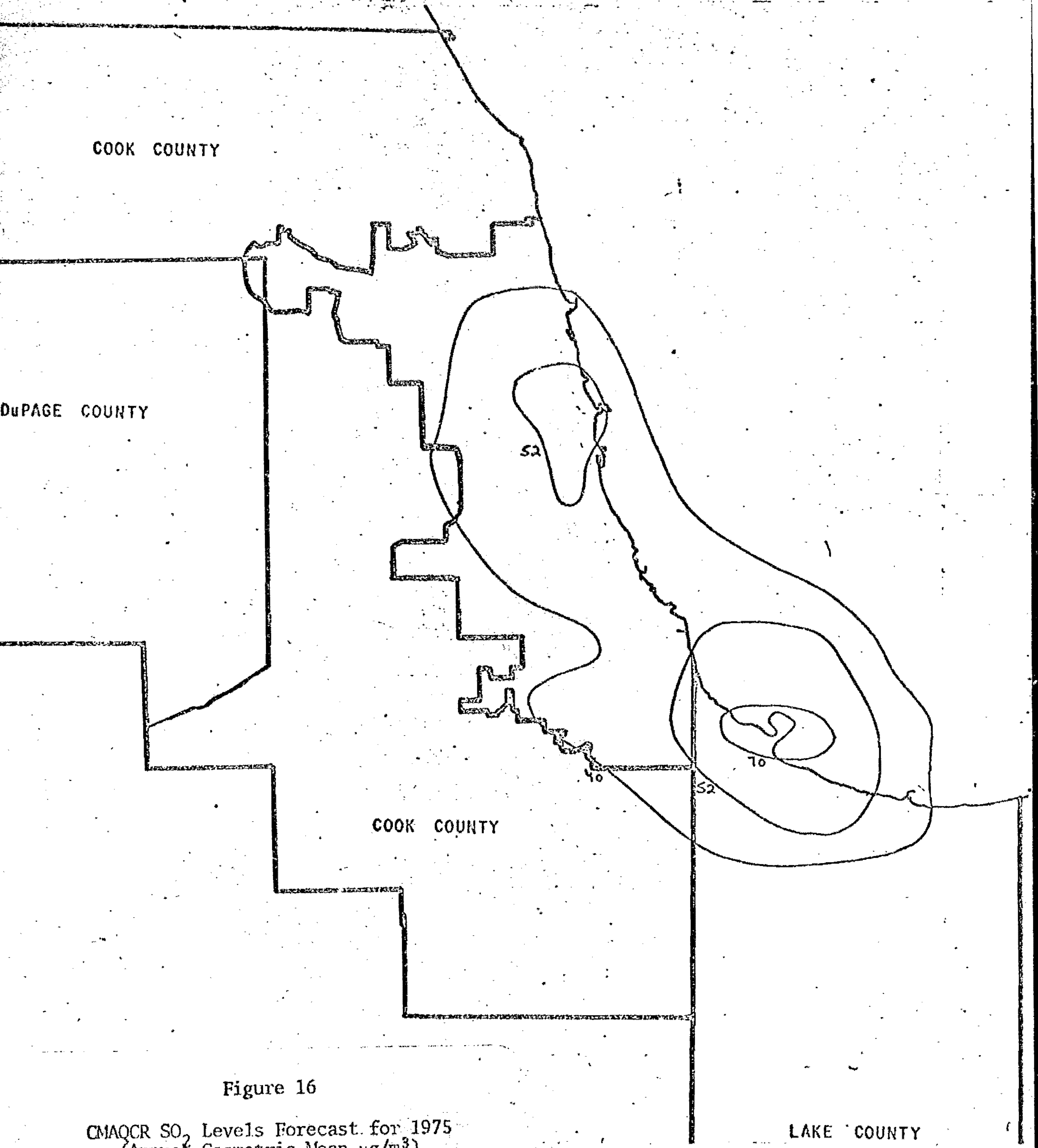

Figure 16

CMAQCR SO_2 Levels Forecast for 1975
(Annual Geometric Mean $\mu g/m^3$)

