GUIDELINE SERIES

GUIDANCE FOR SPECIFYING PRIMARY STANDARD CONDITIONS UNDER ESECA

OAQPS No. 1.2-035

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

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GUIDANCE FOR SPECIFYING PRIMARY STANDARD CONDITIONS UNDER ESECA

Division of Stationary Source Enforcement
Office of Enforcement
Washington, D.C.

Monitoring and Data Analysis Division and
Strategies and Air Standards Division
Office of Air Quality Planning and Standards
Office of Air and Waste Management
U.S. ENVIRONMENTAL PROTECTION AGENCY
Research Triangle Park, N.C. 27711

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I. Introduction

The purpose of this guideline is to provide the EPA Regional Offices with information relevant to the determination of Primary Standard Conditions (PSC). Primary standard conditions are specified by EPA for the control of Emissions from sources granted compliance date extensions (CDE) in accordance with the provisions of the Energy Supply and Environmental Coordination Act of 1974 (ESECA). Primary standard conditions may be expressed as: emission limitations; requirements respecting pollution characteristics of coal; or other enforceable measures (which may include supplementary control systems (SCS)). ESECA authorizes EPA to grant compliance date extensions that temporarily suspend applicable fuel or emission limitations to eligible sources (See 40 CFR Part 551) prohibited by the Federal Energy Administration from burning natural gas or oil as a primary fuel.

ESECA requires EPA to prescribe PSC for each source granted a CDE. The PSC must apply to the pollutant(s) to which the CDE applies and must ensure that, during the period of the CDE, the burning of coal by such a source will not result in emissions which cause or contribute to pollutant concentrations which exceed national primary ambient air quality standards (NPAAQS). EPA must certify to FEA the earliest date by which the source can comply with the PSC, and the effective date of FEA's prohibition order cannot precede the EPA certified date.

The conference committee report for ESECA provides insight into Congressional intent pertinent to compliance date extensions and primary standard conditions. In discussing air pollution control requirements, the report reads,

> "The committee believes that the priority effort of each source which is subject to Section 119(c) should be to obtain low sulfur coal. If an adequate, long-term supply of low sulfur coal is available to such a source, the Administrator should only approve a plan which requires its use (and thus compliance with air pollution requirements) as expeditiously as practicable. In such a case, the Administrator would have to disapprove a plan which proposed to wait until January 1, 1979 before beginning to burn low sulfur coal. The committee believes that requiring priority consideration to the use of nonmetallurgical low sulfur coal will reduce the likelihood of extended violation of applicable emission standards."

The determination of primary standard conditions requires the application of an atmospheric dispersion model to quantify the effect on ambient air quality of the conversion from gas or oil to coal. This, in turn, requires the collection and organization of considerable information on the source. A source ordered to convert is required by 40 CFR Part 55 to provide appropriate information to EPA and is permitted to propose its own primary standard conditions.

Sulfur oxides and particulate matter are the pollutants of primary concern. While nitrogen dioxide should not be excluded from consideration, the effects of conversion on ambient concentrations should be relatively minor because few areas are experiencing excessive concentrations and the NPAAQS is an annual average. Concentrations of the other criteria pollutants (carbon monoxide, hydrocarbons, and photochemical oxidants) are not significantly affected by conversions of combustion sources from gas or oil to coal.

II. Determination of Primary Standard Conditions

A PSC should be determined in several steps which include:

1. establishing a data base;
2. selecting and applying dispersion models;
3. determining the degree of emission control that will ensure that NPAAQS are not exceeded; and
4. specifying the regulatory form of the PSC most appropriate to the particular power plant.

The first three of these steps are described in detail in this guideline. The fourth, guidance in determining the regulatory form of the PSC, is available from the Division of Stationary Source Enforcement, Office of Enforcement, Washington, D. C.

III. Data Base

The first step toward determining the PSC is data acquisition. Meteorological, air quality, and source data from the latest available four quarters should be used as the data base year. In addition, information about present and future sources in the area around the converting plant should be included in the data base. Appendix A outlines the specific data needs.

Experience indicates that major power plants acting either alone or in conjunction with other sources may have a significant impact on ground level pollutant concentrations outward to a distance of 20 kilometers. Therefore, to account for other major sources which may affect portions of the same area, it is necessary to examine sources within 40 kilometers of the converting plant.

