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OAQPS GUIDELINES

GUIDELINES FOR AIR QUALITY MONITORING AND DATA REPORTING UNDER ESECA

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

OAQPS 1.2-034

Guidelines for Air Quality Monitoring and Data Reporting Under ESECA

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I. Introduction and Background

The purpose of this guideline is to provide EPA Regional Offices with information necessary to implement air quality monitoring and data reporting requirements of the Energy Supply and Environmental Coordination Act of 1974 (ESECA). Monitoring guidance is applicable to certain fuel combustion sources converting to coal under the Act. The Act in Section 3, paragraph (k)(1)(H), specifically requires the Environmental Protection Agency (EPA) to prepare plans for monitoring or requiring sources to monitor the impact of conversion to coal usage on concentrations of sulfur dioxide in the ambient air. Monitoring requirements for certain other pollutants are implicit in other provisions of the Act.

A major stated purpose of the ESECA is "to provide a means for assisting in meeting the essential needs of the United States for fuels, in a manner which is consistent to the fullest extent practicable, with existing national commitments to protect and improve the environment." In carrying out this purpose for stationary sources, the Act gives the Federal Energy Administration (FEA) the authority to issue orders to power plants and other major fuel burning installations to convert to coal as their primary fuel. FEA "prohibition orders," however, are subject to requirements imposed by EPA for certain environmental conditions.

The two principal environmental conditions defined in the Act are (1) "Regional Limitation" and (2) "Primary Standard Condition." Separate guidelines, OAQPS Guideline Series Nos. 1.2-033 and 1.2-035, have been prepared specifying criteria for applying these conditions.

Under the Primary Standard Condition, EPA is authorized to grant certain converting sources compliance date extensions. Regulations issued under 40 CFR 55 require that any source to which a compliance date extension may apply must submit and obtain approval of a source compliance schedule for complying with SIP regulations as soon as practicable but no later than January 1, 1979. Air monitoring plans for a source can be required as part of the compliance schedule or separately, if a compliance date extension is not necessary to meet State Implementation Plan (SIP) requirements.

Paragraph k(2) of Section 3, ESECA, requires EPA to publish in the Federal Register at 180-day intervals (1) concise summaries of progress toward compliance by sources granted compliance date extensions, and (2) up-to-date findings on the impact of conversions on applicable implementation plans and ambient air quality.

It is estimated that between 20 and 30 sources will require monitoring under ESECA actions. Typical estimated costs per source are given in Appendix A.

II. General Needs for Air Quality Monitoring

A. Necessity for Monitoring by Sources

States are presently maintaining and reporting data from air monitoring networks meeting at least minimum requirements of SIP regulations, 40 CFR 51. The minimum requirements are based primarily on pollution levels and population. The networks are generally adequate to provide information on pollutant concentration maximums and distributions mainly in urban areas. They are usually not sufficient to determine impacts of specific point sources, especially those located outside urban areas. Hence, separate requirements for monitoring around specific point sources need to be imposed to comply with the monitoring provisions of ESECA.

Monitoring primarily intended to measure the impact of sources undergoing conversion should be required of the owners or operators of such sources. This is necessary so as not to impose significant additional burdens on state and local agencies operating SIP monitoring networks. Additionally, however, for sources located in urban or other areas where SIP air monitoring network sites exist, SIP network data should be utilized from selected existing stations, as necessary. As a rule-of-thumb, most source-related impacts should occur within 20 kilometers of a source. Likewise, a 40 kilometer radius area should account for the additive impact of other sources in an area. Wherever possible, however, the area considered for monitoring should be based on conditions particular to source-related emission and stack parameters, topographic features, and meteorology.

B. Sources Designated for Monitoring

Sources designated for monitoring are those converting to coal under ESECA which either meet all SIP requirements or are granted compliance date extensions.

The EPA may require the use of intermittent or supplementary control systems (SCS) as part of a primary standard condition. An SCS requires considerably more monitoring than a source under a constant emission limitation. Specific guidance for air quality monitoring for an SCS is contained in Guidelines for Evaluating Supplementary Control Systems (EPA 450/3-75-035, OAQPS No. 1.2-036, and Guidance for Air Quality Monitoring in the Vicinity of Large Point Sources, OAQPS No. 1.2-012, Supplement B (in preparation).