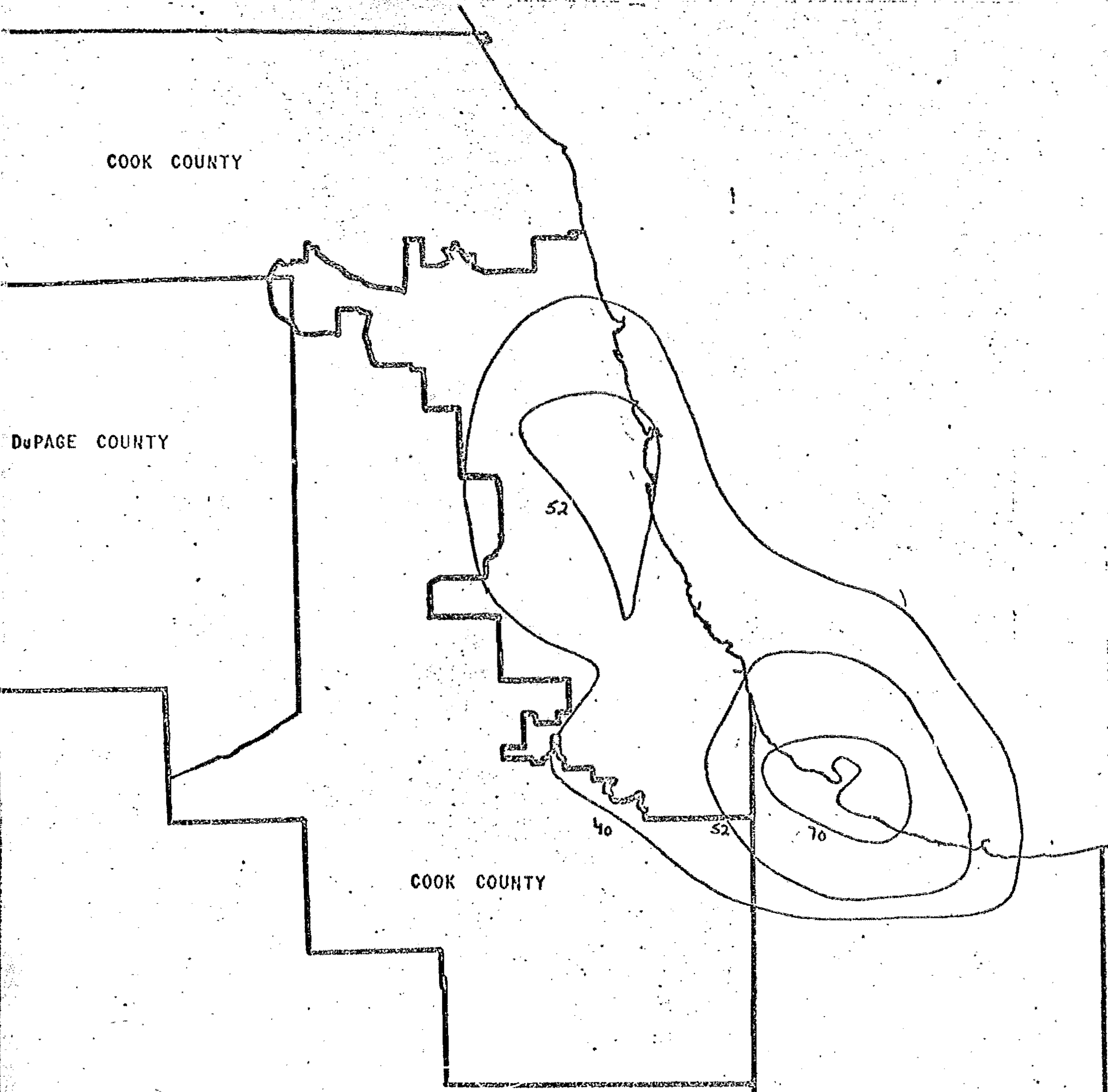

Figure 17

CMAQCR SO_2 Levels Forecast for 1980
(Annual Geometric Mean μg/m³)

Rule 205 . . . HYDROCARBON EMISSION STANDARDS AND LIMITATIONS.