This distance is a recommendation which may be appropriately altered since the area in which a source has a significant impact varies with source configuration and emissions, the impact of emissions from other sources, increases in emissions due to growth, and the topography and meteorology of the area.

All sources within 40 kilometers of the plant (including any non-converting units at the source) should be included in this base year inventory. Source data should be estimated for the years, during which the compliance date extension is effective, when pollutant emissions from plants in the surrounding area are expected to have the greatest impact on air quality. Such data should include expected changes in patterns of fuel use and fuel quality (percent sulfur, percent ash, heat content, etc.), and planned modifications or expansions of existing and projected new sources in the area.

All air quality data in the vicinity of the source for the base year, and other recent years of available data, should be obtained. These data are required to ascertain existing air quality and trends, the contribution from other sources in the area, and the natural background levels. If these data do not exist, estimates should be obtained by modeling.

Meteorological data for the base year and/or data representative of anticipated critical dispersion conditions should be identified and obtained. These data should be used with source data in a dispersion model to estimate 24-hour and annual pollutant concentrations for the year of greatest projected emissions in the areas of the converting source.

IV. Estimating Source Impact

Emphasis should be placed on the 24-hour analysis since a large power plant usually presents a greater threat to short-term NPAAQS than to long-term standards. Further, due to the complex interaction of source parameters, meteorological conditions and terrain configurations, high short-term concentrations may occur with a variety of situations and at a variety of locations. For this reason, it is important to use a dispersion modeling procedure which takes into account variations in the source, receptor, meteorology, and terrain.

Some of the factors which should be considered are the following:

1. source--present emissions under various load conditions, including maximum load from individual converting units;
2. receptor--a wide range of locations in the area should be considered since the most stringent emission limitation may be derived from a receptor location where a relatively small contribution from the converting source would cause NPAAQS to be endangered;
3. meteorology--at least the critical dispersion conditions Appendix B; and,
4. terrain--local features which may effect dispersion.

In most cases, a computerized dispersion model will probably be necessary to adequately consider all of these factors.

Finally, to determine the total concentration due to all sources, an estimate must be made of the level of contributions from other sources in the area, including non-converting units at the power plant. The PSC should be determined with a consideration of area growth and expansion of existing facilities based on new source review information or an appropriate index of industrial growth. Depending on the number of other sources and their nature, additional point and/or multi-source modeling may be necessary to estimate their impact. At the least, a careful estimate of the air quality impact of all sources in the area should be made based on knowledge of emissions, measured air quality data, and consideration of meteorological conditions.

Dispersion model estimates of source impact on an annual basis do not require as detailed a procedure as that for the 24-hour estimates. However, there are similar information requirements for average source and growth data, consideration of meteorological and topographic parameters and use of appropriate simulation models.

With data on the air quality impact of individual power plant units and the combined air quality impact of projected emissions from all other sources in the area, the maximum allowable contribution from converting units at the power plant that would assure compliance with all NPAAQS can be estimated. From this estimate, the allowable pollutant emissions from the converting units at the plant can be determined. To make this determination, the total estimated impact of (1) the maximum projected emissions from all other sources in the area, and (2) natural background is subtracted from the applicable NPAAQS. The remainder is the contribution that the converted units may make to pollutant concentration. The ratio of this remainder to the estimated contribution from the converting units (before conversion to coal) is the change in concentration impact which may be allowed for the converting units. If this ratio is greater than one, pollutant emissions from the converting units can be proportionately increased by conversion to coal (see example below). If the ratio is less than one, pollutant emissions from converting units must be proportionately decreased for any conversion to coal.

If it is determined that a PSC should be more stringent than the existing SIP and the power plant is not eligible for SCS, the Office of Enforcement should be notified and procedures initiated for a revision of the SIP. These cases will then be handled on an individual basis. An amendment to ESECA has been proposed which would require the source to meet the revised SIP as soon as practicable but no later than December 31, 1978.

Example: The estimated 24-hour impact from all other sources (including background and non-converting units) is determined to be 165 $\mu g/m^3$ of SO_2. The allowable contribution is then,

$$365\ \mu g/m^3 - 165\ \mu g/m^3 = 200\ \mu g/m^3.$$

If the current maximum impact of oil-fired units to be converted is estimated from modeling to be 100 $\mu g/m^3$, and the present emission rate is four tons SO_2/hour, the allowable emission after conversion is

$$\frac{200\ \mu g/m^3}{100\ \mu g/m^3} \times 4 \text{ ton/hour} = 8 \text{ ton/hour}$$

It should be noted that a switch in fuel type could result in a change in stack gas characteristics, e.g., volume flow rate or temperature, so that the distance to and magnitude of the maximum concentration could be different from that indicated above. Thus, to be certain that the calculated emission rate is sufficiently stringent to avoid any violations of NPAAQS, the model should be rerun using the estimated allowable emission while burning coal. If a violation is predicted, the allowable emissions should be lowered and the calculation repeated. By this iterative technique, the appropriate emission rate can be determined.

