

D R A F T
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New Source Review Workshop Manual

Prevention of Significant Deterioration
and
Nonattainment Area
Permitting

CHAPTER B
BEST AVAILABLE CONTROL TECHNOLOGY

I. INTRODUCTION

Any major stationary source or major modification subject to PSD must conduct an analysis to ensure the application of best available control technology (BACT). The requirement to conduct a BACT analysis and determination is set forth in section 165(a)(4) of the Clean Air Act (Act), in federal regulations at 40 CFR 52.21(j), in regulations setting forth the requirements for State implementation plan approval of a State PSD program at 40 CFR 51.166(j), and in the SIP's of the various States at 40 CFR Part 52, Subpart A - Subpart FFF. The BACT requirement is defined as:

"an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."

During each BACT analysis, which is done on a case-by-case basis, the reviewing authority evaluates the energy, environmental, economic and other

costs associated with each alternative technology, and the benefit of reduced emissions that the technology would bring. The reviewing authority then specifies an emissions limitation for the source that reflects the maximum degree of reduction achievable for each pollutant regulated under the Act. In no event can a technology be recommended which would not meet any applicable standard of performance under 40 CFR Parts 60 (New Source Performance Standards) and 61 (National Emission Standards for Hazardous Air Pollutants).

In addition, if the reviewing authority determines that there is no economically reasonable or technologically feasible way to accurately measure the emissions, and hence to impose an enforceable emissions standard, it may require the source to use design, alternative equipment, work practices or operational standards to reduce emissions of the pollutant to the maximum extent.

On December 1, 1987, the EPA Assistant Administrator for Air and Radiation issued a memorandum that implemented certain program initiatives designed to improve the effectiveness of the NSR programs within the confines of existing regulations and state implementation plans. Among these was the "top-down" method for determining best available control technology (BACT).

In brief, the top-down process provides that all available control technologies be ranked in descending order of control effectiveness. The PSD applicant first examines the most stringent--or "top"--alternative. That alternative is established as BACT unless the applicant demonstrates, and the permitting authority in its informed judgment agrees, that technical considerations, or energy, environmental, or economic impacts justify a conclusion that the most stringent technology is not "achievable" in that case. If the most stringent technology is eliminated in this fashion, then the next most stringent alternative is considered, and so on.

The purpose of this chapter is to provide a detailed description of the top-down method in order to assist permitting authorities and PSD applicants in conducting BACT analyses.

II. BACT APPLICABILITY

The BACT requirement applies to each individual new or modified affected emissions unit and pollutant emitting activity at which a net emissions increase would occur. Individual BACT determinations are performed for each pollutant subject to a PSD review emitted from the same emission unit. Consequently, the BACT determination must separately address, for each regulated pollutant with a significant emissions increase at the source, air pollution controls for each emissions unit or pollutant emitting activity subject to review.

III. A STEP BY STEP SUMMARY OF THE TOP-DOWN PROCESS

Table B-1 shows the five basic steps of the top-down procedure, including some of the key elements associated with each of the individual steps. A brief description of each step follows.

III.A. STEP 1--IDENTIFY ALL CONTROL TECHNOLOGIES

The first step in a "top-down" analysis is to identify, for the emissions unit in question (the term "emissions unit" should be read to mean emissions unit, process or activity), all "available" control options. Available control options are those air pollution control technologies or techniques with a practical potential for application to the emissions unit and the regulated pollutant under evaluation. Air pollution control technologies and techniques include the application of production process or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of the affected pollutant. This includes technologies employed outside of the United States. As discussed later, in some circumstances inherently lower-polluting processes are appropriate for consideration as available control alternatives. The control alternatives should include not only existing controls for the source category in question, but also (through technology transfer) controls applied to similar source categories and gas streams, and innovative control technologies. Technologies required under lowest achievable emission rate (LAER) determinations are available for BACT purposes and must also be included as control alternatives and usually represent the top alternative.

In the course of the BACT analysis, one or more of the options may be eliminated from consideration because they are demonstrated to be technically infeasible or have unacceptable energy, economic, and environmental impacts on a case-by-case (or site-specific) basis. However, at the outset, applicants

TABLE B-1. - KEY STEPS IN THE "TOP-DOWN" BACT PROCESS

STEP 1: IDENTIFY ALL CONTROL TECHNOLOGIES.

- LIST is comprehensive (LAER included).

STEP 2: ELIMINATE TECHNICALLY INFEASIBLE OPTIONS.

- A demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, and engineering principles, that technical difficulties would preclude the successful use of the control option on the emissions unit under review.

STEP 3: RANK REMAINING CONTROL TECHNOLOGIES BY CONTROL EFFECTIVENESS.

Should include:

- control effectiveness (percent pollutant removed);
- expected emission rate (tons per year);
- expected emission reduction (tons per year);
- energy impacts (BTU, kWh);
- environmental impacts (other media and the emissions of toxic and hazardous air emissions); and
- economic impacts (total cost effectiveness, incremental cost effectiveness).

STEP 4: EVALUATE MOST EFFECTIVE CONTROLS AND DOCUMENT RESULTS.

- Case-by-case consideration of energy, environmental, and economic impacts.
- If top option is not selected as BACT, evaluate next most effective control option.

STEP 5: SELECT BACT

- Most effective option not rejected is BACT.

should initially identify all control options with potential application to the emissions unit under review.

III.B. STEP 2--ELIMINATE TECHNICALLY INFEASIBLE OPTIONS

In the second step, the technical feasibility of the control options identified in step one is evaluated with respect to the source-specific (or emissions unit-specific) factors. A demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, and engineering principles, that technical difficulties would preclude the successful use of the control option on the emissions unit under review. Technically infeasible control options are then eliminated from further consideration in the BACT analysis.

For example, in cases where the level of control in a permit is not expected to be achieved in practice (e.g., a source has received a permit but the project was cancelled, or every operating source at that permitted level has been physically unable to achieve compliance with the limit), and supporting documentation showing why such limits are not technically feasible is provided, the level of control (but not necessarily the technology) may be eliminated from further consideration. However, a permit requiring the application of a certain technology or emission limit to be achieved for such technology usually is sufficient justification to assume the technical feasibility of that technology or emission limit.

III.C. STEP 3--RANK REMAINING CONTROL TECHNOLOGIES BY CONTROL EFFECTIVENESS

In step 3, all remaining control alternatives not eliminated in step 2 are ranked and then listed in order of overall control effectiveness for the pollutant under review, with the most effective control alternative at the top. A list should be prepared for each pollutant and for each emissions unit (or grouping of similar units) subject to a BACT analysis. The list should present the array of control technology alternatives and should include the following types of information:

- control efficiencies (percent pollutant removed);
- expected emission rate (tons per year, pounds per hour);
- expected emissions reduction (tons per year);
- economic impacts (cost effectiveness);
- environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants);
- energy impacts.

However, an applicant proposing the top control alternative need not provide cost and other detailed information in regard to other control options. In such cases the applicant should document that the control option chosen is, indeed, the top, and review for collateral environmental impacts.

III.D. STEP 4--EVALUATE MOST EFFECTIVE CONTROLS AND DOCUMENT RESULTS

After the identification of available and technically feasible control technology options, the energy, environmental, and economic impacts are considered to arrive at the final level of control. At this point the analysis presents the associated impacts of the control option in the listing. For each option the applicant is responsible for presenting an objective evaluation of each impact. Both beneficial and adverse impacts should be discussed and, where possible, quantified. In general, the BACT analysis should focus on the direct impact of the control alternative.

If the applicant accepts the top alternative in the listing as BACT, the applicant proceeds to consider whether impacts of unregulated air pollutants or impacts in other media would justify selection of an alternative control option. If there are no outstanding issues regarding collateral environmental impacts, the analysis is ended and the results proposed as BACT. In the event that the top candidate is shown to be inappropriate, due to energy, environmental, or economic impacts, the rationale for this finding should be

documented for the public record. Then the next most stringent alternative in the listing becomes the new control candidate and is similarly evaluated. This process continues until the technology under consideration cannot be eliminated by any source-specific environmental, energy, or economic impacts which demonstrate that alternative to be inappropriate as BACT.

III.E. STEP 5--SELECT BACT

The most effective control option not eliminated in step 4 is proposed as BACT for the pollutant and emission unit under review.

IV. TOP-DOWN ANALYSIS DETAILED PROCEDURE

IV.A. IDENTIFY ALTERNATIVE EMISSION CONTROL TECHNIQUES (STEP 1)

The objective in step 1 is to identify all control options with potential application to the source and pollutant under evaluation. Later, one or more of these options may be eliminated from consideration because they are determined to be technically infeasible or to have unacceptable energy, environmental or economic impacts.

Each new or modified emission unit (or logical grouping of new or modified emission units) subject to PSD is required to undergo BACT review. BACT decisions should be made on the information presented in the BACT analysis, including the degree to which effective control alternatives were identified and evaluated. Potentially applicable control alternatives can be categorized in three ways.

- ***Inherently Lower-Emitting Processes/Practices***, including the use of materials and production processes and work practices that prevent emissions and result in lower "production-specific" emissions; and
- ***Add-on Controls***, such as scrubbers, fabric filters, thermal oxidizers and other devices that control and reduce emissions after they are produced.
- ***Combinations of Inherently Lower Emitting Processes and Add-on Controls***. For example, the application of combustion and post-combustion controls to reduce NOx emissions at a gas-fired turbine.

The top-down BACT analysis should consider potentially applicable control techniques from all three categories. Lower-polluting processes should be considered based on demonstrations made on the basis of manufacturing identical or similar products from identical or similar raw materials or fuels. Add-on controls, on the other hand, should be considered based on the physical and chemical characteristics of the pollutant-bearing emission stream. Thus, candidate add-on controls may have been applied to a broad range of emission unit types that are similar, insofar as emissions

characteristics, to the emissions unit undergoing BACT review.

IV.A.1. DEMONSTRATED AND TRANSFERABLE TECHNOLOGIES

Applicants are expected to identify all demonstrated and potentially applicable control technology alternatives. Information sources to consider include:

- EPA's BACT/LAER Clearinghouse and Control Technology Center;
- Best Available Control Technology Guideline - South Coast Air Quality Management District;
- control technology vendors;
- Federal/State/Local new source review permits and associated inspection/performance test reports;
- environmental consultants;
- technical journals, reports and newsletters (e.g., JAPCA and the McIvaine reports), air pollution control seminars; and
- EPA's New Source Review (NSR) bulletin board.

The applicant should make a good faith effort to compile appropriate information from available information sources, including any sources specified as necessary by the permit agency. The permit agency should review the background search and resulting list of control alternatives presented by the applicant to check that it is complete and comprehensive.

In identifying control technologies, the applicant needs to survey the range of potentially available control options. Opportunities for technology transfer lie where a control technology has been applied at source categories other than the source under consideration. Such opportunities should be identified. Also, technologies in application outside the United States to the extent that the technologies have been successfully demonstrated in practice on full scale operations. Technologies which have not yet been applied to (or permitted for) full scale operations need not be considered available; an applicant should be able to purchase or construct a process or control device that has already been demonstrated in practice.

To satisfy the legislative requirements of BACT, EPA believes that the applicant must focus on technologies with a demonstrated potential to achieve the highest levels of control. For example, control options incapable of meeting an applicable New Source Performance Standard (NSPS) or State Implementation Plan (SIP) limit would not meet the definition of BACT under any circumstances. The applicant does not need to consider them in the BACT analysis.

The fact that a NSPS for a source category does not require a certain level of control or particular control technology does not preclude its consideration in the top-down BACT analysis. For example, post combustion NOx controls are not required under the Subpart GG of the NSPS for Stationary Gas Turbines. However, such controls must still be considered available technologies for the BACT selection process and be considered in the BACT analysis. An NSPS simply defines the minimal level of control to be considered in the BACT analysis. The fact that a more stringent technology was not selected for a NSPS (or that a pollutant is not regulated by an NSPS) does not exclude that control alternative or technology as a BACT candidate. When developing a list of possible BACT alternatives, the only reason for comparing control options to an NSPS is to determine whether the control option would result in an emissions level less stringent than the NSPS. If so, the option is unacceptable.

IV.A.2. INNOVATIVE TECHNOLOGIES

Although not required in step 1, the applicant may also evaluate and propose innovative technologies as BACT. To be considered innovative, a control technique must meet the provisions of 40 CFR 52.21(b)(19) or, where appropriate, the applicable SIP definition. In essence, if a developing

technology has the potential to achieve a more stringent emissions level than otherwise would constitute BACT or the same level at a lower cost, it may be proposed as an innovative control technology. Innovative technologies are distinguished from technology transfer BACT candidates in that an innovative technology is still under development and has not been demonstrated in a commercial application on identical or similar emission units. In certain instances, the distinction between innovative and transferable technology may not be straightforward. In these cases, it is recommended that the permit agency consult with EPA prior to proceeding with the issuance of an innovative control technology waiver.

In the past only a limited number of innovative control technology waivers for a specific control technology have been approved. As a practical matter, if a waiver has been granted to a similar source for the same technology, granting of additional waivers to similar sources is highly unlikely since the subsequent applicants are no longer "innovative".

IV.A.3. CONSIDERATION OF INHERENTLY LOWER POLLUTING PROCESSES/PRACTICES

Historically, EPA has not considered the BACT requirement as a means to redefine the design of the source when considering available control alternatives. For example, applicants proposing to construct a coal-fired electric generator, have not been required by EPA as part of a BACT analysis to consider building a natural gas-fired electric turbine although the turbine may be inherently less polluting per unit product (in this case electricity). However, this is an aspect of the PSD permitting process in which states have the discretion to engage in a broader analysis if they so desire. Thus, a gas turbine normally would not be included in the list of control alternatives for a coal-fired boiler. However, there may be instances where, in the permit authority's judgment, the consideration of alternative production processes is warranted and appropriate for consideration in the BACT analysis. A production process is defined in terms of its physical and chemical unit operations used to produce the desired product from a specified

set of raw materials. In such cases, the permit agency may require the applicant to include the inherently lower-polluting process in the list of BACT candidates.

In many cases, a given production process or emissions unit can be made to be inherently less polluting (e.g; the use of water-based versus solvent based paints in a coating operation or a coal-fired boiler designed to have a low emission factor for NO_x). In such cases the ability of design considerations to make the process inherently less polluting must be considered as a control alternative for the source. Inherently lower-polluting processes/practice are usually more environmentally effective because of lower amounts of solid wastes and waste water than are generated with add-on controls. These factors are considered in the cost, energy and environmental impacts analyses in step 4 to determine the appropriateness of the additional add-on option.