Hydrocarbons emitted from various chemical plants and operations react with nitrogen oxides in presence of sunlight to form a complex variety of chemical compounds called photochemical oxidants. These oxidants together with suspended solid and liquid particles in the air make up what is commonly known as smog. In air these oxidants cause eye and lung irritation, damage to vegetation, offensive odor and thick haze. In 1967, for example, cities of Chicago and St. Louis averaged total hydrocarbon level of 3.04 ppm and 3.56 ppm respectively. The hydrocarbons corrected for methane for these cities correspond approximately to 0.6 ppm and 0.7 ppm respectively.

The Federal Implementation Plan requires the states to enforce a hydrocarbon emission standard that would reduce hydrocarbon concentration corrected for methane to 0.24 ppm by 1975. The problem of attaing this standard has been discussed in the introduction. The hydrocarbon regulations being proposed here are based upon regulations proposed by Illinois Pollution Control Board in their Newsletter #25, the Federal Implementation Plan Guidelines, the Los Angeles and Bay Area Regulations and the detailed technical and economic feasibility study conducted by the Agency and by consultants to the Agency funded by the Institute for Environmental Quality.

Rule 205 deals with control of hydrocarbon emissions from all stationary sources. Emissions of hydrocarbons like ethylene, toluene, xylene, ethyl benzene, etc. photochemically react with pollutants present in the atmosphere to form photochemical smog. Hence, their control is essential to reduce the possibilities of formation of this type of smog. Hydrocarbons like acetone, benzene, trichloroethane and tetrachloroethylene, etc. do not produce photochemical oxidants, but their control is necessary to prevent any local nuisance.

Rule 205(a) requires use of floating roof tanks for hydrocarbons having vapor pressure between 2.5 psig and 12.5 psig if they are stored in tanks of more than 40,000 gallons capacity. The use of floating roof tanks will cut emissions by more than 85% and an economic evaluation has showed that the investment will pay off in about three years. Use of submierged fill pipe on storage tanks between 250-40,000 gallons capacity will cut down emissions by about 66%. These pipes are inexpensive and easy to install. The rule also regulates use of a system which would either collect the vapors or dispose of them in a manner acceptable to the Agency. Cost of such control equipment, compared to the price of the product has been found to be negligible.

Refineries and other chemical operations produce hydrocarbon water waste. Rule 205(a)(3) limits the total quantity of hydrocarbon emissions from processes that recover the hydrocarbons from such wastes. Loss of hydrocarbons from pumps and compressors is necessary for their effective functioning. These losses can be controlled to some extent by using proper seals. These emissions when controlled, pay off the cost of control device in a period less than the economic life of the equipment.

The maximum hydrocarbon losses occur from fluidized catalytic cracking unit of a refinery. The hydrocarbons deposited on the cracking catalyst are emitted to the atmosphere along with other waste gas streams when the catalyst is regenerated. The proposed rule requires that the waste gases discharged into the atmosphere not contain more than 100 ppm of carbon monoxide. One way this can be achieved is by the use of a CO boiler. The waste gases from a boiler in compliance with Rule 205 (c)(1) would then have less than 100 ppm carbon monoxide and essentially no hydrocarbons.

Preliminary estimates indicate that overall hydrocarbon emissions from refinery operations would be reduced by 85% and odors significantly curtailed if the proposed regulations are implemented. The major beneficiaries of the attendant improvement in air quality will be communities within several miles of refineries. For example, a recent, one-day study funded by the Institute of Environmental Quality in the vicinity of the East St.Louis refinery complex indicated non-methane hydrocarbon levels in excess of 6 times the Federal standard and also significant strong odors. The researchers also concluded that motor vehicles did not have a major influence on the contaminant levels observed in that locality.