V. Specification of PSC

As mentioned in the introduction, a PSC may be specified in the form of an emission limitation, requirements respecting the pollution characteristics of the coal, or other enforceable measures, including an SCS. Guidance in determining the form of the PSC most appropriate to a particular power plant is available from the Division of Stationary Source Enforcement, Office of Enforcement, Washington, D. C.

VI. Responsibility

ESECA requires the Administrator of the EPA to prescribe a PSC after consultation with the state in which the source is located. However, the EPA Regional Offices (RO) will be primarily responsible for specifying the PSC for a given plant. Technical assistance will be provided by the Office of Air Quality Planning and Standards (OAQPS), Research Triangle Park, N. C., if desired. At its discretion, the RO may consider an analysis report submitted by a state agency or by the source; however, in such cases the RO is responsible for judging the acceptability of the analysis.

In the case of a power plant which could potentially cause contravention of a NPAAQS in a state other than the one in which it is located, all affected states and RO's should be involved in determining the PSC. However, the RO responsible for the area in which the power plant is located is responsible for the final determination.

VII. Monitoring Requirements

ESECA requires that EPA publish a summary in the Federal Register semi-annually on the status of compliance by the source with the prescribed PSC. To ensure that PSC are met and that NPAAQS are adequately protected during the period of compliance extension, monitoring is required. This includes monitoring of emissions, meteorological conditions, and air quality. Guidance for air quality monitoring to meet the requirements of ESECA will be provided in Guidelines for Air Quality Monitoring and Data Report for Sources under ESECA which is being prepared by OAQPS.

An SCS requires considerably more monitoring than an emission or fuel limitation. The special needs of this type of PSC are discussed in Appendix C.

Meteorological data should be collected which adequately describes transport and dispersion in the vicinity of the source. If such data are not being collected, the source should be required to acquire such data. As a minimum, this should include data on wind direction and speed, and atmospheric stability that are representative of meteorological conditions. Sufficient data concerning the impact of weather conditions should also be available to analyze trends of air quality in the area.

Emission monitoring is also required of the source to insure that PSC are being met. This includes a routine survey of emissions both at the source meeting PSC and at other sources in the area. To ensure that a PSC emission limit is met, it is recommended that continuous in-stack monitoring be required of the converting source. Where continuous in-stack monitoring is not employed and there is a limit on the pollutant content of the fuel, a method of sampling and analyzing the coal should be specified in the PSC. It is strongly recommended that such sampling and analysis be required on a 24-hour basis so that the quality of the fuel burned in any 24-hour period can be ascertained. In either case monitored emissions and/or data on the pollutant content of the fuel should be routinely reported to the Regional Office.

Monitoring of growth and expansion in the area, and of associated increases in pollutant emissions is also necessary. If unforeseen/uncontrollable growth or expansion occurs near a plant meeting the requirements of a PSC, it may be necessary to modify the PSC to ensure that NPAAQS will not be exceeded.

VIII. <u>Modifications of PSC</u>

All data collected and associated with PSC must be reviewed semi-annually. If a PSC is being met, no action is required. If air quality standards are exceeded, the violations must be reviewed and the cause determined. Such causes might include adverse meteorological conditions which were not considered in the development of the PSC, increased emissions from other sources in the area, failure of the source to meet the PSC due to faulty or inadequate control systems or variability of fuel quality. The likelihood of the cause continuing or recurring must be determined and appropriate changes in the PSC should then be made or, if appropriate, more aggressive enforcement of an existing PSC undertaken.

Modifications of PSC should follow an orderly sequence. The PSC may need to be modified because of monitored air quality violations, because control equipment used by the source is less efficient than predicted, or because emissions from new sources exceed anticipated levels. It should be noted that states may petition the Administrator for a modification of the PSC. The source impact is then reanalyzed and appropriate changes in PSC are determined. After consultation with appropriate state agencies and public hearings, the Administrator can issue a new PSC and certify the earliest date that the source can meet the new PSC.