Combinations of inherently lower-polluting processes/practices (or a process made to be inherently less polluting) and add-on controls are likely to yield more effective means of emissions control than either approach alone. Therefore, the option to utilize a inherently lower-polluting process does not, in and of itself, mean that no additional add-on controls need be included in the BACT analysis. These combinations should be identified in step 1 of the top down process for evaluation in subsequent steps.

IV.A.4. EXAMPLE

The process of identifying control technology alternatives (step 1 in the top-down BACT process) is illustrated in the following hypothetical example.

Description of Source

A PSD applicant proposes to install automated surface coating process equipment consisting of a dip-tank priming stage followed by a two-step spray application and bake-on enamel finish coat. The product is a specialized electronics component (resistor) with strict resistance property specifications that restrict the types of coatings that may be employed.

List of Control Options

The source is not covered by an applicable NSPS. A review of the BACT/LAER Clearinghouse and other appropriate references indicates the following control options may be applicable:

Option #1: water-based primer and finish coat;

[The water-based coatings have never been used in applications similar to this.]

Option #2: low-VOC solvent/high solids coating for primer and finish coat;

[The high solids/low VOC solvent coatings have recently been applied with success with similar products (e.g., other types of electrical components).]

Option #3: electrostatic spray application to enhance coating transfer efficiency; and

[Electrostatically enhanced coating application has been applied elsewhere on a clearly similar operation.]

Option #4: emissions capture with add-on control via incineration or carbon adsorber equipment.

[The VOC capture and control option (incineration or carbon adsorber) has been used in many cases involving the coating of different products and the emission stream characteristics are similar to the proposed resistor coating process and is identified as an option available through technology transfer.]

Since the low-solvent coating, electrostatically enhanced application, and ventilation with add-on control options may reasonably be considered for use in combination to achieve greater emissions reduction efficiency, a total of eight control options are eligible for further consideration. The options include each of the four options listed above and the following four combinations of techniques:

Option #5: **low-solvent coating with electrostatic applications without ventilation and add-on controls;**

Option #6: **low-solvent coating without electrostatic applications with ventilation and add-on controls;**

Option #7: **electrostatic application with add-on control; and**

Option #8: **a combination of all three technologies.**

A "no control" option also was identified but eliminated because the applicant's State regulations require at least a 75 percent reduction in VOC emissions for a source of this size. Because "no control" would not meet the State regulations it could not be BACT and, therefore, was not listed for consideration in the BACT analysis.

Summary of Key Points

The example illustrates several key guidelines for identifying control options. These include:

- All available control techniques must be considered in the BACT analysis.
- Technology transfer must be considered in identifying control options. The fact that a control option has never been applied to process emission units similar or identical to that proposed does not mean it can be ignored in the BACT analysis if the potential for its application exists.
- Combinations of techniques should be considered to the extent they result in more effective means of achieving stringent emissions levels represented by the "top" alternative, particularly if the "top" alternative is eliminated.

IV.B. TECHNICAL FEASIBILITY ANALYSIS (STEP 2)

In step 2, the technical feasibility of the control options identified in step 1 is evaluated. This step should be straightforward for control technologies that are demonstrated--if the control technology has been installed and operated successfully on the type of source under review, it is demonstrated and it is technically feasible. For control technologies that are not demonstrated in the sense indicated above, the analysis is somewhat more involved.

Two key concepts are important in determining whether an undemonstrated technology is feasible: "availability" and "applicability." As explained in more detail below, a technology is considered "available" if it can be obtained by the applicant through commercial channels or is otherwise available within the common sense meaning of the term. An available technology is "applicable" if it can reasonably be installed and operated on the source type under consideration. A technology that is available and applicable is technically feasible.

Availability in this context is further explained using the following process commonly used for bringing a control technology concept to reality as a commercial product:

- concept stage;
- research and patenting;
- bench scale or laboratory testing;
- pilot scale testing;
- licensing and commercial demonstration; and
- commercial sales.

A control technique is considered available, within the context presented above, if it has reached the licensing and commercial sales stage of development. A source would not be required to experience extended time delays or resource penalties to allow research to be conducted on a new technique. Neither is it expected that an applicant would be required to experience extended trials to learn how to apply a technology on a totally new and dissimilar source type. Consequently, technologies in the pilot scale testing stages of development would not be considered available for BACT review. An exception would be if the technology were proposed and permitted under the qualifications of an innovative control device consistent with the provisions of 40 CFR 52.21(v) or, where appropriate, the applicable SIP.

Commercial availability by itself, however, is not necessarily sufficient basis for concluding a technology to be applicable and therefore technically feasible. Technical feasibility, as determined in Step 2, also means a control option may reasonably be deployed on or "applicable" to the source type under consideration.

Technical judgment on the part of the applicant and the review authority is to be exercised in determining whether a control alternative is applicable to the source type under consideration. In general, a commercially available control option will be presumed applicable if it has been or is soon to be deployed (e.g., is specified in a permit) on the same or a similar source type. Absent a showing of this type, technical feasibility would be based on examination of the physical and chemical characteristics of the pollutant-bearing gas stream and comparison to the gas stream characteristics of the source types to which the technology had been applied previously. Deployment of the control technology on an existing source with similar gas stream characteristics is generally sufficient basis for concluding technical feasibility barring a demonstration to the contrary.

For process-type control alternatives the decision of whether or not it is applicable to the source in question would have to be based on an assessment of the similarities and differences between the proposed source and other sources to which the process technique had been applied previously. Absent an explanation of unusual circumstances by the applicant showing why a particular process cannot be used on the proposed source the review authority may presume it is technically feasible.

In practice, decisions about technical feasibility are within the purview of the review authority. Further, a presumption of technical feasibility may be made by the review authority based solely on technology transfer. For example, in the case of add-on controls, decisions of this type would be made by comparing the physical and chemical characteristics of the exhaust gas stream from the unit under review to those of the unit from which the technology is to be transferred. Unless significant differences between source types exist that are pertinent to the successful operation of the control device, the control option is presumed to be technically feasible unless the source can present information to the contrary.

Within the context of the top-down procedure, an applicant addresses the issue of technical feasibility in asserting that a control option identified in Step 1 is technically infeasible. In this instance, the applicant should make a factual demonstration of infeasibility based on commercial unavailability and/or unusual circumstances which exist with application of the control to the applicant's emission units. Generally, such a demonstration would involve an evaluation of the pollutant-bearing gas stream characteristics and the capabilities of the technology. Also a showing of unresolvable technical difficulty with applying the control would constitute a showing of technical infeasibility (e.g., size of the unit, location of the proposed site, and operating problems related to specific circumstances of the source). Where the resolution of technical difficulties is a matter of cost, the applicant should consider the technology as technically feasible. The economic feasibility of a control alternative is reviewed in the economic impacts portion of the BACT selection process.

A demonstration of technical infeasibility is based on a technical assessment considering physical, chemical and engineering principles and/or empirical data showing that the technology would not work on the emissions unit under review, or that unresolvable technical difficulties would preclude the successful deployment of the technique. Physical modifications needed to resolve technical obstacles do not in and of themselves provide a justification for eliminating the control technique on the basis of technical infeasibility. However, the cost of such modifications can be considered in estimating cost and economic impacts which, in turn, may form the basis for eliminating a control technology (see later discussion at V.D.2).

Vendor guarantees may provide an indication of commercial availability and the technical feasibility of a control technique and could contribute to a determination of technical feasibility or technical infeasibility, depending on circumstances. However, EPA does not consider a vendor guarantee alone to be sufficient justification that a control option will work. Conversely, lack of a vendor guarantee by itself does not present sufficient justification that a control option or an emissions limit is technically infeasible. Generally, decisions about technical feasibility will be based on chemical, and engineering analyses (as discussed above) in conjunction with information about vendor guarantees.

A possible outcome of the top-down BACT procedures discussed in this document is the evaluation of multiple control technology alternatives which result in essentially equivalent emissions. It is not EPA's intent to encourage evaluation of unnecessarily large numbers of control alternatives for every emissions unit. Consequently, judgment should be used in deciding what alternatives will be evaluated in detail in the impacts analysis (Step 4) of the top-down procedure discussed in a later section. For example, if two or more control techniques result in control levels that are essentially identical considering the uncertainties of emissions factors and other parameters pertinent to estimating performance, the source may wish to point this out and make a case for evaluation and use only of the less costly of these options. The scope of the BACT analysis should be narrowed in this way

only if there is a negligible difference in emissions and collateral environmental impacts between control alternatives. Such cases should be discussed with the reviewing agency before a control alternative is dismissed at this point in the BACT analysis due to such considerations.

It is encouraged that judgments of this type be discussed during a preapplication meeting between the applicant and the review authority. In this way, the applicant can be better assured that the analysis to be conducted will meet BACT requirements. The appropriate time to hold such a meeting during the analysis is following the completion of the control hierarchy discussed in the next section.

Summary of Key Points

In summary, important points to remember in assessing technical feasibility of control alternatives include:

- A control technology that is "demonstrated" for a given type or class of sources is assumed to be technically feasible unless source-specific factors exist and are documented to justify technical infeasibility.
- Technical feasibility of technology transfer control candidates generally is assessed based on an evaluation of pollutant-bearing gas stream characteristics for the proposed source and other source types to which the control had been applied previously.
- Innovative controls that have not been demonstrated on any source type similar to the proposed source need not be considered in the BACT analysis.
- The applicant is responsible for providing a basis for assessing technical feasibility or infeasibility and the review authority is responsible for the decision on what is and is not technically feasible.

IV.C. RANKING THE TECHNICALLY FEASIBLE ALTERNATIVES TO ESTABLISH A CONTROL HIERARCHY (STEP 3)

Step 3 involves ranking all the technically feasible control alternatives which have been previously identified in Step 2. For the regulated pollutant and emissions unit under review, the control alternatives are ranked-ordered from the most to the least effective in terms of emission reduction potential. Later, once the control technology is determined, the focus shifts to the specific limits to be met by the source.

Two key issues that must be addressed in this process include:

- What common units should be used to compare emissions performance levels among options?
- How should control techniques that can operate over a wide range of emission performance levels (e.g., scrubbers, etc.) be considered in the analysis?

IV.C.1. CHOICE OF UNITS OF EMISSIONS PERFORMANCE TO COMPARE LEVELS AMONGST CONTROL OPTIONS

In general, this issue arises when comparing inherently lower-polluting processes to one another or to add-on controls. For example, direct comparison of powdered (and low-VOC) coatings and vapor recovery and control systems at a metal furniture finishing operation is difficult because of the different units of measure for their effectiveness. In such cases, it is generally most effective to express emissions performance as an average steady state emissions level per unit of product produced or processed. Examples are:

- pounds VOC emission per gallons of solids applied,
- pounds PM emission per ton of cement produced,
- pounds SO2 emissions per million Btu heat input, and
- pounds SO2 emission per kilowatt of electric power produced,

Calculating annual emissions levels (tons/yr) using these units becomes straightforward once the projected annual production or processing rates are known. The result is an estimate of the annual pollutant emissions that the source or emissions unit will emit. Annual "potential" emission projections are calculated using the source's maximum design capacity and full year round operation (8760 hours), unless the final permit is to include federally enforceable conditions restricting the source's capacity or hours of operation. However, emissions estimates used for the purpose of calculating and comparing the cost effectiveness of a control option are based on a different approach (see section V.D.2.b. COST EFFECTIVENESS).

IV.C.2. CONTROL TECHNIQUES WITH A WIDE RANGE OF EMISSIONS PERFORMANCE LEVELS

The objective of the top-down BACT analysis is to not only identify the best control technology, but also a corresponding performance level (or in some cases performance range) for that technology considering source-specific factors. Many control techniques, including both add-on controls and inherently lower polluting processes can perform at a wide range of levels. Scrubbers, high and low efficiency electrostatic precipitators (ESPs), and low-VOC coatings are examples of just a few. It is not the EPA's intention to require analysis of each possible level of efficiency for a control technique, as such an analysis would result in a large number of options. Rather, the applicant should use the most recent regulatory decisions and performance data for identifying the emissions performance level(s) to be evaluated in all cases.

The EPA does not expect an applicant to necessarily accept an emission limit as BACT solely because it was required previously of a similar source type. While the most effective level of control must be considered in the

BACT analysis, different levels of control for a given control alternative can be considered.¹ For example, the consideration of a lower level of control for a given technology may be warranted in cases where past decisions involved different source types. The evaluation of an alternative control level can also be considered where the applicant can demonstrate to the satisfaction of the permit agency demonstrate that other considerations show the need to evaluate the control alternative at a lower level of effectiveness.

Manufacturer's data, engineering estimates and the experience of other sources provide the basis for determining achievable limits. Consequently, in assessing the capability of the control alternative, latitude exists to consider any special circumstances pertinent to the specific source under review, or regarding the prior application of the control alternative. However, the basis for choosing the alternate level (or range) of control in the BACT analysis must be documented in the application. In the absence of a showing of differences between the proposed source and previously permitted sources achieving lower emissions limits, the permit agency should conclude that the lower emissions limit is representative for that control alternative.

In summary, when reviewing a control technology with a wide range of emission performance levels, it is presumed that the source can achieve the same emission reduction level as another source unless the applicant demonstrates that there are source-specific factors or other relevant information that provide a technical, economic, energy or environmental justification to do otherwise. Also, a control technology that has been eliminated as having an adverse economic impact at its highest level of performance, may be acceptable at a lesser level of performance. For example, this can occur when the cost effectiveness of a control technology at its

¹ In reviewing the BACT submittal by a source the permit agency may determine that an applicant should consider a control technology alternative otherwise eliminated by the applicant, if the operation of that control technology at a lower level of control (but still higher than the next control alternative. For example, while scrubber operating at 98% efficiency may be eliminated as BACT by the applicant due to source specific economic considerations, the scrubber operating in the 90% to 95% efficiency range may not have an adverse economic impact.

highest level of performance greatly exceeds the cost of that control technology at a somewhat lower level (or range) of performance.

IV.C.3. ESTABLISHMENT OF THE CONTROL OPTIONS HIERARCHY

After determining the emissions performance levels (in common units) of each control technology option identified in Step 2, a hierarchy is established that places at the "top" the control technology option that achieves the lowest emissions level. Each other control option is then placed after the "top" in the hierarchy by its respective emissions performance level, ranked from lowest emissions to highest emissions (most effective to least stringent effective emissions control alternative).

From the hierarchy of control alternatives the applicant should develop a chart (or charts) displaying the control hierarchy and, where applicable,:

- expected emission rate (tons per year, pounds per hour);
- emissions performance level (e.g., percent pollutant removed, emissions per unit product, lb/MMbtu, ppm);
- expected emissions reduction (tons per year);
- economic impacts (total annualized costs, cost effectiveness, incremental cost effectiveness);
- environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and the relative ability of each control alternative to control emissions of toxic or hazardous air contaminants);
- energy impacts (indicate any significant energy benefits or disadvantages).