Rule 205(b) controls hydrocarbon emissions from chemical industries which use photochemically reactive solvents. The regulations proposed apply, for example, to paint, varnish, lacquer, vapor degreasing and dry cleaning industries. The intent of the regulation is not only to limit the total quantity of hydrocarbon emissions but also to encourage such chemical industries to convert their products from organic solvent bases to water and/or alkali bases. The effect of the regulation will be to reduce emissions of photochemically reactive solvents by at least 85%.

Hydrocarbon emission limits set for industries using photochemically reactive solvents would require reduction of such emissions by either absorption or adsorption or any other process with a removal efficiency of at least 85% or by incineration so that the CO content of effluent gases is 100 ppm or less. Solvent emissions from such industries are excessive, and because of the nature of many of the processes, large volumes of air accompany these emissions so that control of the relatively low concentrations of such solvents is expensive. Considering this general situation, these regulations encourage industry to use non-organic solvents or to use processes where large quantities of air are not required. The National Institute of Drycleaning recommends use of adsorbers to their members using perchloroethylene. A return of about three years on adsorber investment is estimated.

Rule 206 . . . CARBON MONOXIDE EMISSION STANDARDS AND LIMITATIONS.

The total quantity of carbon monoxide emitted into the open atmosphere in 1968 from incinerators and industrial sources alone, was estimated by the National Air Pollution Control Administration to be about 100 million tons. Even though larger amounts of carbon monoxide are produced and handled in industrial processes, in most cases this is used as fuel or raw material and emissions result only from leaks or abnormal operations. As compared to the quantity of carbon monoxide produced from incineration and industrial processes, stationary fuel combustion sources emit a negligible amount. The hearly contribution from coal burning installations has been estimated to be about 0.8 million tons only.

The average concentration of carbon monoxide at the CAMP Station of the National Air Surveillance Networks has been reported to be 12.0, 17.1 and 12.5 arithmetic average in ppm for 1964, 1965 and 1966 respectively. The Federal Ambient Air Quality Standards for arbon monoxide require that 8-hour average not exceed 9 ppm. Even though there is at present no 8-hour average data available, it is evident that this standard is being exceeded. Preliminary analyses by Argonne National Laboratory indicate that, although approximately 85 percent of all CO emissions in the urban areas is attributable to motor vehicles which are controlled under national emission standards, considerable control over stationary sources of CO will be required to achieve the National Ambient Air Quality Standards by 1975.

Rule 206(a) would allow carbon monoxide emissions from fuel-combustion sources up to 200 ppm (corrected to 50 percent excess air) from any stack. As was pointed out before, fuel combustion contributes a negligible amount to the ambient air concentration. However, the possibilities of excessive emissions from a poorly operated fuel combustion emission source exists. These emissions could not only cause a significant increase in the carbon monoxide level around the plant, but also increase the ambient air concentration over a wide area as the plume direction changes. The relative inertness of carbon monoxide in reactions with normal gaseous atmospheric constituents effectively eliminates the possibility of chemical reactions as a mechanism for removal. It has also been predicted that the turnover period of carbon monoxide once emitted into the atmosphere varies anywhere from 0.1 to 5 years.

The main purpose of Rule 206(a) therefore is to make sure that all fuel combustion emission sources are operated properly. If these units follow the guidelines published by the fuel industry, equipment manufacturers, engineering associations or government agencies, they would be in compliance with this rule.