Appendix A--Data Requirements

Determination of the primary standard condition (PSC) should rely on dispersion model procedures requiring specific, accurate data. The degree of detail required of the data is determined by the use to be made of it, and time and resources available for obtaining the data and for the modeling. In general, the source, meteorological, and air quality data required for dispersion modeling procedures are listed below. The use of the data is described in Appendix B and the references cited in Appendix B.

I. Source Data

Data on design characteristics of the source and operating levels should be obtained for the following:

1. Plant layout--the connection scheme between boilers, generators, and stacks, and the distance and direction between stacks, building parameters (length, width, height, location and orientation relative to stacks) for plant structures which house boilers, control equipment, etc.;
2. Stack parameters--for all stacks, the stack height and diameter (in meters), and the temperature (in $^{\circ}K$) and volume flow rate (in actual cubic meters per second) or exit gas velocity (meters per second) for operation at 100%, 75%, and 50% load;
3. Boiler size--for all boilers, the associated megawatts and pounds of steam per hour, and the design and/or actual fuel consumption rate for 100 percent load for coal (tons/hr), oil (barrels/hr), and natural gas (thousand cubic feet/hr);

4. Boiler parameters--for all boilers, the percent excess air used, the boiler type (e.g., wet bottom, cyclone, etc.), and the type of firing (e.g., pulverized coal, front firing, etc.);
5. Operating conditions--for all boilers, the type and amounts of fuel used for each month of the latest year for which data are available, the total hours of boiler operation and the boiler capacity factor during the year, and the percent load for winter and summer peaks;
6. Pollution control equipment parameters--for each boiler served and each pollutant affected, the type of emission control equipment, the year of its installation, its design efficiency and mass emission rate, the date of the last test and the tested efficiency, the number of hours of operation during the latest year, and the best engineering estimate of its projected efficiency if used in conjunction with coal combustion; data for any anticipated modifications or additions;
7. Data for new boilers or stacks--for all new boilers and stacks under construction and for all planned modifications to existing boilers or stacks, the scheduled date of completion, and the data or best estimates available for items 1 through 6 above following completion of construction or modification.

Sources for these data include the Federal Power Commission[2,3], National Coal Association[4], OAQPS/Energy Strategies Branch, and individual contacts with the power plants.

Information on the location of the plant and the nearby topographic features should be obtained in either latitude-longitude or Universal Transverse Mercator (UTM) system coordinates. Such features include:

1. Stacks
2. Significant terrain features, including valleys, hills and other elevated terrain features, major bodies of water, other large structures, etc., within 20 kilometers of the plant.

For ease of analysis, the location of the plant should be indicated on a U.S. Geological Survey (USGS) topographic map of appropriate scale.

It is recommended that all point and area sources within 40 kilometers of the power plant be examined to determine their additive impact on air quality. (Experience has indicated that major sources may have an impact on ground level pollution concentrations outward to a distance of 20 kilometers. To account for other point and area sources which may affect the same geographical area, it may be necessary to examine sources within 40 kilometers of the converting plant.) While this distance is a useful rule of thumb, the actual area of significant impact will vary with power plant configuration and emissions, the impact of emissions from other sources, increases in emissions due to growth, and the topography and meteorology of the area. Locations of the major point and area sources (in either latitude-longitude or UTM system coordinates) should also be plotted.

Data on the operating and design parameters of these sources and their emission rates should be documented in the standard format established for EPA's National Emissions Data System (NEDS) to facilitate updating of this file. Data already in NEDS should be reviewed for accuracy. Sources of new or increased emissions resulting from area growth or the expansion of existing facilities should also be identified. Information on their projected operations and expected emissions should be gathered into a format compatible with the model to be used.

II. Meteorological Data

In the specification of PSC for particular plants it is essential that consideration be given to the meteorological parameters involved in atmospheric dispersion. The principal variables of concern are wind and temperature. An analysis of the wind field is necessary to determine the area over which a plant's emissions have significant impact on ground level concentration and the probable direction(s) of the impact. An analysis of the vertical temperature profile yields information regarding the presence of temperature inversions. This information is required to determine the horizontal and vertical dilution of pollutants as they are transported by the wind. Data on these variables can be translated into stability, mixing height, ventilation, and wind direction-speed relationships, which are commonly used in estimating the transport and dispersion of pollutants.