This should be done for each pollutant and for each emissions unit (or grouping of similar units) subject to a BACT analysis. The chart is used in comparing the control alternatives during step 4 of the BACT selection process. Some sample charts are displayed in Table B-2 and Table B-3. Completed sample charts accompany the example BACT analyses provided in section VI.

At this point, it is recommended that the applicant contact the reviewing agency to determine whether the agency feels that any other applicable control alternative should be evaluated or if any issues require special attention in the BACT selection process.

IV.D. THE BACT SELECTION PROCESS (STEP 4)

After identifying and listing the available control options the next step is the determination of the energy, environmental, and economic impacts of each option and the selection of the final level of control. The applicant is responsible for presenting an evaluation of each impact along with appropriate supporting information. Consequently, both beneficial and adverse impacts should be discussed and, where possible, quantified. In general, the BACT analysis should focus on the direct impact of the control alternative.

Step 4 validates the suitability of the top control option in the listing for selection as BACT, or provides clear justification why the top candidate is inappropriate as BACT. If the applicant accepts the top alternative in the listing as BACT from an economic and energy standpoint, the applicant proceeds to consider whether collateral environmental impacts (e.g., emissions of unregulated air pollutants or impacts in other media) would justify selection of an alternative control option. If there are no outstanding issues regarding collateral environmental impacts, the analysis is ended and the results proposed as BACT. In the event that the top candidate

TABLE B-2. SAMPLE BACT CONTROL HIERARCHY

Pollutant	Technology	Range of control (%)	Control level for BACT analysis (%)	Emissions limit
SO ₂	First Alternative	80-95	95	15 ppm
	Second Alternative	80-95	90	30 ppm
	Third Alternative	70-85	85	45 ppm
	Fourth Alternative	40-80	75	75 ppm
	Fifth Alternative	50-85	70	90 ppm
	Baseline Alternative	-	-	-

TABLE B-3. SAMPLE SUMMARY OF TOP-DOWN BACT IMPACT ANALYSIS RESULTS

Pollutant/ Emissions Unit	Control alternative	Emissions (lb/hr, tpy)	Emissions reduction(a) (tpy)	Economic Impacts			Environmental Impacts		Energy Impacts
				Total annualized cost(b) (\$/yr)	Average Cost effectiveness(c) (\$/ton)	Incremental cost effectiveness(d) (\$/ton)	Toxics impact(e) (Yes/No)	Adverse environmental impacts(f) (Yes/No)	Incremental increase over baseline(g) (MMBtu/yr)
NOx/Unit A	Top Alternative Other Alternative(s) Baseline								
NOx/Unit B	Top Alternative Other Alternative(s) Baseline								
SO2/Unit A	Top Alternative Other Alternative(s) Baseline								
SO2/Unit B	Top Alternative Other Alternative(s) Baseline								

(a) Emissions reduction over baseline level.

(b) Total annualized cost (capital, direct, and indirect) of purchasing, installing, and operating the proposed control alternative. A capital recovery factor approach using a real interest rate (i.e., absent inflation) is used to express capital costs in present-day annual costs.

(c) Average Cost Effectiveness is total annualized cost for the control option divided by the emissions reductions resulting from the option.

(d) The incremental cost effectiveness is the difference in annualized cost for the control option and the next most effective control option divided by the difference in emissions reduction resulting from the respective alternatives.

(e) Toxics impact means there is a toxics impact consideration for the control alternative.

(f) Adverse environmental impact means there is an adverse environmental impact consideration with the control alternative.

(g) Energy impacts are the difference in total project energy requirements with the control alternative and the baseline expressed in equivalent millions of Btus per year.

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is shown to be inappropriate, due to energy, environmental, or economic impacts, the rationale for this finding needs to be fully documented for the public record. Then, the next most effective alternative in the listing becomes the new control candidate and is similarly evaluated. This process continues until the control technology under consideration cannot be eliminated by any source-specific environmental, energy, or economic impacts which demonstrate that the alternative is inappropriate as BACT.

The determination that a control alternative to be inappropriate involves a demonstration that circumstances exist at the source which distinguish it from other sources where the control alternative may have been required previously, or that argue against the transfer of technology or application of new technology. Alternately, where a control technique has been applied to only one or a very limited number of sources, the applicant can identify those characteristic(s) unique to those sources that may have made the application of the control appropriate in those case(s) but not for the source under consideration. In showing unusual circumstances, objective factors dealing with the control technology and its application should be the focus of the consideration. The specifics of the situation will determine to what extent an appropriate demonstration has been made regarding the elimination of the more effective alternative(s) as BACT. In the absence of unusual circumstance, the presumption is that sources within the same category are similar in nature, and that cost and other impacts that have been borne by one source of a given source category may be borne by another source of the same source category.

IV.D.1. ENERGY IMPACTS ANALYSIS

Applicants should examine the energy requirements of the control technology and determine whether the use of that technology results in any significant or unusual energy penalties or benefits. A source may, for example, benefit from the combustion of a concentrated gas stream rich in volatile organic compounds; on the other hand, more often extra fuel or electricity is required to power a control device or incinerate a dilute gas stream. If such benefits or penalties exist, they should be quantified. Because energy penalties or benefits can usually be quantified in terms of

additional cost or income to the source, the energy impacts analysis can, in most cases, simply be factored into the economic impacts analysis. However, certain types of control technologies have inherent energy penalties associated with their use. While these penalties should be quantified, so long as they are within the normal range for the technology in question, such penalties should not, in general, be considered adequate justification for nonuse of that technology.

Energy impacts should consider only direct energy consumption and not indirect energy impacts. For example, the applicant could estimate the direct energy impacts of the control alternative in units of energy consumption at the source (e.g., Btu, kWh, barrels of oil, tons of coal). The energy requirements of the control options should be shown in terms of total (and in certain cases also incremental) energy costs per ton of pollutant removed. These units can then be converted into dollar costs and, where appropriate, factored into the economic analysis.

As noted earlier, indirect energy impacts (such as energy to produce raw materials for construction of control equipment) generally are not considered. However, if the permit authority determines, either independently or based on a showing by the applicant, that the indirect energy impact is unusual or significant and that the impact can be well quantified, the indirect impact may be considered. The energy impact should still focus on the application of the control alternative and not a concern over general energy impacts associated with the project under review as compared to alternative projects for which a permit is not being sought, or as compared to a pollution source which the project under review would replace (e.g., it would be inappropriate to argue that a cogeneration project is more efficient in the production of electricity than the powerplant production capacity it would displace and, therefore, should not be required to spend equivalent costs for the control of the same pollutant).

The energy impact analysis may also address concerns over the use of locally scarce fuels. The designation of a scarce fuel may vary from region to region, but in general a scarce fuel is one which is in short supply

locally and can be better used for alternative purposes, or one which may not be reasonably available to the source either at the present time or in the near future.

IV.D.2. COST/ECONOMIC IMPACTS ANALYSIS

Average and incremental cost effectiveness are the two economic criteria that are considered in the BACT analysis. Cost effectiveness, is the dollars per ton of pollutant emissions reduced. Incremental cost is the cost per ton reduced and should be considered in conjunction with total average effectiveness.

In the economical impacts analysis, primary consideration should be given to quantifying the cost of control and not the economic situation of the individual source. Consequently, applicants generally should not propose elimination of control alternatives on the basis of economic parameters that provide an indication of the affordability of a control alternative relative to the source. BACT is required by law. Its costs are integral to the overall cost of doing business and are not to be considered an afterthought. Consequently, for control alternatives that have been effectively employed in the same source category, the economic impact of such alternatives on the particular source under review should be not nearly as pertinent to the BACT decision making process as the average and, where appropriate, incremental cost effectiveness of the control alternative. Thus, where a control technology has been successfully applied to similar sources in a source category, an applicant should concentrate on documenting significant cost differences, if **any**, between the application of the control technology on those other sources and the particular source under review.

Cost effectiveness (dollars per ton of pollutant reduced) values above the levels experienced by other sources of the same type and pollutant, are taken as an indication that unusual and persuasive differences exist with respect to the source under review. In addition, where the cost of a control alternative for the specific source reviewed is within the range of normal costs for that control alternative, the alternative, in certain limited circumstances, may still be eligible for elimination. To justify elimination

of an alternative on these grounds, the applicant should demonstrate to the satisfaction of the permitting agency that costs of pollutant removal for the control alternative are disproportionately high when compared to the cost of control for that particular pollutant and source in recent BACT determinations. If the circumstances of the differences are adequately documented and explained in the application and are acceptable to the reviewing agency they may provide a basis for eliminating the control alternative.

In all cases, economic impacts need to be considered in conjunction with energy and environmental impacts (e.g., toxics and hazardous pollutant considerations) in selecting BACT. It is possible that the environmental impacts analysis or other considerations (as described elsewhere) would override the economic elimination criteria as described in this section. However, absent overriding environmental impacts concerns or other considerations, an acceptable demonstration of a adverse economic impact can be adequate basis for eliminating the control alternative.

IV.D.2.a. ESTIMATING THE COSTS OF CONTROL

Before costs can be estimated, the control system design parameters must be specified. The most important item here is to ensure that the design parameters used in costing are consistent with emissions estimates used in other portions of the PSD application (e.g., dispersion modeling inputs and permit emission limits). In general, the BACT analysis should present vendor-supplied design parameters. Potential sources of other data on design parameters are BID documents used to support NSPS development, control technique guidelines documents, cost manuals developed by EPA, or control data in trade publications. Table B-4 presents some example design parameters which are important in determining system costs.

To begin, the limits of the area or process segment to be costed specified. This well defined area or process segment is referred to as the control system battery limits. The second step is to list and cost each major piece of equipment within the battery limits. The top-down BACT analysis should provide this list of costed equipment. The basis for equipment cost estimates also should be documented, either with data supplied by an equipment vendor (i.e., budget estimates or bids) or by a referenced source [such as the OAQPS Control Cost Manual (Fourth Edition), EPA 450/3-90-006, January 1990, Table B-4]. Inadequate documentation of battery limits is one of the most common reasons for confusion in comparison of costs of the same controls applied to similar sources. For control options that are defined as inherently lower-polluting processes (and not add-on controls), the battery limits may be the entire process or project.

Design parameters should correspond to the specified emission level. The equipment vendors will usually supply the design parameters to the applicant, who in turn should provide them to the reviewing agency. In order to determine if the design is reasonable, the design parameters can be compared with those shown in documents such as the OAQPS Control Cost Manual, Control Technology for Hazardous Air Pollutants (HAPS) Manual (EPA 625/6-86-014, September 1986), and background information documents for NSPS and NESHAP regulations. If the design specified does not appear reasonable, then the applicant should be requested to supply performance test data for the control technology in question applied to the same source, or a similar source.

TABLE B-4. EXAMPLE CONTROL SYSTEM DESIGN PARAMETERS

Control	Example Design parameters
Wet Scrubbers	Scrubber liquor (water, chemicals, etc.) Gas pressure drop Liquid/gas ratio
Carbon Absorbers	Specific chemical species Gas pressure drop lbs carbon/lbs pollutant
Condensers	Condenser type Outlet temperature
Incineration	Residence time Temperature
Electrostatic Precipitator	Specific collection area (ft ² /acfm) Voltage density
Fabric Filter	Air to cloth ratio Pressure drop
Selective Catalytic Reduction	Space velocity Ammonia to NO _x molar ratio Pressure drop Catalyst life

Once the control technology alternatives and achievable emissions performance levels have been identified, capital and annual costs are developed. These costs form the basis of the cost and economic impacts (discussed later) used to determine and document if a control alternative should be eliminated on grounds of its economic impacts.

Consistency in the approach to decision-making is a primary objective of the top-down BACT approach. In order to maintain and improve the consistency of BACT decisions made on the basis of cost and economic considerations, procedures for estimating control equipment costs are based on EPA's OAQPS Control cost Manual and are set forth in Appendix B of this document. Applicants should closely follow the procedures in the appendix and any deviations should be clearly presented and justified in the documentation of the BACT analysis.

Normally the submittal of very detailed and comprehensive project cost data is not necessary. However, where initial control cost projections on the part of the applicant appear excessive or unreasonable (in light of recent cost data) more detailed and comprehensive cost data may be necessary to document the applicant's projections. An applicant proposing the top alternative usually does not need to provide cost data on the other possible control alternatives.

Total cost estimates of options developed for BACT analyses should be on order of plus or minus 30 percent accuracy. If more accurate cost data are available (such as specific bid estimates), these should be used. However, these types of costs may not be available at the time permit applications are being prepared. Costs should also be site specific. Some site specific factors are costs of raw materials (fuel, water, chemicals) and labor. For example, in some remote areas costs can be unusually high. For example, remote locations in Alaska may experience a 40-50 percent premium on installation costs. The applicant should document any unusual costing assumptions used in the analysis.

IV.D.2.b. COST EFFECTIVENESS

Cost effectiveness is the economic criterion used to assess the potential for achieving an objective at least cost. Effectiveness is measured in terms of tons of pollutant emissions removed. Cost is measured in terms of annualized control costs.

The Cost effectiveness calculations can be conducted on an average, or incremental basis. The resultant dollar figures are sensitive to the number of alternatives costed as well as the underlying engineering and cost parameters. There are limits to the use of cost-effectiveness analysis. For example, cost-effectiveness analysis should not be used to set the environmental objective. Second, cost-effectiveness should, in and of itself, not be construed as a measure of adverse economic impacts. There are two measures of cost-effectiveness that will be discussed in this section: (1) average cost-effectiveness, and (2) incremental cost-effectiveness.

Average Cost Effectiveness

Average cost effectiveness (total annualized costs of control divided by annual emission reductions, or the difference between the baseline emission rate and the controlled emission rate) is a way to present the costs of control. Average cost effectiveness is calculated as shown by the following formula:

Average cost Effectiveness (dollars per ton removed) =

$$\frac{\text{Control option annualized cost}}{\text{Baseline emissions rate} - \text{Control option emissions rate}}$$

Costs are calculated in (annualized) dollars per year (\$/yr) and emissions rates are calculated in tons per year (tons/yr). The result is a cost effectiveness number in (annualized) dollars per ton (\$/ton) of pollutant removed.