Rule 206(b) would prohibit carbon monoxide emissions from refuse-burning equipment to exceed 500 ppm. Carbon monoxide appears in considerable amounts in the stack when the air supply in the combustion chamber is below the theoretical requirement. This also occurs with improper mixing of the fuel, combustibles, and air. It is an accepted fact that high temperature incineration considerably reduces the amount of carbon monoxide emitted. For example, in a normal sized incinerator, if (1) the incineration temperature is maintained above 1,600° F, (2) more than 150 percent excess air is supplied and (3) heat-release rates of less than 18,000 BTU per hour per cubic foot of total combustion space is maintained, then the total carbon monoxide emission could be brought down to about 1.0 pound per ton of waste incinerated. Since this represents an incinerator of very good design which has to be operated at optimum conditions to maintain this level of emissions, it is very difficult to require existing incinerator to meet this standard. Even if new incinerators are built to these specifications, maintaining the optimum operating conditions is very difficult. Just to make a comparison between what can be accomplished and what Rule 206(b) requires, consider a 1,000 pounds per hour incinerator. If this incinerator is operating with 200 percent excess air and if it complies with the 500 ppm limitation, the total amount of carbon monoxide emitted into the open atmosphere will be about 11 pounds per ton or 5.5 pounds per hour. This is approximately the amount of carbon monoxide produced by a present - day automobile.

Rule 206 (c)requires that the carbon monoxide waste gas stream from any petroleum process be burned in a direct flame afterburner or any other equivalent device before the gas stream is emitted into the atmosphere. In the petroleum industry, the efficient operation of a fluid catalytic cracking unit produces gases rich in carbon monoxide. The catalyst used in such units accumulates a carbonaceous deposit in the reactor and the products of combustion from burning of this carbon coating in the regnerator contain anywhere from 5 to 8 percent carbon monoxide . Some refineries in the U.S. have carbon monoxide boilers as an integral part of a fluid catalytic cracking unit. Economics in many cases dictate the application of such a system for controlling carbon monoxide emissions.

The average CO emissions from fluid catalytic cracking units have been estimated to be about 13,700 pounds per 1,000 barrels of fresh feed. Even though this represents a small amount when compared to the total CO emitted from automobiles, it would definitely cause a very severe local problem if uncontrolled. By requiring that the waste gases containing large amounts of CO be burned in either a direct flame afterburner or an equivalent device, a lot of flexibility is being granted to accomplish the end results. This has been shown to be desirable because of the complexity of the problem as well as the economics involved.

Rule 206(d) limits the quantity of CO emitted from blast furnaces and basic oxygen furnaces. Gases containing as much as 25 percent of CO are generated from blast furnaces and hence it is normally used as fuel. Only during abnormal condition, i.e. when "slips" occur, these gases are emitted directly into the atmosphere. Rule 206(d) will require use of an afterburner or equivalent control methods in such situations. Exhaust gases from basic oxygen furnaces contain small amounts of CO when compared to that in the gas generated from a blast furnace. Nevertheless, these are also required to be burned in an afterburner or equivalent device because of the potential for causing a localized problem.

Rule 206(e) limits the quantity of CO emitted from cupola's with a manufacturer's rated melt rate in excess of 5 tons per hour. Gray-iron cupolas are the largest source of carbon monoxide emissions in the industrial process category. The uncontrolled carbon monoxide emissions from gray iron foundries using these cupolas have been estimated to be approximately 145 pounds per ton of metal charged. A cupola with a melt rate of 10 tons per hour would then be producing about 1450 pounds per hour of CO.

Rule 207 . . . NITROGEN OXIDE STANDARDS AND LIMITATIONS (PROPOSAL B)

Over 60 percent of the total oxides of nitrogen emissions have been estimated to be emitted from stationary sources. In decreasing order of magnitude, these sources are as follows:

1) Electric power generating industry, 38 percent
2) Industrial fuel combustion sources, 29 percent
3) Stationary internal combustion engines in pipelines and gas plants, 21 percent
4) Small domestic and commercial combustion sources, 10 percent
5) Non-combustion sources, 2 percent.