The level of detail required in these analyses is largely dependent on the complexity of the terrain in the vicinity of the plant in question. Unevenness of terrain often results in distortions of the thermal and wind structure of the lower atmosphere.

Before undertaking a massive local meteorological data-gathering program, sources of existing data such as nearby National Weather Service Offices, military installations, and universities should be investigated. The surface data required (temperature, wind speed, and wind direction) are among those routinely taken at any weather observation facility. The required upper air data are regularly recorded at some 62 National Weather Service sites across the country. Summaries of existing data are available in various formats from the National Climatic Center at Asheville, North Carolina.

The critical meteorological conditions conducive to high ground level pollutant impact vary from plant to plant as a function of variables such as stack height. Even for a specified plant such critical meteorological conditions may vary with the plant's mode of operation, inasmuch as the stack gas parameters are affected.

Before an adequate dispersion model analysis can be conducted, judgments should be made concerning:

1. The degree of detail needed in the meteorological data base;
2. The extent to which necessary data are already available;
3. The necessity of conducting a measurement program to obtain additional data. Such a program could vary from the simple surface observation of wind and temperature, to the measurement of these variables aloft using quick-response instrumentation mounted on trackable balloons and/or aircraft.

Once the data base is assembled, the following steps are necessary:

1. Place the data in a form amenable to dispersion work; develop stability-wind joint frequencies, average mixing-heights for certain times of the day and year, hourly variations in meteorological conditions, and critical meteorological conditions with regard to wind, stability and mixing;
2. Perform preliminary estimations of plant-impact and choose an appropriate simulation model for more detailed analysis as required;
3. Tailor the meteorological data as required in order to render it usable in the chosen model.

III. Air Quality Data

Air quality monitoring data is needed to estimate either the natural background of a pollutant or the contributions from other sources in the area to ground level concentrations. These steps should be taken:

1. Identify all air pollution monitoring sites which may provide information about the air quality in the vicinity of the source. Monitors operated by EPA, state and local pollution control agencies, universities, or industry may be included. Monitoring site locations should be specified by either latitude-longitude or Universal Transverse Mercator (UTM) system coordinates.
2. Gather all available data from the identified monitors in a format compatible with EPA's Storage and Retrieval of Aerometric Data (SAROAD) system.

3. The available air quality data for the pollutants of concern should be examined with two goals in mind: (1) to determine the natural background, if any, or the background from distant sources, and (2) to determine the impact of all other sources in the area. A monitor isolated from the influence of local sources of the pollutant could provide information on ambient background concentrations. If no such monitor exists, an estimate must be made using the best knowledge of possible natural sources, measured air quality and emission sources from neighboring AQCR's, and meteorological information on the prevailing wind direction, etc.

Determination of possible contributions to ambient concentrations from sources other than the power plant will require careful examination of air quality data and nearby source data. If sufficient data are not available, or if a complex interaction of many sources exists, appropriate multi-source atmospheric simulation models[6,7,8] may be employed to assist in estimating air quality[9].

If little or no air quality data are available for estimating background and impact from other sources, the simulation models alone may be used to estimate air quality. However, future monitoring should be required. Such new monitors should be located in areas where the modeling indicates the highest total concentrations and highest contributions from the power plant in question might be expected to occur.

Appendix B--Atmospheric Simulation Models

I. Introduction

A key element in the determination of primary standard conditions 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.[10]

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.[11], and Pooler[12], 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[5]); 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[5] and Volume 10 to Guidelines for Air Quality Maintenance Planning and Analysis[9]. It is suggested that the set of plume rise equations given by Briggs[13] 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[14], Massachusetts[15] and Ohio[16]. 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[17]. 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[18,19] 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[20] 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[6], and the Climatological Dispersion Model[7] 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.

Appendix C--Supplementary Control Systems as a Primary Standard Condition

ESECA makes clear that EPA may require the use of intermittent or supplementary control strategies as a primary standard condition (PSC) or as part of a PSC to assure the maintenance of the NPAAQS during the period of a compliance date extension. The conference report for ESECA indicates that supplementary control systems (SCS) may be used for meeting the NPAAQS for SO_2 only. This report also provides guidance for determining the circumstances and time period for which SCS may be applicable. In discussing Section 119 of the Clean Air Act (added by ESECA), the report reads,

> "The committee believes that the priority effort of each source which is subject to Section 119(c) should be to obtain low sulfur coal. If an adequate, long-term supply of low sulfur coal is available to such a source, the Administrator should only approve a plan which requires its use (and thus compliance with air pollution requirements) as expeditiously as practicable. In such a case, the Administrator would have to disapprove a plan which proposed to wait until January 1, 1979, before beginning to burn low sulfur coal. The committee believes that requiring priority consideration to the use of non-metallurgical low sulfur coal will reduce the likelihood of extended violation of applicable emission standards."