C. Pollutants to be Monitored

Pollutants for which monitoring may be necessary under ESECA are SO_2, TSP, and sulfates. Reporting of plans for monitoring SO_2 is specifically required in the Act. While not mentioned specifically, monitoring for the other pollutants is implicit in the Act. Emissions of NO_2, hydrocarbons, or carbon monoxide in amounts which may cause or contribute to exceeding the ambient standards are very unlikely from power plants or other large fuel burning installations.

There is no air quality standard presently applicable to sulfates but recent information indicates possible adverse health effects at elevated concentration levels. A provision of ESECA implies for non-criteria pollutants, such as sulfates, that plant fuel conversions to coal shall not result in an increase in emissions of such pollutants or of their precursors that may result in a significant risk to public health. Requiring monitoring for sulfates would allow evaluation of trends of sulfate levels near a source that could possibly be related to fuel conversion or a change in sulfate precursor emissions. Such monitoring also improves the data base upon which future actions by EPA relative to sulfates can be assessed. Further information related to the need for monitoring for sulfates may be obtained from EPA 450/2-75-007, September 1975, Position Paper on Regulation of Atmospheric Sulfates.

D. Meteorological Data

Monitoring for source pollutant impacts must also include collection of meteorological data which adequately describes the transport and dispersion of pollutants in the vicinity of greatest impact of the source. Monitoring of meteorological parameters may be performed by source operators or equivalent, representative data collected by the National Weather Service or private firms may be utilized.

E. Means for Requiring Monitoring by Source Operators

The compliance schedule requirement under 40 CFR 55 should be utilized whenever possible for requiring monitoring of sources to receive compliance date extensions. A separate means, such as requirement of a monitoring plan, may be imposed if a compliance date extension is not necessary to meet SIP requirements. Monitors should be required to be operational at least 60 days prior to conversion in order to obtain some ambient data on source impact prior to conversion and to gain assurance that monitors are operating properly prior to conversion.

F. Reporting Schedules

EPA must track the air quality impact of ESECA source conversion activities. EPA Regional Offices, with necessary assistance from OAQPS, should accomplish this on a quarterly basis. Depending on the reported air quality around these sources, EPA may take subsequent actions to alter the conditions of ESECA actions. Also, EPA must issue a summary report in the Federal Register at least every 180 days on the impact of ESECA source actions on ambient air quality. Air quality monitoring needs of ESECA make it imperative to have a short reporting lag. To minimize the time lag, monthly reporting should be requested from source operators, when possible, and the schedule should be such that an evaluation can be initiated no later than 60-90 days after a month or quarter for which data are collected. For selected data from SIP networks, an accelerated schedule should be requested, if possible, to coincide with the schedules applicable to monitoring by sources.

III. Specific Criteria for Monitoring and Data Reporting

A. Definitions

a. "Designated source" shall be used to specify sources converting to coal under ESECA. Such sources shall be designated for monitoring of pollutant concentrations and, if necessary, pertinent meteorological parameters in their vicinity.

b. "Isolated source" for the purpose of this guideline shall mean any emission point or group of emission points to which greater than 80 percent of the pollutant concentrations at any distance on an annual average basis (measured or estimated) is attributable to that source except for identifiable background concentration. Any other point source shall be classified as an "urban source."

B. Monitoring Requirements

For each designated source, a minimum of 3 monitors per specified pollutant should be required (See Table 1). In addition, at least one wind speed and direction data collection system should be required along with an acceptable means (by measurement or inference) for estimating atmospheric stability. Requirements for meteorological measurements may be waived if representative, equivalent data can be obtained from the National Weather Service or private firms within 40 kilometers of the source. On-site wind sensors should be at least 10 meters above ground level or nearby obstructions--preferably as close as practicable to the average stack height of the source.

Table 1

Minimum Network--Monitoring Around Designated Sources

Pollutant	Measurement Method[1]	Sampling Frequency	Minimum No. of Sites
SO_2	Parosaniline	Continuous	3
TSP and/or Sulfates	Hi-Vol 24-hour Filter	One every 3 days	3

[1]Refer to OAQPS Guideline Number 1.2-018 for other methods that may be acceptable.

Of the minimum 3 monitors for each pollutant, at least one monitor should be placed in the area of maximum short-term (1-24 hour average) concentration. For SO_2, two periods for short-term standards apply, 3-hour and 24-hour. The maximum concentrations for those two periods may not occur in the same area. Therefore, more than one maximum concentration area may have to be monitored for SO_2. All monitors should not be placed along a single downwind direction so that for periods with consistent wind direction, at least one monitor will indicate background levels or levels not contributed by the source. A summary of guidance for physical placement of monitors contained in OAQPS 1.2-012 "Guidelines for Air Quality Monitoring Networks and Instrument Siting," July 1975, is given in Table 2.