The most important aspect of the relationship of NO_x with air pollution is associated with the generation of oxidants. The rates of formation and the steady-state concentrations of oxidants are a function of light intensity, the concentrations of hydrocarbons and nitrogen oxides, the $HC-NO_x$ ratio, and temperature. Colorless when emitted, some NO present in the flue gases from a fuel combustion unit is photochemically converted to the visible NO_2 and this is one of the principal ingredients of photochemical smog.

The national ambient air quality standards for nitrogen oxides is .05 ppm, annual arithmetic average. Ambient air quality data obtained at the Chicago CAMP station has been at or slightly below this value for the past 6 years with the exception of 1966 and 1970 for which the averages were .057 and .056 respectively (data for 1969 is not available). A study of air quality data in Chicago during the summer of 1971 indicates a three month average of .07 ppm which, when modified by typical seasonal patterns, correlates with an estimate of .06 ppm for the annual average. This estimate is consistant with the 1970 annual average and with five months of measurements of nitrogen oxides by the Chicago DEC. Argonne has estimated that by 1975, the national vehicle emission standards would cause a reduction in nitrogen oxide levels to the .05 standard assuming no growth in emissions from stationary sources. This of course will not be the case and the proposed regulations require controls of large fuel combustion installations and of facilities which manufacture or use nitric acid. Such controls are desirable not only from the standpoint of attaining regional air quality standards but also for the minimization of localized problems.

Rules 207(a) and 207(b) regulate the emission of oxides of nitrogen from new and existing fuel combustion emission sources with a rated heat of equal to or greater than 250 million btu. All fossil fuel combustion processes produce oxides of nitrogen in varying quantities and concentrations depending to a great extent on the amount of excess air used for combustion, the heat release and removal rates, transport effects, and fuel type and composition. Recent Federal EPA sponsored studies show that oxides of nitrogen emissions from these stationary sources can be reduced by modifying those equipment operating and design features which affect the combustion parameters described above. Such modifications are technically as well as economically feasible. It has been found that these modifications are comparatively difficult to accomplish on coal fired units as opposed to gas or oil fired units; hence coal fired units are being given until December 31, 1974 to reduce their oxides of nitrogen levels to meet these regulations.

Rule 207(c) limits the emission of oxides of nitrogen from nitric acid manufacturing plants and related operations. Of the three basic steps utilized in the manufacture of nitric acid by the catalytic oxidation process, only the third and final step i.e. the absorption of nitrogen dioxide in water is the source of NO_x emissions. These emissions, called off-gas or tail-gas, contain about 0.3 percent $NO+NO_2$ and are usually reddish brown or yellow in color. Since in the past this color has been the cause of complaints against the acid plant operators, effo ts were directed toward eliminating the color rather than the pollutant itself. Reductions in actual quantities of NO_x emissions were first accomplished in a catalytic combustor by providing sufficient fuel for the nitrogen oxide to react with all the oxygen and other oxides of nitrogen in the tail gas. However, the most obvious method of reducing nitrogen oxide emissions is by providing additional capacity in the absorption tower.

The proposed limitation of 5.5 pounds of nitrogen oxides per ton of acid produced (100% acid basis) in existing plants corresponds approximately to a concentration of 400 ppm in the tail gas. This limit has been found to be attainable by either using catalytic combustion or increasing the absorber capacity. These two most promising abatement schemes, if used in a new plant, can be so designed that they meet the proposed 3 pound per ton limit without affecting, to an unreasonable extent, the overall plant economics.

Rule 207(d) limits the emissions of NO_x from process sources using nitric acid. Approximately 75 percent of the total nitric acid produced is used for the manufacture of ammonium nitrate. If these manufacturing processes take reasonable care and maintain good operating conditions, NO_x emissions can be maintained at a minimal level and are likely to comply with the proposed limitation without the requirement for control systems.

The commercially important compounds produced by nitric acid oxidation include adipic acid and terephthalic acid. In processes producing these compounds, economy requires the recovery of NO_x as nitric acid in absorbers similar to those used in the manufacture of nitric acid. Because of the small quantity of effluent gases, fume incineration could be the most effective and economical means of complying with the standard.