Calculating Baseline Emissions

The baseline emissions rate represents a realistic scenario of upper boundary uncontrolled emissions for the source. The NSPS/NESHAP requirements or the application of controls, including other controls necessary to comply with State or local air pollution regulations, are not considered in calculating the baseline emissions. In other words, baseline emissions are essentially uncontrolled emissions, calculated using realistic upper boundary operating assumptions. When calculating the cost effectiveness of adding post process emissions controls to certain inherently lower polluting processes, baseline emissions may be assumed to be the emissions from the lower polluting process itself. In other words, emission reduction credit can be taken for use of inherently lower polluting processes.

Estimating realistic upper-bound case scenario does not mean that the source operates in an absolute worst case manner all the time. For example, in developing a realistic upper boundary case, baseline emissions calculations can also consider inherent physical or operational constraints on the source. Such constraints should accurately reflect the true upper boundary of the source's ability to physically operate and the applicant should submit documentation to verify these constraints. If the applicant does not adequately verify these constraints, then the reviewing agency should not be compelled to consider these constraints in calculating baseline emissions. In addition, the reviewing agency may require the applicant to calculate cost

effectiveness based on values exceeding the upper boundary assumptions to determine whether or not the assumptions have a deciding role in the BACT determination. If the assumptions have a deciding role in the BACT determination, the reviewing agency should include enforceable conditions in the permit to assure that the upper bound assumptions are not exceeded.

For example, VOC emissions from a storage tank might vary significantly with temperature, volatility of liquid stored, and throughput. In this case, potential emissions would be overestimated if annual VOC emissions were estimated by extrapolating over the course of a year VOC emissions based solely on the hottest summer day. Instead, the range of expected temperatures should be considered in determining annual baseline emissions. Likewise, potential emissions would be overestimated if one assumed that gasoline would be stored in a storage tank being built to feed an oil-fired power boiler or such a tank will be continually filled and emptied. On the other hand, an upper bound case for a storage tank being constructed to store and transfer liquid fuels at a marine terminal should consider emissions based on the most volatile liquids at a high annual throughput level since it would not be unrealistic for the tank to operate in such a manner.

In addition, historic upper bound operating data, typical for the source or industry, may be used in defining baseline emissions in evaluating the cost effectiveness of a control option for a specific source. For example, if for a source or industry, historical upper bound operations call for two shifts a day, it is not necessary to assume full time (8760 hours) operation on an annual basis in calculating baseline emissions. For comparing cost effectiveness, the same realistic upper boundary assumptions must, however, be used for both the source in question and other sources (or source categories) that will later be compared during the BACT analysis.

For example, suppose (based on verified historic data regarding the industry in question) a given source can be expected to utilize numerous colored inks over the course of a year. Each color ink has a different VOC content ranging from a high VOC content to a relatively low VOC content. The source verifies that its operation will indeed call for the application of numerous color inks. In this case, it is more realistic for the baseline

emission calculation for the source (and other similar sources) to be based on the expected mix of inks that would be expected to result in an upper boundary case annual VOC emissions rather than an assumption that only one color (i.e., the ink with the highest VOC content) will be applied exclusively during the whole year.

In another example, suppose sources in a particular industry historically operate at most at 85 percent capacity. For BACT cost effectiveness purposes (but **not** for applicability), an applicant may calculate cost effectiveness using 85 percent capacity. However, in comparing costs with similar sources, the applicant must consistently use an 85 percent capacity factor for the cost effectiveness of controls on those other sources.

Although permit conditions are normally used to make operating assumptions enforceable, the use of "standard industry practice" parameters for cost effectiveness calculations (but **not** applicability determinations) can be acceptable without permit conditions. However, when a source projects operating parameters (e.g., limited hours of operation or capacity utilization, type of fuel, raw materials or product mix or type) that are lower than standard industry practice or which have a deciding role in the BACT determination, then these parameters or assumptions must be made enforceable with permit conditions. If the applicant will not accept enforceable permit conditions, then the reviewing agency should use the absolute worst case uncontrolled emissions in calculating baseline emissions. This is necessary to ensure that the permit reflects the conditions under which the source intends to operate.

For example, the baseline emissions calculation for an emergency standby generator may consider the fact that the source does not intend to operate more than 2 weeks a year. On the other hand, baseline emissions associated with a base-loaded turbine would not consider limited hours of operation. This produces a significantly higher level of baseline emissions than in the case of the emergency/standby unit and results in more cost effective controls. As a consequence of the dissimilar baseline emissions, BACT for the

two cases could be very different. Therefore, it is important that the applicant confirm that the operational assumptions used to define the source's baseline emissions (and BACT) are genuine. As previously mentioned, this is usually done through enforceable permit conditions which reflect limits on the source's operation which were used to calculate baseline emissions.

In certain cases, such explicit permit conditions may not be necessary. For example, a source for which continuous operation would be a physical impossibility (by virtue of its design) may consider this limitation in estimating baseline emissions, without a direct permit limit on operations. However, the permit agency has the responsibility to verify that the source is constructed and operated consistent with the information and design specifications contained in the permit application.

For some sources it may be more difficult to define what emissions level actually represents uncontrolled emissions in calculating baseline emissions. For example, uncontrolled emissions could theoretically be defined for a spray coating operation as the maximum VOC content coating at the highest possible rate of application that the spray equipment could physically process, (even though use of such a coating or application rate would be unrealistic for the source). Assuming use of a coating with a VOC content and application rate greater than expected is unrealistic and would result in an overestimate in the amount of emissions reductions to be achieved by the installation of various control options. Likewise, the cost effectiveness of the options could consequently be greatly underestimated. To avoid these problems, uncontrolled emission factors should be represented by the highest realistic VOC content of the types of coatings and highest realistic application rates that would be used by the source, rather than by highest VOC based coating materials or rate of application in general.

Conversely, if uncontrolled emissions are underestimated, emissions reductions to be achieved by the various control options would also be underestimated and their cost effectiveness overestimated. For example, this type of situation occurs in the previous example if the baseline for the above

coating operation was based on a VOC content coating or application rate that is too low [when the source had the ability and intent to utilize (even infrequently) a higher VOC content coating or application rate].

Incremental Cost Effectiveness

In addition to the average cost effectiveness of a control option, incremental cost effectiveness between control options should also be calculated. The incremental cost effectiveness should be examined in combination with the total cost effectiveness in order to justify elimination of a control option. The incremental cost effectiveness calculation compares the costs and emissions performance level of a control option to those of the next most stringent option, as shown in the following formula:

$$\text{Incremental Cost (dollars per incremental ton removed) =} \\ \frac{\text{Total costs (annualized) of control option} - \text{Total costs (annualized) of next control option}}{\text{Next control option emission rate} - \text{Control option emissions rate}}$$

Care should be exercised in deriving incremental costs of candidate control options. Incremental cost-effectiveness comparisons should focus on annualized cost and emission reduction differences between **dominant** alternatives. Dominant set of control alternatives are determined by generating what is called the envelope of least-cost alternatives. This is a graphical plot of total annualized costs for a total emissions reductions for all control alternatives identified in the BACT analysis (see Figure B-1).

For example, assume that eight technically available control options for analysis are listed in the BACT hierarchy. These are represented as A through H in Figure B-1. In calculating incremental costs, the analysis should only be conducted for control options that are dominant among all possible options. In Figure B-1, the dominant set of control options, A, B, D, F, G, and H, represent the least-cost envelope depicted by the curvilinear line connecting them. Points C and E are inferior options and should not be considered in the

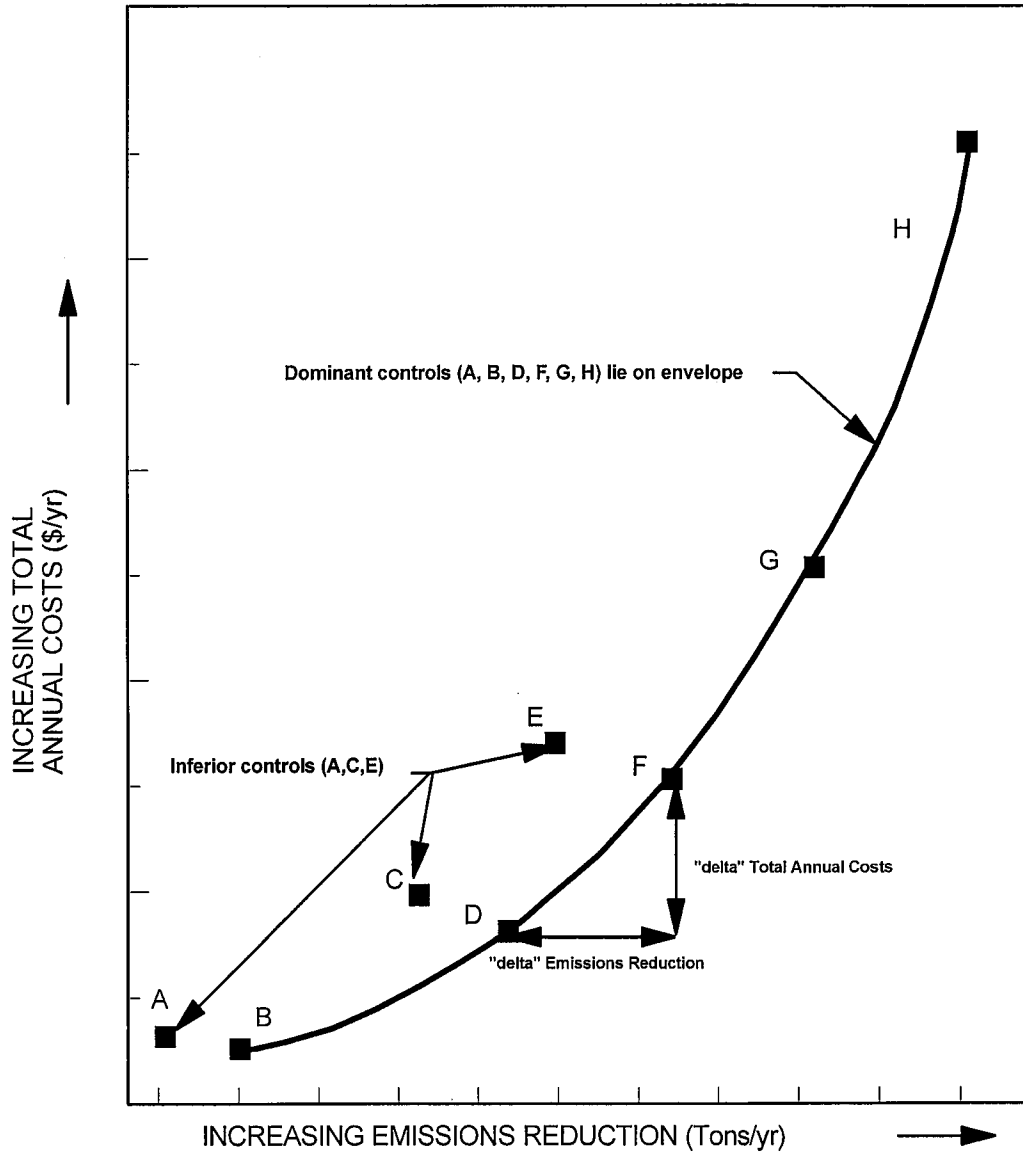


Figure B-1. LEAST-COST ENVELOPE

derivation of incremental cost effectiveness. Points A, C and E represent inferior controls because B will buy more emissions reduction for less money than A; and similarly, D and F will buy more reductions for less money than E, respectively.

Consequently, care should be taken in selecting the dominant set of controls when calculating incremental costs. First, the control options need to be rank ordered in ascending order of annualized total costs. Then, as Figure B-1 illustrates, the most reasonable smooth curve of the control options is plotted. The incremental cost effectiveness is then determined by the difference in total annual costs between two contiguous options divided by the difference in emissions reduction. An example is illustrated in Figure B-1 for the incremental cost effectiveness for control option F. The vertical distance, "delta" Total Costs Annualized, divided by the horizontal distance, "delta" Emissions Reduced (tpy), would be the measure of the incremental cost effectiveness for option F.

A comparison of incremental costs can also be useful in evaluating the economic viability of a specific control option over a range of efficiencies. For example, depending on the capital and operational cost of a control device, total and incremental cost may vary significantly (either increasing or decreasing) over the operation range of a control device.

As a precaution, differences in incremental costs among dominant alternatives cannot be used by itself to argue one dominant alternative is preferred to another. For example, suppose dominant alternative is preferred to another. For example, suppose dominant alternatives B, D and F on the least-cost envelope (see Figure B-1) are identified as alternatives for a BACT analysis. We may observe the incremental cost effectiveness between dominant alternative B and D is \$500 per ton whereas between dominant alternative D and F is \$1000 per ton. Alternative D does not dominate alternative F. Both alternatives are dominant and hence on the least cost envelope. Alternative D cannot legitimately be preferred to F on grounds of incremental cost effectiveness.

In addition, when evaluating the total or incremental cost effectiveness of a control alternative, reasonable and supportable assumptions regarding control efficiencies should be made. An unrealistically low assessment of the emission reduction potential of a certain technology could result in inflated cost effectiveness figures.

The final decision regarding the reasonableness of calculated cost effectiveness values will be made by the review authority considering previous regulatory decisions. Study cost estimates used in BACT are typically accurate to ± 20 to 30 percent. Therefore, control cost options which are within ± 20 to 30 percent of each other should generally be considered to be indistinguishable when comparing options.

IV.D.2.c. DETERMINING AN ADVERSE ECONOMIC IMPACT

It is important to keep in mind that BACT is primarily a technology-based standard. In essence, if the cost of reducing emissions with the top control alternative, expressed in dollars per ton, is on the same order as the cost previously borne by other sources of the same type in applying that control alternative, the alternative should initially be considered economically achievable, and therefore acceptable as BACT. However, unusual circumstances may greatly affect the cost of controls in a specific application. If so they should be documented. An example of an unusual circumstance might be the unavailability in an arid region of the large amounts of water needed for a scrubbing system. Acquiring water from a distant location might add unreasonable costs to the alternative, thereby justifying its elimination on economic grounds. Consequently, where unusual factors exist that result in cost/economic impacts beyond the range normally incurred by other sources in that category, the technology can be eliminated provided the applicant has adequately identified the circumstances, including the cost or other analyses, that show what is significantly different about the proposed source.

Where the cost of a control alternative for the specific source being reviewed is within the range of normal costs for that control alternative, the

alternative may also be eligible for elimination in limited circumstances. This may occur, for example, where a control alternative has not been required as BACT (or its application as BACT has been extremely limited) and there is a clear demarcation between recent BACT control costs in that source category and the control costs for sources in that source category which have been driven by other constraining factors (e.g., need to meet a PSD increment or a NAAQS).