Models described in Appendix B, essentially repeated from OAQPS 1.2-035, can be used to estimate maximum concentrations and the locations relative to a source at which the maxima are likely to occur.

For isolated point sources, the above network design considerations are sufficient. For urban sources, additional information on the contribution of ESECA actions on general pollution levels is desirable. Therefore, selected SIP surveillance network data may be utilized for this purpose. Data should be utilized from SIP monitoring sites exhibiting the maximum annual and short-term concentrations within a 40 kilometer radius and from monitoring sites close to the designated source. The maximum concentration site(s) should be that (those) recording maximum levels during the previous calendar year.

C. Data Collection and Reporting

As mentioned previously, source owners or operators can be required to include for EPA approval as part of the compliance schedule requirement of 40 CFR 55, a plan for air monitoring. Alternatively, a separate monitoring plan can be required as a condition to fuel conversion. In either case, a monitoring plan should include a description of the proposed air quality and meteorological monitoring network. It should include as a minimum a brief description of the basis for determining the need for monitoring and the following information:

a. UTM coordinates, city, county, state, AQCR, operator, and the name of laboratory performing analysis for the proposed stations.

b. SAROAD site identification for all existing stations.

c. The pollutants to be sampled at each station, the number of stations for each pollutant, the sampling methods, and sampling schedules.

TABLE 2. SUMMARY OF GUIDELINES FOR STATION SITING AND PROBE PLACEMENT TO MONITOR POINT SOURCE IMPACT

Pollutant	Site type	Site selection	Probe placement (meters)		
		Site location	Height above ground	Vertical clearance[a]	Horizontal clearance[b]
Sulfur dioxide	Peak	Maximum point determined from emissions information, diffusion model, and historical air quality data (if available)	3 to 15	1 to 2	>2
	Neighborhood	Determined on basis of population patterns and air quality gradients	3 to 15	1 to 2	>2
	Background	Nonurban area within Region	3 to 15	1 to 2	>2
Suspended particulates and sulfates	Peak	Same as for SO_2	2 to 15	-	>2
	Neighborhood	Same as for SO_2	2 to 15	-	>2
	Background	Same as for SO_2	2 to 15	-	>2

[a]Vertical clearance above rooftop or other supporting structure.

[b]Horizontal clearance from side of supporting structure or other restriction to air flow.

d. The objective(s) for which sampling for each pollutant is carried out, i.e., maximum post-conversion 24-hour concentration, impact on pre-conversion maximum concentration sites, etc.

e. In addition, Regional Administrators may require additional information about sampling sites as outlined in OAQPS Guideline No. 1.2-019, "Air Quality Monitoring Site Description Guideline."

The approved networks should be established by at least 60 days prior to effective date of conversion. On a monthly basis, after establishment of the approved network, the source owner or operator should be required to submit air quality and meteorological data in SAROAD format either on magnetic tape or card form, preferably tape, to the appropriate EPA Regional Office. To meet the rapid reporting schedule, an automatic data logging and processing system is advised. The submittal by the source operator should be no later than 30 days after the end of the month for which the data were collected. The EPA Regional Office should submit the data, after checking for completeness and general accuracy, to the NADB no later than 60 days after the end of a monthly period. Any SIP network data to be used to supplement ESECA source-oriented networks should also be submitted at this time, if possible. This schedule will allow an evaluation of a source's air quality impact status between 60 and 90 days after the end of any monthly or quarterly period.

On a semi-annual basis, in January and July, EPA must publish in the Federal Register up-to-date summaries of impact of conversion actions on ambient air quality. EPA Regional

Offices should submit by the 10th of those months data to OAQPS for the preparation of that report. An example format for entering the data is given in Appendix C. The reports should contain data for the latest (available) 6-month period, except for annual averages where the latest 12-month period is applicable. They should be submitted to Chief, Monitoring and Reports Branch (MD-14), MDAD, OAQPS, Research Triangle Park, N.C. 27711.