Rule 208 . . . ODOR

Since the public is more aware of malodor than any other manifestation of air pollution, Rule 208 limits the emissions of 57 different odor producing substances. Rule 208(a)(1) does not allow the concentrations of these substances to exceed the odor threshold in any recreational, institutional, retail sales, hotel or educational premises. Rules 208(a)(2) and 208(a)(3) allow a higher concentration of these substances to exist in the ambient air depending upon the location of a particular source emitting such substances.

Arthur D. Little, Inc. made some tests for the Manufacturing Chemist's Association, to determine odor thresholds of 53 odorant chemicals. In their report, presented by Gregory Leonardos et. al. at the 61st Annual APCA Meeting, odor thresholds for 57 chemicals were listed and these chemicals along with their odor thresholds are shown in Table 2.4. By standardizing the method of sample presentation and minimizing extraneous sensory interference, they determined that these thresholds produced minimum identifiable odor response and provided consistent and internally comparable data for one parameter of odor. The odor thresholds shown in this table are the concentrations at which a particular substance in the gaseous or vapor phase produces the ultimate sensation of smell.

Rule 208(b) calls for a quantitative chemical analysis, of a certain degree of accuracy, to determine the concentrations of odorous substances. Odor as defined is most generally considered to be any stimulus which is perceived by the sense of smell. Since the "sense of smell" itself has broader or narrower connotations, a quantitative chemical analysis is desirable to prove whether a particular source is in violation or not. The best method which, depending upon the human olfactory sense, is the one published by ASTM designated D1391-57. This method however is not accurate enough because of the variations in olfactory sense from person to person. Concentrations of most of the compounds listed in Table 2.4 can be easily determined by analytical procedures in any well equipped lab and the rest of them may need certain special types of testing equipment, e.g. a gas chromatograph. Other methods like the Standard Method of Test for Concentration of Odorous Vapors, ASTM Designation D1354-60, can also be used in cases where the concentrations are below the level at which an accurate quantitative determination could be made.

Rule 208(c) limits the emission of odorous substances specifically from inedible rendering plants. Due to the lack of data for determining the exact type and quantity of substances emitted from these plants no quantitative emission limitations are being proposed. However, it has been established that the decomposition of protein material and the cooking of stale meat is a substantial source of odorous substances, especially hydrogen sulfide. The Air Pollution Engineering Manual compiled and edited by John A. Danielson lists dry-batch type blood cookers as the largest source of odor emissions; 3,800 million odor units per ton of feed. Next is the dry-batch type rendering cooker with an emission rate of 1,000 million odor units per ton of feed. Other sources of odors from rendering operations are feather dryers and blood spray dryers.

By limiting odor to 120 units per cubic foot of exhaust gases, rendering plants will have to control odors with 99 percent efficient or better control equipment. Afterburners, condensers, adsorbers and scrubbers are devices that can be used to attain these removal efficiencies. Typical combination of condensers and afterburners have also been employed to reduce odor levels to a very desirable level but the operating costs of such system are known to be higher than those for single units. Depending, of course, on the specific plant operating conditions, single units can very well attain efficiencies of better than 99 percent if operated under proper conditions. These types of control equipment would then bring most of the plants into compliance.

Unlike the measurement method specified in Rule 208(b), odor levels from rendering plants will be determined by making use of the human olfactory sense. The Standard Method for Measurement of Odor in Atmosphere (Dilution Method) ASTM Designation: D1391-57 as modified by Mills will be used to determine odor concentrations. Measurements made by this syringe-dilution method are expressed in odor units which is essentially the amount of the odorous material (odorant in air) necessary to contaminate a cubic foot of non-odorous air to the median barely perceptible level in humans. Other threshold methods, which make quantitative measurements can also be used if a direct relationship between the odor unit and the unit of measurement by this method exists.