To justify elimination of an alternative on these grounds, the applicant should demonstrate to the satisfaction of the permitting agency that costs of pollutant removal (e.g., dollars per total ton removed) for the control alternative are disproportionately high when compared to the cost of control for the pollutant in recent BACT determinations. Specifically, the applicant should document that the cost to the applicant of the control alternative is significantly beyond the range of recent costs normally associated with BACT for the type of facility (or BACT control costs in general) for the pollutant. This type of analysis should demonstrate that a technically and economically feasible control option is nevertheless, by virtue of the magnitude of its associated costs and limited application, unreasonable or otherwise not "achievable" as BACT in the particular case. Total and incremental cost effectiveness numbers are factored into this type of analysis. However, such economic information should be coupled with a comprehensive demonstration, based on objective factors, that the technology is inappropriate in the specific circumstance.

The economic impact portion of the BACT analysis should not focus on inappropriate factors or exclude pertinent factors, as the results may be misleading. For example, the capital cost of a control option may appear excessive when presented by itself or as a percentage of the total project cost. However, this type of information can be misleading. If a large emissions reduction is projected, low or reasonable cost effectiveness numbers may validate the option as an appropriate BACT alternative irrespective of the apparent high capital costs. In another example, undue focus on incremental cost effectiveness can give an impression that the cost of a control

alternative is unreasonably high, when, in fact, the total cost effectiveness, in terms of dollars per total ton removed, is well within the normal range of acceptable BACT costs.

IV.D.3. ENVIRONMENTAL IMPACTS ANALYSIS

The environmental impacts analysis is not to be confused with the air quality impact analysis (i.e., ambient concentrations), which is an independent statutory and regulatory requirement and is conducted separately from the BACT analysis. The purpose of the air quality analysis is to demonstrate that the source (using the level of control ultimately determined to be BACT) will not cause or contribute to a violation of any applicable national ambient air quality standard or PSD increment. Thus, regardless of the level of control proposed as BACT, a permit cannot be issued to a source that would cause or contribute to such a violation. In contrast, the environmental impacts portion of the BACT analysis concentrates on impacts other than impacts on air quality (i.e., ambient concentrations) due to emissions of the regulated pollutant in question, such as solid or hazardous waste generation, discharges of polluted water from a control device, visibility impacts, or emissions of unregulated pollutants.

Thus, the fact that a given control alternative would result in only a slight decrease in ambient concentrations of the pollutant in question when compared to a less stringent control alternative should not be viewed as an adverse **environmental** impact justifying rejection of the more stringent control alternative. However, if the cost effectiveness of the more stringent alternative is exceptionally high, it may (as provided in section V.D.2.) be considered in determining the existence of an adverse **economic** impact that would justify rejection of the more stringent alternative.

The applicant should identify any significant or unusual environmental impacts associated with a control alternative that have the potential to affect the selection or elimination of a control alternative. Some control technologies may have potentially significant secondary (i.e., collateral) environmental impacts. Scrubber effluent, for example, may affect water quality and land use. Similarly, emissions of water vapor from technologies using cooling towers may affect local visibility. Other examples of secondary environmental impacts could include hazardous waste discharges, such as spent catalysts or contaminated carbon. Generally, these types of environmental concerns become important when sensitive site-specific receptors exist or when the incremental emissions reduction potential of the top control is only marginally greater than the next most effective option. However, the fact that a control device creates liquid and solid waste that must be disposed of does not necessarily argue against selection of that technology as BACT, particularly if the control device has been applied to similar facilities elsewhere and the solid or liquid waste problem under review is similar to those other applications. On the other hand, where the applicant can show that unusual circumstances at the proposed facility create greater problems than experienced elsewhere, this may provide a basis for the elimination of that control alternative as BACT.

The procedure for conducting an analysis of environmental impacts should be made based on a consideration of site-specific circumstances. In general, however, the analysis of environmental impacts starts with the identification and quantification of the solid, liquid, and gaseous discharges from the control device or devices under review. This analysis of environmental impacts should be performed for the entire hierarchy of technologies (even if the applicant proposes to adopt the "top", or most stringent, alternative). However, the analysis need only address those control alternatives with any significant or unusual environmental impacts that have the potential to affect the selection or elimination of a control alternative. Thus, the relative environmental impacts (both positive and negative) of the various alternatives can be compared with each other and the "top" alternative.

Initially, a qualitative or semi-quantitative screening is performed to narrow the analysis to discharges with potential for causing adverse environmental effects. Next, the mass and composition of any such discharges should be assessed and quantified to the extent possible, based on readily available information. Pertinent information about the public or environmental consequences of releasing these materials should also be assembled.

IV.D.3.a. EXAMPLES (Environmental Impacts)

The following paragraphs discuss some possible factors for considerations in evaluating the potential for an adverse other media impact.

- **Water Impact**

Relative quantities of water used and water pollutants produced and discharged as a result of use of each alternative emission control system relative to the "top" alternative would be identified. Where possible, the analysis would assess the effect on ground water and such local surface water quality parameters as ph, turbidity, dissolved oxygen, salinity, toxic chemical levels, temperature, and any other important considerations. The analysis should consider whether applicable water quality standards will be met and the availability and effectiveness of various techniques to reduce potential adverse effects.

- **Solid Waste Disposal Impact**

The quality and quantity of solid waste (e.g., sludges, solids) that must be stored and disposed of or recycled as a result of the application of each alternative emission control system would be compared with the quality and quantity of wastes created with the "top" emission control system. The composition and various other characteristics of the solid waste (such as permeability, water retention, rewatering of dried material, compression strength, leachability of dissolved ions, bulk density, ability to support vegetation growth and hazardous characteristics) which are significant with

regard to potential surface water pollution or transport into and contamination of subsurface waters or aquifers would be appropriate for consideration.

- **Irreversible or Irretrievable Commitment of Resources**

The BACT decision may consider the extent to which the alternative emission control systems may involve a trade-off between short-term environmental gains at the expense of long-term environmental losses and the extent to which the alternative systems may result in irreversible or irretrievable commitment of resources (for example, use of scarce water resources).

- **Other Environmental Impacts**

Significant differences in noise levels, radiant heat, or dissipated static electrical energy may be considered.

One environmental impact that could be examined is the trade-off between emissions of the various pollutants resulting from the application of a specific control technology. The use of certain control technologies may lead to increases in emissions of pollutants other than those the technology was designed to control. For example, the use of certain volatile organic compound (VOC) control technologies can increase nitrogen oxides (NOx) emissions. In this instance, the reviewing authority may want to give consideration to any relevant local air quality concern relative to the secondary pollutant (in this case NOx) in the region of the proposed source. For example, if the region in the example were nonattainment for NOx, a premium could be placed on the potential NOx impact. This could lead to elimination of the most stringent VOC technology (assuming it generated high quantities of NOx) in favor of one having less of an impact on ambient NOx concentrations. Another example is the potential for higher emissions of toxic and hazardous pollutants from a municipal waste combustor operating at a low flame temperature to reduce the formation of NOx. In this case the real concern to mitigate the emissions of toxic and hazardous emissions (via high

combustion temperatures) may well take precedent over mitigating NOx emissions through the use of a low flame temperature. However, in most cases (unless an overriding concern over the formation and impact of the secondary pollutant is clearly present as in the examples given), it is not expected that this type impact would affect the outcome of the decision.

Other examples of collateral environmental impacts would include hazardous waste discharges such as spent catalysts or contaminated carbon. Generally these types of environmental concerns become important when site-specific sensitive receptors exist or when the incremental emissions reduction potential of the top control option is only marginally greater than the next most effective option.

IV.D.3.b. CONSIDERATION OF EMISSIONS OF TOXIC AND HAZARDOUS AIR POLLUTANTS

The generation or reduction of toxic and hazardous emissions, including compounds not regulated under the Clean Air Act, are considered as part of the environmental impacts analysis. Pursuant to the EPA Administrator's decision in North County Resource Recovery Associates, PSD Appeal No. 85-2 (Remand Order, June 3, 1986), a PSD permitting authority should consider the effects of a given control alternative on emissions of toxics or hazardous pollutants not regulated under the Clean Air Act. The ability of a given control alternative to control releases of unregulated toxic or hazardous emissions must be evaluated and may, as appropriate, affect the BACT decision. Conversely, hazardous or toxic emissions resulting from a given control technology should also be considered and may, as appropriate, also affect the BACT decision.

Because of the variety of sources and pollutants that may be considered in this assessment, it is not feasible for the EPA to provide highly detailed national guidance on performing an evaluation of the toxic impacts as part of the BACT determination. Also, detailed information with respect to the type and magnitude of emissions of unregulated pollutants for many source categories is currently limited. For example, a combustion source emits hundreds of substances, but knowledge of the magnitude of some of these

emissions or the hazards they produce is sparse. The EPA believes it is appropriate for agencies to proceed on a case-by-case basis using the best information available. Thus, the determination of whether the pollutants would be emitted in amounts sufficient to be of concern is one that the permitting authority has considerable discretion in making. However, reasonable efforts should be made to address these issues. For example, such efforts might include consultation with the:

- EPA Regional Office;
- Control Technology Center (CTC);
- National Air Toxics Information Clearinghouse;
- Air Risk Information Support Center in the Office of Air Quality Planning and Standards (OAQPS); and
- Review of the literature, such as; EPA-prepared compilations of emission factors.

Source-specific information supplied by the permit applicant is often the best source of information, and it is important that the applicant be made aware of its responsibility to provide for a reasonable accounting of air toxics emissions.

Similarly, once the pollutants of concern are identified, the permitting authority has flexibility in determining the methods by which it factors air toxics considerations into the BACT determination, subject to the obligation to make reasonable efforts to consider air toxics. Consultation by the review authority with EPA's implementation centers, particularly the CTC, is again advised.

It is important to note that several acceptable methods, including risk assessment, exist to incorporate air toxics concerns into the BACT decision. The depth of the toxics assessment will vary with the circumstances of the particular source under review, the nature and magnitude of the toxic pollutants, and the locality. Emissions of toxic or hazardous pollutant of concern to the permit agency should be identified and, to the extent possible, quantified. In addition, the effectiveness of the various control

alternatives in the hierarchy at controlling the toxic pollutant should be estimated and summarized to assist in making judgements about how potential emissions of toxic or hazardous pollutants may be mitigated through the selection of one control option over another. For example, the response to the Administrator made by EPA Region IX in its analysis of the North County permitting decision illustrates one of several approaches (for further information see the September 22, 1987 EPA memorandum from Mr. Gerald Emission titled "Implementation of North County Resource Recover PSD Remand" and July 28, 1988 EPA memorandum from Mr. John Calcagni titled "Supplemental guidance on Implementing the North County Prevention of Significant Deterioration (PSD) Remand").

Under a top-down BACT analysis, the control alternative selected as BACT will most likely reduce toxic emissions as well as the regulated pollutant. An example is the emissions of heavy metals typically associated with coal combustion. The metals generally are a portion of, or adsorbed on, the fine particulate in the exhaust gas stream. Collection of the particulate in a high efficiency fabric filter rather than a low efficiency electrostatic precipitator reduces criteria pollutant particulate matter emissions and toxic heavy metals emissions. Because in most instances the interests of reducing toxics coincide with the interests of reducing the pollutants subject to BACT, consideration of toxics in the BACT analysis generally amounts to quantifying toxic emission levels for the various control options.

In limited other instances, though, control of regulated pollutant emissions may compete with control of toxic compounds, as in the case of certain selective catalytic reduction (SCR) NO_x control technologies. The SCR technology itself results in emissions of ammonia, which increase, generally speaking, with increasing levels of NO_x control. It is the intent of the toxics screening in the BACT procedure to identify and quantify this type of toxic effect. Generally, toxic effects of this type will not necessarily be overriding concerns and will likely not to affect BACT decisions. Rather, the intent is to require a screening of toxics emissions effects to ensure that a possible overriding toxics issue does not escape notice.

On occasion, consideration of toxics emissions may support the selection of a control technology that yields less than the maximum degree of reduction in emissions of the regulated pollutant in question. An example is the municipal solid waste combustor and resource recovery facility that was the subject of the North County remand. Briefly, BACT for SO₂ and PM was selected to be a lime slurry spray drier followed by a fabric filter. The combination yields good SO₂ control (approximately 83 percent), good PM control (approximately 99.5 percent) and also removes acid gases (approximately 95 percent), metals, dioxins, and other unregulated pollutants. In this instance, the permitting authority determined that good balanced control of regulated and unregulated pollutants took priority over achieving the maximum degree of emissions reduction for one or more regulated pollutants. Specifically, higher levels (up to 95 percent) of SO₂ control could have been obtained by a wet scrubber.

IV.E. SELECTING BACT (STEP 5)

The most effective control alternative not eliminated in Step 4 is selected as BACT.

It is important to note that, regardless of the control level proposed by the applicant as BACT, the ultimate BACT decision is made by the permit issuing agency after public review. The applicant's role is primarily to provide information on the various control options and, when it proposes a less stringent control option, provide a detailed rationale and supporting documentation for eliminating the more stringent options. It is the responsibility of the permit agency to review the documentation and rationale presented and; (1) ensure that the applicant has addressed all of the most effective control options that could be applied and; (2) determine that the applicant has adequately demonstrated that energy, environmental, or economic impacts justify any proposal to eliminate the more effective control options. Where the permit agency does not accept the basis for the proposed elimination of a control option, the agency may inform the applicant of the need for more information regarding the control option. However, the BACT selection essentially should default to the highest level of control for which the

applicant could not adequately justify its elimination based on energy, environmental and economic impacts. If the applicant is unable to provide to the permit agency's satisfaction an adequate demonstration for one or more control alternatives, the permit agency should proceed to establish BACT and prepare a draft permit based on the most effective control option for which an adequate justification for rejection was not provided.

IV.F. OTHER CONSIDERATIONS

Once energy, environmental, and economic impacts have been considered, BACT can only be made more stringent by other considerations outside the normal scope of the BACT analysis as discussed under the above steps. Examples include cases where BACT does not produce a degree of control stringent enough to prevent exceedances of a national ambient air quality standard or PSD increment, or where the State or local agency will not accept the level of control selected as BACT and requires more stringent controls to preserve a greater amount of the available increment. A permit cannot be issued to a source that would cause or contribute to such a violation, regardless of the outcome of the BACT analysis. Also, States which have set ambient air quality standards at levels tighter than the federal standards may demand a more stringent level of control at a source to demonstrate compliance with the State standards. Another consideration which could override the selected BACT are legal constraints outside of the Clean Air Act requiring the application of a more stringent technology (e.g., a consent decree requiring a greater degree of control). In all cases, regardless of the rationale for the permit requiring a more stringent emissions limit than would have otherwise been chosen as a result of the BACT selection process, the emission limit in the final permit (and corresponding control alternative) represents BACT for the permitted source on a case-by-case basis.