This appendix provides guidance to the regional office for determining whether this approach is appropriate, and in properly specifying the conditions for the use of SCS as a PSC should this approach be selected.

I. Background

Supplementary control systems employ a methodology whereby SO_2 may be emitted by a source (usually up to a fixed maximum level) during favorable atmospheric conditions, but emissions are reduced during poor atmospheric dispersion conditions in order to avoid ambient SO_2 concentrations in excess of primary ambient air quality standards. Ambient air monitoring instruments are placed at points where the highest SO_2 concentrations are expected, and the information from these instruments is correlated with meteorological data, weather forecasts, and operating parameters, including emissions rates.

Each SCS must necessarily be tailored to the circumstances surrounding each source. Therefore, an SCS capable of reliably attaining and maintaining primary standards must be highly sophisticated. Regulation, surveillance, and enforcement with respect to a source using an SCS can be correspondingly complex due to the large number of interrelated factors that must be continually analyzed and balanced. Enforceable requirements for an SCS which will assure the necessary degree of sophistication are presented in detail below. SCS may be used as a PSC only by those sources that can satisfy each of the conditions specified.

II. Requirements for a Reliable and Enforceable SCS

The conference report for ESECA states:

> "The Administrator of EPA may require that the source use intermittent or alternative controls during such period of a compliance date extension if he determines that such measures are enforceable and will provide the necessary assurance pertaining to the attainment and maintenance of the national primary air quality standards. (Conference report for ESECA: H.R. No. 1085, 93d Cong., 2d Sess., June 4, 1974, at page 33.)"

Only one power plant has successfully operated an SCS for a meaningful period of time (TVA Paradise Steam Generating Station). Three primary non-ferrous smelters have also used supplementary control systems with varying degrees of success (ASARCO, Inc., at Glover, Missouri, El Paso, Texas, and Tacoma, Washington). Based on experience with these operating systems, EPA developed regulations for the use of supplementary control systems, which were proposed as amendments to Part 51 of the Federal Register on September 14, 1973, at page 25697. Although there are no present plans to finalize these regulations, the concepts contained therein have been applied in the development of federally-promulgated SIP regulations for the control of SO_2 at western primary non-ferrous smelters. One such smelter regulation was promulgated in Part 52 of the Federal Register on February 6, 1975, at page 5508. Seven more SCS regulations for individual smelters are nearing completion.

Major requirements of current supplementary control systems are that the system be reliable and enforceable. Since an SCS as a primary standard condition must also meet these requirements, the regional office should ensure that the following conditions are met:

1. The regional office must be assured that the periodic curtailment actions of an SCS can be appropriately implemented at the plant.

    (a) If fuel switching is to be utilized,

(i) adequate supplies of clean fuels must be available (in addition to coal, gas or oil is acceptable under the provisions of FEA's ESECA regulations and the definition of "primary energy source" therein at 10 CFR 303.2);

(ii) the source must be capable of accomplishing the necessary switching with sufficient promptness;

(iii) the switching must not cause the violation of a regional limitation or other federally enforceable requirement which has not been extended by the CDE, (e.g., switching from high sulfur coal to a lower sulfur coal may cause an increase in particulate emissions); and

(iv) the date by which the source will begin the use of coal must be clearly specified by the regional office. That date must not precede complete implementation of the SCS compliance schedule (item 11 below).

(b) If load switching is to be utilized, the regional office must be assured that power needs can be met if the output of the facility is reduced in accordance with the requirements of the SCS. As FEA is concerned that this method of SCS operation might result in impairment of service, that agency should be notified in the Letter of Certification that the source intends to utilize this method of emission curtailment.

2. Regardless of the method(s) chosen to reduce emissions -- (1(a) or (b) above) -- the regional office should specify an emission limitation which reflects the lowest sulfur content coal reasonably

available to the source. This will reduce the total SO_x emissions from the source over a period of time, and is thus consistent with Congress' intent to minimize the total atmospheric loading of sulfur compounds. This emission limitation will also increase the likelihood that the SCS will be effective in meeting the primary standards by minimizing the number of emission curtailments necessary to meet standards.