Appendix A

Typical Annual Costs*
for Source Oriented Air Monitoring Network

SO_2 Continuous (3)	$24,000
High Volume Samplers (3)	$ 6,000
Sulfate Analysis (As separate item)	$ 3,500
Wind Direction and Speed (1) (Including 10 m. tower)	$ 1,200
Shelter	$ 1,000
Automatic Data Logging	$ 3,150
Processing to Mag Tape in SAROAD Format	$ 1,750
	$40,600

*Includes Purchase, Operating and Maintenance Costs (Capital equipment costs amortized over 5 years in equal amounts)

PRINCIPAL SOURCE: Final Report, "Cost of Monitoring Air Quality in the United States,"Research Triangle Institute, EPA Contract No. 68-02-1096, Task No. 3, December 1973 (20 percent inflation cost increase added).

Appendix B--Atmospheric Simulation Models

I. Introduction

A key element in the determination of pollutant source impact is an adequate methodology for relating pollutant emissions to ambient air quality. The most commonly used tool for relating emissions and air quality is an atmospheric simulation or dispersion model.

An atmospheric simulation model is a mathematical description of the transport, dispersion and transformation processes that occur in the atmosphere. In its simplest form, such a model relates pollutant concentrations (x) to pollutant emissions rates (Q) and a background concentration (b),

$$x = kQ + b.$$

The constant k is a function of atmospheric conditions and the spatial relationship between source and receptor. Atmospheric simulation models are ultimately concerned with the variabilities of k and Q and their impacts on pollutant concentrations.

Simulation models estimate concentrations only for pollutants which have identified sources, the emissions from which are inputs to the models. If pollutants occur naturally in the atmosphere or are the result of unidentified distant pollutant sources, these pollutant concentrations must be accounted for and separately added to the dispersion model estimates in order to approximate total ambient concentrations. For example, it is commonly assumed that the natural background concentration of total suspended particulate matter is 30-40 $\mu g/m^3$ over much of the Eastern United States.[1]

II. Critical Dispersion Conditions

Dispersion models should be used to simulate meteorological conditions conducive to high ground level pollutant concentrations. Generally, the highest pollutant concentrations from point sources with stacks are experienced with one of four critical dispersion conditions: looping, inversion breakup fumigation, high wind coning, or limited mixing. The looping and fumigation conditions are transient phenomena which generally do not occur for periods long enough to endanger a 24-hour standard. However, as has been shown by Carpenter et.al.[2], and Pooler[3], high concentrations may occur with high-wind coning and limited mixing conditions. Because of the persistence of these meteorological conditions, the 24-hour standard may be endangered.

The principal characteristics of two dispersion conditions, which may cause point sources to pose a threat to ground-level air quality, are:

1. High-Wind Coning. High-wind coning occurs with neutral stability conditions (See Turner[4]); these conditions are generally associated with cloudy, windy weather. The effluent plume is shaped like a cone, with its axis roughly parallel to the ground, The maximum ground-level concentration is a function of the wind speed and the source characteristics (stack height, gas volume, gas temperature). The wind speed strongly influences the plume rise, i.e., the height above the stack at which the plume bends from the vertical toward the parallel position mentioned above, which in turn influences the maximum ground level concentration and the distance from the stack at which this concentration will occur.

2. Limited Mixing. Limited mixing or trapping occurs when the upward dispersion of the plume is inhibited by a stable or inversion layer aloft and the plume is mixed uniformly between the ground and the stable layer. Maximum concentrations are accompanied by light winds and occur from 5-10 kilometers from the source. The maximum concentration is primarily determined by the elevation and intensity of the stable layer aloft; stack height has a minor influence.

Reasonable rules-of-thumb are (1) the high-wind coning condition causes highest ground-level concentrations from sources with relatively short stacks (500 feet or less) and (2) the limited mixing situation causes greatest ground-level concentrations from sources with tall stacks (greater than 500 feet). Mathematical models which simulate these critical dispersion conditions are available from Turner[4] and Volume 10 to Guidelines for Air Quality Maintenance Planning and Analysis[5]. It is suggested that the set of plume rise equations given by Briggs[6] be used in any dispersion estimates.

Most dispersion models provide estimates of 1-hour average concentrations. To estimate 24-hour concentrations from 1-hour concentrations it is suggested that a 4:1 ratio of the 1-to-24-hour concentrations be assumed. This accounts for the daily variability of weather conditions by implicitly assuming that the wind direction prevails in one direction for 6 of the 24 hours during the day on which the critical condition occurs. The suggested ratio of 4:1 is supported by substantial data collected around power plants in the States of Kentucky[7], Massachusetts[8] and Ohio[9]. Wherever observed data are available, location-specific estimates of the 1-to-24-hour concentration ratios should be used.

III. Special Situations

In addition to the critical dispersion conditions noted above, special situations such as aerodynamic downwash of the plume and plume impaction on prominent terrain features can cause high pollutant concentrations.