The BACT emission limit in a new source permit is not set until the final permit is issued. The final permit is not issued until a draft permit has gone through public comment and the permitting agency has had an opportunity to consider any new information that may have come to light during the comment period. Consequently, in setting a proposed or final BACT limit,

the permit agency can consider new information it learns, including recent permit decisions, subsequent to the submittal of a complete application. This emphasizes the importance of ensuring that prior to the selection of a proposed BACT, all potential sources of information have been reviewed by the source to ensure that the list of potentially applicable control alternatives is complete (most importantly as it relates to any more effective control options than the one chosen) and that all considerations relating to economic, energy and environmental impacts have been addressed.

V. ENFORCEABILITY OF BACT

To complete the BACT process, the reviewing agency must establish an enforceable emission limit for each subject emission unit at the source and for each pollutant subject to review that is emitted from the source. If technological or economic limitations in the application of a measurement methodology to a particular emission unit would make an emissions limit infeasible, a design, equipment, work practice, operation standard, or combination thereof, may be prescribed. Also, the technology upon which the BACT emissions limit is based should be specified in the permit. These requirements should be written in the permit so that they are specific to the individual emission unit(s) subject to PSD review.

The emissions limits must be included in the proposed permit submitted for public comment, as well as the final permit. BACT emission limits or conditions must be met on a continual basis at all levels of operation (e.g., limits written in pounds/MMbtu or percent reduction achieved), demonstrate protection of short term ambient standards (limits written in pounds/hour) and be enforceable as a practical matter (contain appropriate averaging times, compliance verification procedures and recordkeeping requirements).

Consequently, the permit must:

- be able to show compliance or noncompliance (i.e., through monitoring times of operation, fuel input, or other indices of operating conditions and practices); and
- specify a reasonable averaging time consistent with established reference methods, contain reference methods for determining compliance, and provide for adequate reporting and recordkeeping so that the permitting agency can determine the compliance status of the source.

VI. EXAMPLE BACT ANALYSES FOR GAS TURBINES

Note: The following example provided is for illustration only. The example source is fictitious and has been created to highlight many of the aspects of the top-down process. Finally, it must be noted that the cost data and other numbers presented in the example are used only to demonstrate the BACT decision making process. Cost data are used in a relative sense to compare control costs among sources in a source category or for a pollutant. Determination of appropriate costs is made on a case-by-case basis.

In this section a BACT analysis for a stationary gas turbine project is presented and discussed under three alternative operating scenarios:

- Example 1--Simple Cycle Gas Turbines Firing Natural Gas
- Example 2--Combined Cycle Gas Turbines Firing Natural Gas
- Example 3--Combined Cycle Gas Turbines Firing Distillate Oil

The purpose of the examples are to illustrate points to be considered in developing BACT decision criteria for the source under review and selecting BACT. They are intended to illustrate the process rather than provide universal guidance on what constitutes BACT for any particular source category. BACT must be determined on a case-by-case basis.

These examples are not based on any actual analyses performed for the purposes of obtaining a PSD permit. Consequently, the actual emission rates, costs, and design parameters used are neither representative of any actual case nor do they apply to any particular facility.

VI.A. EXAMPLE 1--SIMPLE CYCLE GAS TURBINES FIRING NATURAL GAS

VI.A.1 PROJECT SUMMARY

Table B-5 presents project data, stationary gas design parameters, and uncontrolled emission estimates for the new source in example 1. The gas turbine is designed to provide peaking service to an electric utility. The planned operating hours are less than 1000 hours per year. Natural gas fuel will be fired. The source will be limited through enforceable conditions to the specified hours of operation and fuel type. The area where the source is to be located is in compliance for all criteria pollutants. No other changes are proposed at this facility, and therefore the net emissions change will be equal to the emissions shown on Table B-5. Only NOx emissions are significant (i.e., greater than the 40 tpy significance level for NOx) and a BACT analysis is required for NOx emissions only.

VI.A.2. BACT ANALYSIS SUMMARY

VII.A.2.a. CONTROL TECHNOLOGY OPTIONS

The first step in evaluating BACT is identifying all candidate control technology options for the emissions unit under review. Table B-6 presents the list of control technologies selected as potential BACT candidates. The first three control technologies, water or steam injection and selective catalytic reduction, were identified by a review of existing gas turbine facilities in operation. Selective noncatalytic reduction was identified as a potential type of control technology because it is an add-on NOx control which has been applied to other types of combustion sources.

TABLE B-5. EXAMPLE 1--COMBUSTION TURBINE DESIGN PARAMETERS

Characteristics

Number of emissions units	1
Unit Type	Gas Turbines
Cycle Type	Simple-cycle
Output	75 MW
Exhaust temperature,	1,000 °F
Fuel(s)	Natural Gas
Heat rate, Btu/kw hr	11,000
Fuel flow, Btu/hr	1,650 million
Fuel flow, lb/hr	83,300
Service Type	Peaking
Operating Hours (per year)	1,000
Uncontrolled Emissions, tpy(a)	
NO _x	564 (169 ppm)
SO ₂	<1
CO	4.6 (6 ppm)
VOC	1
PM	5 (0.0097 gr/dscf)

(a) Based on 1000 hours per year of operation at full load

TABLE B-6. EXAMPLE 1--SUMMARY OF POTENTIAL NO_x CONTROL
TECHNOLOGY OPTIONS

Control technology(a)	Typical control efficiency range (% reduction)	In Service On:			Technically feasible on simple cycle turbines
		Simple cycle turbines	Combined cycle gas turbines	Other combustion sources(c)	
Selective Catalytic Reductions	40-90	No	Yes	Yes	Yes(b)
Water Injection	30-70	Yes	Yes	Yes	Yes
Steam Injection	30-70	No	Yes	Yes	No
Low NO _x Burner	30-70	Yes	Yes	Yes	Yes
Selective Noncatalytic Reduction	20-50	No	Yes	Yes	No

(a) Ranked in order of highest to lowest stringency.

(b) Exhaust must be diluted with air to reduce its temperature to 600-750°F.

(c) Boiler incinerators, etc.

In this example, the control technologies were identified by the applicant based on a review of the BACT/LAER Clearinghouse, and discussions with State agencies with experience permitting gas turbines in NOx nonattainment areas. A preliminary meeting with the State permit issuing agency was held to determine whether the permitting agency felt that any other applicable control technologies should be evaluated and they agreed on the proposed control hierarchy.

VI.A.2.b. TECHNICAL FEASIBILITY CONSIDERATIONS

Once potential control technologies have been identified, each technology is evaluated for its technical feasibility based on the characteristics of the source. Because the gas turbines in this example are intended to be used for peaking service, a heat recovery steam generator (HRSG) will not be included. A HRSG recovers heat from the gas turbine exhaust to make steam and increase overall energy efficiency. A portion of the steam produced can be used for steam injection for NOx control, sometimes increasing the effectiveness of the net injection control system. However, the electrical demands of the grid dictate that the turbine will be brought on line only for short periods of time to meet peak demands. Due to the lag time required to bring a heat recovery steam generator on line, it is not technically feasible to use a HRSG at the facility. Use of an HRSG in this instance was shown to interfere with the performance of the unit for peaking service, which requires immediate response times for the turbine. Although it was shown that a HRSG was not feasible and therefore not available, water and steam are readily available for NOx control since the turbine will be located near an existing steam generating powerplant.

The turbine type and, therefore, the turbine model selection process, affects the achievability of NOx emissions limits. Factors which the customer considered in selecting the proposed turbine model were outlined in the application as: the peak demand which must be met, efficiency of the gas turbine, reliability requirements, and the experience of the utility with the operation and maintenance service of the particular manufacturer and turbine design. In this example, the proposed turbine is equipped with a combustor

designed to achieve an emission level, at 15 percent O₂, of 25 ppm NO_x with steam injection or 42 ppm with water injection.²

Selective noncatalytic reduction (SNCR) was eliminated as technically infeasible and therefore not available, because this technology requires a flue gas temperature of 1300 to 2100°F. The exhaust from the gas turbines will be approximately 1000°F, which is below the required temperature range.

Selective catalytic reduction (SCR) was evaluated and no basis was found to eliminate this technology as technically infeasible. However, there are no known examples where SCR technology has been applied to a simple-cycle gas turbine or to a gas turbine in peaking service. In all cases where SCR has been applied, there was an HRSG which served to reduce the exhaust temperature to the optimum range of 600-750°F and the gas turbine was operated continuously. Consequently, application of SCR to a simple cycle turbine involves special circumstances. For this example, it is assumed that dilution air can be added to the gas turbine exhaust to reduce its temperature. However, the dilution air will make the system more costly due to higher gas flows, and may reduce the removal efficiency because the NO_x concentration at the inlet will be reduced. Cost considerations are considered later in the analysis.

VI.A.2.c. CONTROL TECHNOLOGY HIERARCHY

After determining technical feasibility, the applicant selected the control levels for evaluation shown in Table B-7. Although the applicant

² For some gas turbine models, 25 ppm is not achievable with either water or steam injection.

TABLE B-7. EXAMPLE 1--CONTROL TECHNOLOGY HIERARCHY

Control Technology	Emissions Limits	
	ppm(a)	TPY
Steam Injection plus SCR	13	44
Steam Injection at maximum ^(b) design rate	25	84
Water Injection at maximum ^(b) design rate	42	140
Steam Injection to meet NSPS	93	312

(a) Corrected to 15 percent oxygen.

(b) Water to fuel ratio.

reported that some sites in California have achieved levels as low as 9 ppm, at this facility a 13 ppm level was determined to be the feasible limit with SCR. This decision is based on the lowest achievable level with steam injection of 25 ppm and an SCR removal efficiency of 50 percent. Even though the reported removal efficiencies for SCR are up to 90 percent at some facilities, at this facility the actual NO_x concentration at the inlet to the SCR system will only be approximately 17 ppm (at actual conditions) due to the dilution air required. Also the inlet concentrations, flowrates, and temperatures will vary due to the high frequency of startups. These factors make achieving the optimum 90 percent NO_x removal efficiency unrealistic. Based on discussions with SCR vendors, the applicant has established a 50 percent removal efficiency as the highest level achievable, thereby resulting in a 13 ppm level (i.e., 50 percent of 25 ppm).

The next most stringent level achievable would be steam injection at the maximum water-to-fuel ratio achievable by the unit within its design operating range. For this particular gas turbine model, that level is 25 ppm as supported by vendor NO_x emissions guarantees and unit test data. The applicant provided documentation obtained from the gas turbine manufacturer³ verifying ability to achieve this range.

After steam injection the next most stringent level of control would be water injection at the maximum water-to-fuel ratio achievable by the unit within its design operating range. For this particular gas turbine model, that level is 42 ppm as supported by vendor NO_x emissions guarantees and actual unit test data. The applicant provided documentation obtained from the gas turbine manufacturer verifying ability to achieve this range.

The least stringent level evaluated by the applicant was the current NSPS for utility gas turbines. For this model, that level is 93 ppm at 15 percent O₂. By definition, BACT can be no less stringent than NSPS.

³ It should be noted that achievability of the NO_x limits is dependent on the turbine model, fuel, type of wet injection (water or steam), and system design. Not all gas turbine models or fuels can necessarily achieve these levels.

Therefore, less stringent levels are not evaluated.

VI.A.2.d. IMPACTS ANALYSIS SUMMARY

The next steps completed by the applicant were the development of the cost, economic, environmental and energy impacts of the different control alternatives. Although the top-down process would allow for the selection of the top alternative without a cost analysis, the applicant felt cost/economic impacts were excessive and that appropriate documentation may justify the elimination of SCR as BACT and therefore chose to quantify cost and economic impacts. Because the technologies in this case are applied in combination, it was necessary to quantify impacts for each of the alternatives. The impact estimates are shown in Table B-8. Adequate documentation of the basis for the impacts was determined to be included in the PSD permit application.

The incremental cost impacts shown are the cost of the alternative compared to the next most stringent control alternative. Figure B-2 is a plot of the least-cost envelope defined by the list of control options.

VI.A.2.e. TOXICS ASSESSMENT

If SCR were applied, potential toxic emissions of ammonia could occur. Ammonia emissions resulting from application of SCR could be as large as 20 tons per year. Application of SCR would reduce NOx by an additional 20 tpy over steam injection alone (25 ppm) (not including ammonia emissions).

Another environmental impact considered was the spent catalyst which would have to be disposed of at certain operating intervals. The catalyst contains vanadium pentoxide, which is listed as a hazardous waste under RCRA regulations (40 CFR 261.3). Disposal of this waste creates an additional economic and environmental burden. This was considered in the applicant's proposed BACT determination.

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TABLE B-8. EXAMPLE 1--SUMMARY OF TOP-DOWN BACT IMPACT ANALYSIS RESULTS FOR NO_x

Control alternative	Emissions per Turbine			Economic Impacts			Energy Impacts	Environmental Impacts		
	Emissions (lb/hr)	Emissions (tpy)	Emissions reduction(a) (tpy)	Installed capital cost (b) (\$)	Total annualized cost (c) (\$/yr)	Cost effectiveness over baseline (d) (\$/ton)	Incremental cost effectiveness (e) (\$/ton)	Incremental increase over baseline (f) (MMBtu/yr)	Toxics impact (Yes/No)	Adverse environmental impact (Yes/No)
13 ppm Alternative	44	22	260	11,470,000	1,717,000 (g)	6,600	56,200	464,000	Yes	No
25 ppm Alternative	84	42	240	1,790,000	593,000	2,470	8,460	30,000	No	No
42 ppm Alternative	140	70	212	1,304,000	356,000	1,680	800	15,300	No	No
NSPS Alternative	312	156	126	927,000	288,000	2,285		8,000	No	No
Uncontrolled Baseline	564	282	-	-	-	-	-	-	-	-

(a) Emissions reduction over baseline control level.

(b) Installed capital cost relative to baseline.

(c) Total annualized cost (capital, direct, and indirect) of purchasing, installing, and operating the proposed control alternative. A capital recovery factor approach using a real interest rate (i.e., absent inflation) is used to express capital costs in present-day annual costs.

(d) Cost Effectiveness over baseline is equal to total annualized cost for the control option divided by the emissions reductions resulting from the uncontrolled baseline.

(e) The optional incremental cost effectiveness criteria is the same as the total cost effectiveness criteria except that the control alternative is considered relative to the next most stringent alternative rather than the baseline control alternative.

(f) Energy impacts are the difference in total project energy requirements with the control alternative and the baseline control alternative expressed in equivalent millions of Btus per year.

(g) Assued 10 year catalyst life since this turbine operates only 1000 hours per year. Assumptions made on catalyst life may have a profound affect upon cost effectiveness.