3. A "designated liability area" (DLA), must be clearly specified for the source. *The designated liability area is defined as* that geographical area in which the amibient air quality is significantly affected by post-conversion emissions from the source. Unless a refined source-receptor analysis indicates that a different area should be selected, it is suggested that the DLA be a circular area defined by the appropriate radius taken from the following table.

SO_2 Emission Rate		Radius	
tons per hour	grams per sec	Statute miles	Kilometers
16 or less	4,000 or less	7	11
24	6,000	10	16
32	8,000	15	24
40	10,000	20	32
48 or more	12,000 or more	25	40

4. The regional office must be able to hold the source owner or operator responsible for all primary ambient air quality standard violations that occur within the designated liability area. The source must specifically agree, in writing, to be held responsible in this matter before an SCS can be used as a PSC.

This requirement is necessary to ensure that SCS is used as a PSC only at these isolated power plants that can and will operate an SCS with the diligence necessary to reliably meet the standards.

5. In-stack, meteorological, and ambient air monitoring instruments must be operational during the period in which the source assumes liability for maintaining the NPAAQS. Data from such instruments must be available to the control agency.

6. The source owner or operator must conduct at least a 4-month field study, which encompasses the time period when NPAAQS are most likely to be exceeded, in order to develop information necessary for the day-to-day operation of the SCS. This field study is to be conducted prior to the time that the source assumes liability for maintaining the NPAAQS. The study must show that a SCS can be operated reliably to attain the NPAAQS around the source, and the results of the study must be submitted to EPA for approval.

7. Using the information from Item 5, the source owner or operator must develop and submit for EPA approval an operating manual spelling out the specific steps that will be taken when each of the SCS emission curtailment criteria is met. These steps must be shown to be adequate to prevent such air quality violations from occurring.

8. The source owner or operator must follow procedures contained in the operating manual required by Item 6, and systematically evaluate and improve the reliability of the SCS. Each change in an operating manual must be approved. These requirements must be specified in the PSC.

9. Periodic reporting requirements, adequate for maintaining surveillance of the operation and effectiveness of the SCS, must be specified in the PSC.

10. The PSC must clearly define the conditions by which the source will be held in violation of an applicable requirement, and the conditions by which permission to use an SCS will be withdrawn and the PSC revoked.

11. The source must develop and implement the SCS according to a compliance schedule specifying, as a minimum, the following increments:

(a) Date of submittal to the Administrator of the sources's plan for developing and implementing a supplementary control system;

(b) Date by which all contracts and purchase order for stack extensions (if necessary), monitors, and other component parts to accomplish a supplementary control system will be awarded or issued;

(c) Date by which the construction of stack extension (if necessary) and the installation of monitors and other component parts will be completed;

(d) Date of submittal to the Administrator of the study and operating manual for the supplementary control system (as required by Items 6 and 7);

(e) Date by which the periodic emission curtailment procedures contained in the operating manual for the supplementary control system will be initiated on a continuing basis; and

(f) Date by which the source will become responsible for all violations of the primary ambient air quality standards in the designated liability area (as required by Item 3).

III. Follow-up

The following guidance material on SCS is being prepared by EPA:

A. Guidelines for Evaluating Supplementary Control Systems (EPA-450/3-75-035, OAQPS No. 1.2-036). This draft document is being revised by the Monitoring and Data Analysis Division, OAQPS, RTP, N.C. It is is designed to help the responsible control agency evaluate an SCS during the various stages of development in order to assure that the SCS will be reliable. It will provide information on evaluating the results of the background study, including the source's plans for the placement of ambient air, in-stack, and meteorological monitoring instruments. It also will provide guidance for evaluating the periodic emission reduction procedures proposed by the source in its operating manual.

B. Guidelines for Enforcement and Surveillance of Supplementary Control Systems. This manual, now being developed by Division of Stationary Source Enforcement, is designed to provide assistance to the responsible control agency in surveillance of the SCS and in enforcing SCS regulations after the source has assumed responsibility for maintaining the ambient air quality standard. It will provide guidance in detecting ambient air concentrations in excess of the national standards, and in determining whether the source has adhered to the requirements of the operational manual. It also will provide inspection checklists, and procedures for inspecting and calibrating the monitors associated with the operation of an SCS.

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