In the case of emissions released from a short stack, e.g., one which is less than 2 1/2 times the height of an adjacent building, emissions can become trapped under some wind conditions in the turbulent cavity immediately downwind of the adjacent building. In this case, the maximum concentration can be estimated by the use of simple volume approximation[10]. While such downwash is generally a short-lived phenomenon, sources subject to downwash which encounter periods of persistent high winds may cause substantial 24-hour pollutant concentrations. In such cases, downwash should be considered the critical condition.

If rough terrain is present, major differences in the height of the source and the height of the significant receptor locations may be accounted for by modifying the effective plume height as follows:

$$h = H + Z_s - Z_r$$

where

h = height of source plume with respect to the height of the critical location (meters)

Z_s = elevation of source (meters)

Z_r = elevation of critical location (meters)

The above correction procedure should be used only where major terrain variations due to hills and valleys are present. Negative and small positive values of h, derived from this equation, should not be used in the modeling equation. In such cases it is recommended that a value of h = 10 meters be used. Estimates of the 1-hour concentrations developed for these situations can be ratioed to 24-hour concentrations in a manner similar to that for the coning and limited mixing models.

While the simplified techniques noted above make reasonable assumptions about plume behavior in complex situations, they cannot consider the impact of the plume in the detail which is desirable. The use of physical models in wind tunnels or water channels allows a more detailed study of plume behavior. Physical modeling is recommended for complex terrain situations when feasible.

IV. Computerized Simulation Models

Specific computer programs which provide a more detailed analysis than the simplified mathematical models are available. Computerized models can consider a wide variety of meteorological conditions so that both average and worst case conditions and their frequencies can be determined. Such point source models are available within EPA[11,12] which (1) estimate concentrations at numerous receptors for averaging times of 1 hour, 24 hours and 1 year, and (2) simulate the impact of sources on elevated terrain.

It is also possible to use point source models in the UNAMAP[13] system to estimate concentrations for the high wind and limited mixing situations or to repetitiously apply the models to hourly periods for a long period of time. To estimate annual average concentrations with computerized dispersion models, the Air Quality Display Model[14], and the Climatological Dispersion Model[15] are available.

The models discussed in this appendix are applicable for estimating concentrations of SO_2, particulate matter, and non-decaying pollutants. In those cases where the impact of pollutants undergoing major atmospheric transformations are of concern, e.g., between NO and NO_2, no widely accepted methods are available for determining pollutant concentrations. In such cases, it is necessary to make assumptions concerning the conversion rate of the pollutant and the chemical constituents of resulting compounds before concentration estimates can be made.

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Appendix C

FEDERAL REGISTER REPORTING OF IMPACT ON AIR QUALITY OF COAL CONVERSION ACTIONS (SEMI-ANNUAL)

Suggested Format for Source Information Requested for FR Report Preparation:

Source Name ____________________

Location ____________________

Type of ESECA Action ____________________

Total No. of Units ____________________

Units Converted to Coal ____________________

Dates of Conversion ____________________

Fuels Burned in Each Unit Prior to Conversion ____________________

Fuel Consumption Rate Per Unit (Amount/Mo.):

Before Conversion ____________________

After Conversion ____________________

Fuel Quality Data:	Coal	Oil	Gas
Avg. Sulfur Content (%)	___	___	___
Avg. Ash Content (%)	___	___	___
Avg. Heating Value (BTU/Amt.)	___	___	___

Type Control Equipment & Efficiency:

SO_2 ____________________

Particulate Matter (PM) ____________________

Date of Last Emissions Test ____________________

Type of Test: Stack ( ) Fuel Analysis ( )

Estimated Emission Rate* (g/sec):	Avg. Load	Peak Load
Before Conversion -		
SO_2	___	___
PM	___	___
After Conversion -		
SO_2	___	___
PM	___	___

*by total facility or breakdown by separate units

Suggested Format for Air Quality Information Requested for FR Report Preparation

Location of Air Monitoring Sites
Pollutant(s) Monitored at Sites
Pollutant Summary

Monitoring Site Data -

Pollutant	Avg. Period	Quarter	No. Values	No. NAAQS	Highest 1st	Highest 2nd
SO_2	3-hour					
	24-hour					
	Annual Avg.* =					
TSP	24-hour					
	Annual Avg.* =					

Other (Sulfates, NO_2, etc.)

*Last 12 months ending with latest reporting period.

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