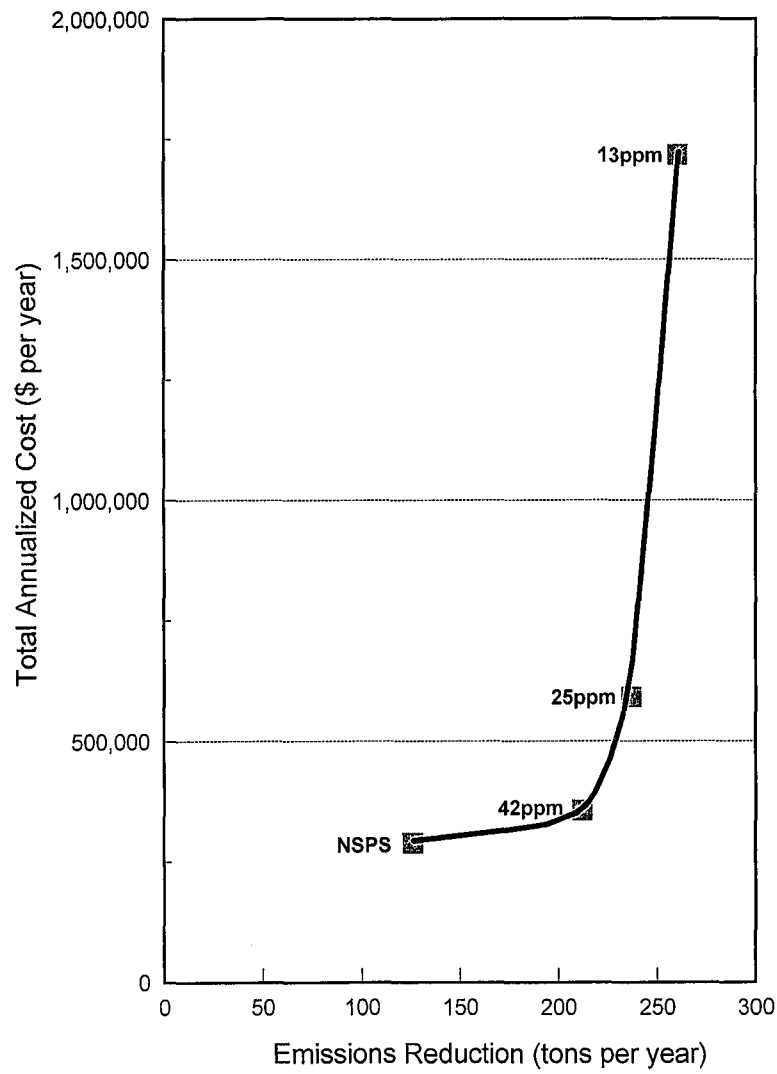


Figure B-2. Least-Cost Envelope for Example 1

VI.A.2.f. RATIONALE FOR PROPOSED BACT

Based on these impacts, the applicant proposed eliminating the 13 ppm alternative as economically infeasible. The applicant documented that the cost effectiveness is high at 6,600 \$/ton, and well out of the range of recent BACT NOx control costs for similar sources. The incremental cost effectiveness of \$56,200 also is high compared to the incremental cost effectiveness of the next option.

The applicant documented that the other combustion turbine sources which have applied SCR have much higher operating hours (i.e., all were permitted as base-loaded units). Also, these sources had heat recovery steam generators so that the cost effectiveness of the application of SCR was lower. For this source, dilution air must be added to cool the flue gas to the proper temperature. This increases the cost of the SCR system relative to the same gas turbine with a HRSG. Therefore, the other sources had much lower cost impacts for SCR relative to steam injection alone, and much lower cost effectiveness numbers. Application of SCR would also result in emission of ammonia, a toxic chemical, of possibly 20 tons per year while reducing NOx emissions by 20 tons per year. The applicant asserted that, based on these circumstances, to apply SCR in this case would be an unreasonable burden compared to what has been done at other similar sources.

Consequently, the applicant proposed eliminating the SCR plus steam injection alternative. The applicant then accepted the next control alternative, steam injection to 25 ppmv. The use of steam injection was shown by the applicant to be consistent with recent BACT determinations for similar sources. The review authority concurred with the proposed elimination of SCR and the selection of a 25 ppmv limit as BACT. The use of steam injection was shown by the applicant to be consistent with recent BACT determinations for similar sources. The review authority concurred with the proposed elimination of SCR and the selection of a 25 ppmv limit as BACT.

VI.B. EXAMPLE 2--COMBINED CYCLE GAS TURBINES FIRING NATURAL GAS

Table B-9 presents the design parameters for an alternative set of circumstances. In this example, two gas turbines are being installed. Also, the operating hours are 5000 per year and the new turbines are being added to meet intermediate loads demands. The source will be limited through enforceable conditions to the specified hours of operation and fuel type. In this case, HRSG units are installed. The applicable control technologies and control technology hierarchy are the same as the previous example except that no dilution is required for the gas turbine exhaust because the HRSG serves to reduce the exhaust temperature to the optimum level for SCR operation. Also, since there is no dilution required and fewer startups, the most stringent control option proposed is 9 ppm based on performance limits for several other natural gas fired baseload combustion turbine facilities.

Table B-10 presents the results of the cost and economic impact analysis for the example and Figure B-3 is a plot of the least-cost envelope defined by the list of control options. The incremental cost impacts shown are the cost of the alternative compared to the next most stringent control alternative. Due to the increased operating hours and design changes, the economic impacts of SCR are much lower for this case. There does not appear to be a persuasive argument for stating that SCR is economically infeasible. Cost effectiveness numbers are within the range typically required of this and other similar source types.

In this case, there would also be emissions of ammonia. However, now the magnitude of ammonia emissions, approximately 40 tons per year, is much lower than the additional NO_x reduction achieved, which is 270 tons per year.

Under these alternative circumstances, PM emissions are also now above the significance level (i.e., greater than 25 tpy). The gas turbine

TABLE B-9. EXAMPLE 2--COMBUSTION TURBINE DESIGN PARAMETERS

Characteristics	
Number of emission units	2
Emission units	Gas Turbine
Cycle Type	Combined-cycle
Output	
Gas Turbines (2 @ 75 MW each)	150 MW
Steam Turbine (no emissions generated)	70 MW
Fuel(s)	Natural Gas
Gas Turbine Heat Rate, Btu/kw-hr	11,000 Btu/kw-hr
Fuel Flow per gas turbine, Btu/hr	1,650 million
Fuel Flow per gas turbine, lb/hr	83,300
Service Type	Intermediate
Hours per year of operation	5000
Uncontrolled Emissions per gas turbine, tpy (a)(b)	
NO _x	1,410 (169 ppm)
SO ₂	<1
CO	23 (6 ppm)
VOC	5
PM	25 (0.0097 gr/dscf)

(a) Based on 5000 hours per year of operation.

(b) Total uncontrolled emissions for the proposed project is equal to the pollutants uncontrolled emission rate multiplied by 2 turbines. For example, total NO_x = (2 turbines) x 1410 tpy per turbine = 2820 tpy.

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TABLE B-10. EXAMPLE 2--SUMMARY OF TOP-DOWN BACT IMPACT ANALYSIS RESULTS FOR NO_x

Control alternative	Emissions per Turbine			Economic Impacts			Energy Impacts	Environmental Impacts		
	Emissions (lb/hr)	Emissions reduction (tpy)	Emissions reduction(a,h) (tpy)	Installed capital cost(b) (\$)	Total annualized cost(c) (\$/yr)	Cost effectiveness over baseline(d) (\$/ton)	Incremental cost effectiveness(e) (\$/ton)	Incremental increase over baseline(f) (MMBtu/yr)	Toxics impact (Yes/No)	Adverse environmental impact (Yes/No)
9 ppm Alternative	30	75	1,335	10,980,000	3,380,000 (g)	2,531	12,200	160,000	Yes	No
25 ppm Alternative	84	210	1,200	1,791,000	1,730,000	1,440	6,050	105,000	No	No
42 ppm Alternative	140	350	1,060	1,304,000	883,000	833	181	57,200	No	No
NSPS Alternative	312	780	630	927,000	805,000	1,280		27,000	No	No
Uncontrolled Baseline	564	1,410	-	-	-	-	-	-	-	-

(a) Emissions reduction over baseline control level.

(b) Installed capital cost relative to baseline.

(c) Total annualized cost (capital, direct, and indirect) of purchasing, installing, and operating the proposed control alternative. A capital recovery factor approach using a real interest rate (i.e., absent inflation) is used to express capital costs in present-day annual costs.

(d) Cost Effectiveness over baseline is equal to total annualized cost for the control option divided by the emissions reductions resulting from the uncontrolled baseline.

(e) The optional incremental cost effectiveness criteria is the same as the total cost effectiveness criteria except that the control alternative is considered relative to the next most stringent alternative rather than the baseline control alternative.

(f) Energy impacts are the difference in total project energy requirements with the control alternative and the baseline control alternative expressed in equivalent millions of Btus per year.

(g) Assumes a 2 year catalyst life. Assumptions made on catalyst life may have a profound affect upon cost effectiveness.

(h) Since the project calls for two turbines, actual project wide emissions reductions for an alternative will be equal to two times the reduction listed.

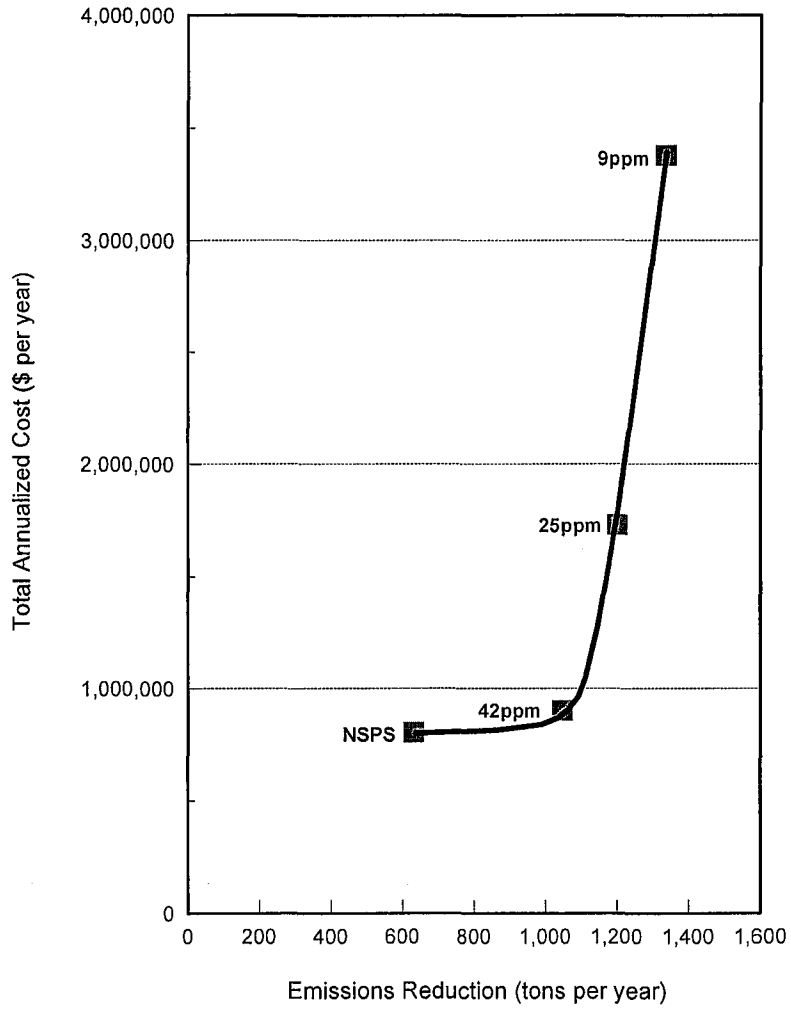


Figure B-3. Least-Cost Envelope for Example 2

combustors are designed to combust the fuel as completely as possible and therefore reduce PM to the lowest possible level. Natural gas contains no solids and solids are removed from the injected water. The PM emission rate without add-on controls is on the same order (0.009 gr/dscf) as that for other particulate matter sources controlled with stringent add-on controls (e.g., fabric filter). Since the applicant documented that precombustion or add-on controls for PM have never been required for natural gas fired turbines, the reviewing agency accepted the applicants analysis that natural gas firing was BACT for PM emissions and that no additional analysis of PM controls was required.

VI.C. EXAMPLE 3--COMBINED CYCLE GAS TURBINE FIRING DISTILLATE OIL

In this example, the same combined cycle gas turbines are proposed except that distillate oil is fired rather than natural gas. The reason is that natural gas is not available on site and there is no pipeline within a reasonable distance. The fuel change raises two issues; the technical feasibility of SCR in gas turbines firing sulfur bearing fuel, and NOx levels achievable with water injection while firing fuel oil.

In this case the applicant proposed to eliminate SCR as technically infeasible because sulfur present in the fuel, even at low levels, will poison the catalyst and quickly render it ineffective. The applicant also noted that there are no cases in the U.S. where SCR has been applied to a gas turbine firing distillate oil as the primary fuel.⁴

A second issue would be the most stringent NOx control level achievable with wet injection. For oil firing the applicant has proposed 42 ppm at 15 percent oxygen. Due to flame characteristics inherent with oil firing, and limits on the amount of water or steam that can be injected, 42 ppm is the lowest NOx emission level achievable with distillate oil firing. Since

⁴ Though this argument was considered persuasive in this case, advances in catalyst technology have now made SCR with oil firing technically feasible.

natural gas is not available and SCR is technically infeasible, 42 ppm is the most stringent alternative considered. Based on the cost effectiveness of wet injection, approximately 833 \$/ton, there is no economic basis to eliminate the 42 ppm option since this cost is well within the range of BACT costs for NOx control. Therefore, this option is proposed as BACT.

The switch to oil from gas would also result in SO2, CO, PM, and beryllium emissions above significance levels. Therefore, BACT analyses would also be required for these pollutants. These analyses are not shown in this example, but would be performed in the same manner as the BACT analysis for NOx.

VI.D. OTHER CONSIDERATIONS

The previous judgements concerning economic feasibility were in an area meeting NAAQS for both NOx and ozone. If the natural gas fired simple cycle gas turbine example previously presented were sited adjacent to a Class I area, or where air quality improvement poses a major challenge, such as next to a nonattainment area, the results may differ. In this case, even though the region of the actual site location is achieving the NAAQS, adherence to a local or regional NOx or ozone attainment strategy might result in the determination that higher costs than usual are appropriate. In such situations, higher costs (e.g., 6,600 \$/ton) may not necessarily be persuasive in eliminating SCR as BACT.

While it is not the intention of BACT to prevent construction, it is possible that local or regional air quality management concerns regarding the need to minimize the air quality impacts of new sources would lead the permitting authority to require a source to either achieve stringent emission control levels or, at a minimum, that control cost expenditures meet certain cost levels without consideration of the resultant economic impact to the source.

Besides local or regional air quality concerns, other site constraints may significantly impact costs of particular control technologies. For the

examples previously presented, two factors of concern are land and water availability.

The cost of the raw water is usually a small part of the cost of wet controls. However, gas turbines are sometimes located in remote locations. Though water can obviously be trucked to any location, the costs may be very high.

Land availability constraints may occur where a new source is being located at an existing plant. In these cases, unusual design and additional structural requirements could make the costs of control technologies which are commonly affordable prohibitively expensive. Such considerations may be pertinent to the calculations of impacts and ultimately the selection of BACT.

CHAPTER C

THE AIR QUALITY ANALYSIS

I. INTRODUCTION

An applicant for a PSD permit is required to conduct an air quality analysis of the ambient impacts associated with the construction and operation of the proposed new source or modification. The main purpose of the air quality analysis is to demonstrate that new emissions emitted from a proposed major stationary source or major modification, in conjunction with other applicable emissions increases and decreases from existing sources (including secondary emissions from growth associated with the new project), will not cause or contribute to a violation of any applicable NAAQS or PSD increment. Ambient impacts of noncriteria pollutants must also be evaluated.

A separate air quality analysis must be submitted for each regulated pollutant if the applicant proposes to emit the pollutant in a significant amount from a new major stationary source, or proposes to cause a significant net emissions increase from a major modification (see *Table I-A-4*, chapter A of this part). [*Note: The air quality analysis requirement also applies to any pollutant whose rate of emissions from a proposed new or modified source is considered to be "significant" because the proposed source would construct within 10 kilometers of a Class I area and would have an ambient impact on such area equal to or greater than 1 $\mu\text{g}/\text{m}^3$, 24-hour average.*] Regulated pollutants include (1) pollutants for which a NAAQS exists (criteria pollutants) and (2) other pollutants, which are regulated by EPA, for which no NAAQS exist (noncriteria pollutants).

Each air quality analysis will be unique, due to the variety of sources and meteorological and topographical conditions that may be involved. Nevertheless, the air quality analysis must be accomplished in a manner consistent with the requirements set forth in either EPA's PSD regulations under 40 CFR 52.21, or a State or local PSD program approved by EPA pursuant to 40 CFR 51.166. Generally, the analysis will involve (1) an assessment of existing air quality, which may include ambient monitoring data and air

quality dispersion modeling results, and (2) predictions, using dispersion modeling, of ambient concentrations that will result from the applicant's proposed project and future growth associated with the project.

In describing the various concepts and procedures involved with the air quality analysis in this section, it is assumed that the reader has a basic understanding of the principles involved in collecting and analyzing ambient monitoring data and in performing air dispersion modeling. Considerable guidance is contained in EPA's Ambient Monitoring Guidelines for Prevention of Significant Deterioration [Reference 1] and Guideline on Air Quality Models (Revised) [Reference 2] . Numerous times throughout this chapter, the reader will be referred to these guidance documents, hereafter referred to as the PSD Monitoring Guideline and the Modeling Guideline, respectively.

In addition, because of the complex character of the air quality analysis and the site-specific nature of the modeling techniques involved, applicants are advised to review the details of their proposed modeling analysis with the appropriate reviewing agency before a complete PSD application is submitted. This is best done using a modeling protocol. The modeling protocol should be submitted to the reviewing agency for review and approval prior to commencing any extensive analysis. Further description of the modeling protocol is contained in this chapter.

The PSD applicant should also be aware that, while this chapter focuses primarily on compliance with the NAAQS and PSD increments, additional impact analyses are required under separate provisions of the PSD regulations for determining any impairment to visibility, soils and vegetation that might result, as well as any adverse impacts to Class I areas. These provisions are described in the following chapters D and E, respectively.

II. NATIONAL AMBIENT AIR QUALITY STANDARDS AND PSD INCREMENTS

As described in the introduction to this chapter, the air quality analysis is designed to protect the *national ambient air quality standards* (NAAQS) and *PSD increments*. The NAAQS are maximum concentration "ceilings" measured in terms of the total concentration of a pollutant in the atmosphere (See *Table C-1*). For a new or modified source, compliance with any NAAQS is based upon the total estimated air quality, which is the sum of the ambient estimates resulting from existing sources of air pollution (modeled source impacts plus measured background concentrations, as described in this section) and the modeled ambient impact caused by the applicant's proposed emissions increase (or net emissions increase for a modification) and associated growth.

A PSD increment, on the other hand, is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant (see section II.E). The baseline concentration is defined for each pollutant (and relevant averaging time) and, in general, is the ambient concentration existing at the time that the first complete PSD permit application affecting the area is submitted. Significant deterioration is said to occur when the amount of new pollution would exceed the applicable PSD increment. It is important to note, however, that the air quality cannot deteriorate beyond the concentration allowed by the applicable NAAQS, even if not all of the PSD increment is consumed.

II.A CLASS I, II, AND III AREAS AND INCREMENTS.

The PSD requirements provide for a system of area classifications which affords States an opportunity to identify local land use goals. There are three area classifications. Each classification differs in terms of the amount of growth it will permit before significant air quality deterioration would be deemed to occur. Class I areas have the smallest increments and thus allow only a small degree of air quality deterioration. Class II areas can

TABLE C-1. National Ambient Air Quality Standards

Pollutant/averaging time	Primary Standard	Secondary Standard
<u>Particulate Matter</u>		
o PM ₁₀ , annual ^a	50 µg/m ³	50 µg/m ³
o PM ₁₀ , 24-hour ^b	150 µg/m ³	150 µg/m ³
<u>Sulfur Dioxide</u>		
o SO ₂ , annual ^c	80 µg/m ³ (0.03 ppm)	
o SO ₂ , 24-hour ^d	365 µg/m ³ (0.14 ppm)	
o SO ₂ , 3-hour ^d		1.300 µg/m ³ (0.5 ppm)
<u>Nitrogen Dioxide</u>		
o NO ₂ , annual ^c	0.053 ppm (100 µg/m ³)	0.053 ppm (100 µg/m ³)
<u>Ozone</u>		
o O ₃ , 1-hour ^b	0.12 ppm (235 µg/m ³)	0.12 ppm (235 µg/m ³)
<u>Carbon Monoxide</u>		
o CO, 8-hour ^d	9 ppm (10 mg/m ³)	--
o CO, 1-hour ^d	35 ppm (40 mg/m ³)	--
<u>Lead</u>		
o Pb, calendar quarter ^c	1.5 µg/m ³	--

a Standard is attained when the expected annual arithmetic mean is less than or equal to 50 µg/m³.

b Standard is attained when the expected number of exceedances is less than or equal to 1.

c Never to be exceeded.

d Not to be exceeded more than once per year.

accommodate normal well-managed industrial growth. Class III areas have the largest increments and thereby provide for a larger amount of development than either Class I or Class II areas.

Congress established certain areas, e.g., wilderness areas and national parks, as mandatory Class I areas. These areas cannot be redesignated to any other area classification. All other areas of the country were initially designated as Class II. Procedures exist under the PSD regulations to redesignate the Class II areas to either Class I or Class III, depending upon a State's land management objectives.

PSD increments for SO₂ and particulate matter--measured as total suspended particulate (TSP)--have existed in their present form since 1978. On July 1, 1987, EPA revised the NAAQS for particulate matter and established the new PM-10 indicator by which the NAAQS are to be measured. (Since each State is required to adopt these revised NAAQS and related implementation requirements as part of the approved implementation plan, PSD applicants should check with the appropriate permitting agency to determine whether such State action has already been taken. Where the PM-10 NAAQS are not yet being implemented, compliance with the TSP-based ambient standards is still required in accordance with the currently-approved State implementation plan.) Simultaneously with the promulgation of the PM-10 NAAQS, EPA announced that it would develop PM-10 increments to replace the TSP increments. Such new increments have not yet been promulgated, however. Thus the national PSD increment system for particulate matter is still based on the TSP indicator.

The EPA promulgated PSD increments for NO₂ on October 17, 1988. These new increments become effective under EPA's PSD regulations (40 CFR 52.21) on November 19, 1990, although States may have revised their own PSD programs to incorporate the new increments for NO₂ on some earlier date. Until November 19, 1990, PSD applicants should determine whether the NO₂ increments are being implemented in the area of concern; if so, they must include the necessary analysis, if applicable, as part of a complete permit application. [NOTE: the "trigger date" (described below in section II.B) for the NO₂ increments has been established by regulation as of February 8, 1988. This applies to all State PSD programs as well as EPA's Part 52 PSD program. Thus,

consumption of the NO₂ increments may actually occur before the increments become effective in any particular PSD program.] The PSD increments for SO₂, TSP and NO₂ are summarized in *Table C-2*.

II.B ESTABLISHING THE BASELINE DATE

As already described, the *baseline concentration* is the reference point for determining air quality deterioration in an area. The baseline concentration is essentially the air quality existing at the time of the first complete PSD permit application submittal affecting that area. In general, then, the submittal date of the first complete PSD application in an area is the "baseline date." On or before the date of the first PSD application, most emissions are considered to be part of the baseline concentration, and emissions changes which occur after that date affect the amount of available PSD increment. However, to fully understand how and when increment is consumed or expanded, three different dates related to baseline must be explained. In chronological order, these dates are as follows:

- *the major source baseline date;*
- *the trigger date;* and
- *the minor source baseline date.*

The *major source baseline date* is the date after which actual emissions associated with construction (i.e., physical changes or changes in the method of operation) at a major stationary source affect the available PSD increment. Other changes in actual emissions occurring at any source after the major source baseline date do not affect the increment, but instead (until after the minor source baseline date is established) contribute to the baseline concentration. The *trigger date* is the date after which the minor source

TABLE C-2. PSD INCREMENTS
($\mu\text{g}/\text{m}^3$)

	Class I	Class II	Class III
<u>Sulfur Dioxide</u>			
o SO_2 , annual ^a	2	20	40
o SO_2 , 24-hour ^b	5	91	182
o SO_2 , 3-hour ^b	25	512	700
<u>Particulate Matter</u>			
o TSP, annual ^a	5	19	37
o TSP, 24-hour ^b	10	37	75
<u>Nitrogen Dioxide</u>			
o NO_2 , annual ^a	2.5	25	50

a Never to be exceeded.

b Not to be exceeded more than once per year.

baseline date (described below) may be established. Both the major source baseline date and the trigger date are fixed dates, although different dates apply to (1) SO₂ and particulate matter, and (2) NO₂, as follows:

<u>Pollutant</u>	<u>Major Source Baseline Date</u>	
	<u>Trigger Date</u>	
PM	January 6, 1975	August 7, 1977
SO ₂	January 6, 1975	August 7, 1977
NO ₂	February 8, 1988	February 8, 1988

The minor source baseline date is the earliest date after the trigger date on which a complete PSD application is received by the permit reviewing agency. If the application that established the minor source baseline date is ultimately denied or is voluntarily withdrawn by the applicant, the minor source baseline date remains in effect nevertheless. Because the date marks the point in time after which actual emissions changes from all sources affect the available increment (regardless of whether the emissions changes are a result of construction), it is often referred to as the "baseline date."

The minor source baseline date for a particular pollutant is triggered by a PSD applicant only if the proposed increase in emissions of that pollutant is significant. For instance, a PSD application for a major new source or modification that proposes to increase its emissions in a significant amount for SO₂, but in an insignificant amount for PM, will establish the minor source baseline date for SO₂, but not for PM. Thus, the minor source baseline dates for different pollutants (for which increments exist) need not be the same in a particular area.

II.C ESTABLISHING THE BASELINE AREA

The area in which the minor source baseline date is established by a PSD permit application is known as the *baseline area*. The extent of a baseline area is limited to intrastate areas and may include one or more areas designated as attainment or unclassified under Section 107 of the Act. The baseline area established pursuant to a specific PSD application is to include 1) all portions of the attainment or unclassifiable area in which the PSD applicant would propose to locate, and 2) any attainment or unclassifiable area in which the proposed emissions would have a significant ambient impact. For this purpose, a significant impact is defined as at least a $1 \mu\text{g}/\text{m}^3$ annual increase in the average annual concentration of the applicable pollutant. Again, a PSD applicant's establishment of a baseline area in one State does not trigger the minor source baseline date in, or extend the baseline area into, another State.

II.D REDEFINING BASELINE AREAS (AREA REDESIGNATIONS)

It is possible that the boundaries of a baseline area may not reasonably reflect the area affected by the PSD source which established the baseline area. A state may redefine the boundaries of an existing baseline area by redesignating the section 107 areas contained therein. Section 107(d) of the Clean Air Act specifically authorizes states to submit redesignations to the EPA. Consequently, a State may submit redefinitions of the boundaries of attainment or unclassifiable areas at any time, as long as the following criteria are met:

- *area redesignations can be no smaller than the $1 \mu\text{g}/\text{m}^3$ area of impact of the triggering source; and*
- *the boundaries of any redesignated area cannot intersect the $1 \mu\text{g}/\text{m}^3$ area of impact of any major stationary source that established or would have established a minor source baseline date for the area proposed for redesignation.*

II.E INCREMENT CONSUMPTION AND EXPANSION

The amount of PSD increment that has been consumed in a PSD area is determined from the emissions increases and decreases which have occurred from sources since the applicable baseline date. It is useful to note, however, that in order to determine the amount of PSD increment consumed (or the amount of available increment), no determination of the baseline concentration needs to be made. Instead, increment consumption calculations must reflect only the ambient pollutant concentration change attributable to increment-affecting emissions.

Emissions increases that consume a portion of the applicable increment are, in general, all those not accounted for in the baseline concentration and specifically include:

- *actual emissions increases occurring after the major source baseline date, which are associated with physical changes or changes in the method of operation (i.e., construction) at a major stationary source; and*
- *actual emissions increases at any stationary source, area source, or mobile source occurring after the minor source baseline date.*

The amount of available increment may be added to, or "expanded," in two ways. The primary way is through the reduction of actual emissions from any source after the minor source baseline date. Any such emissions reduction would increase the amount of available increment to the extent that ambient concentrations would be reduced.

Increment expansion may also result from the reduction of actual emissions after the major source baseline date, but before the minor source baseline date, if the reduction results from a physical change or change in the method of operation (i.e., construction) at a major stationary source. Moreover, the reduction will add to the available increment only if the reduction is included in a federally enforceable permit or SIP provision. Thus, for major stationary sources, actual emissions reductions made prior to the minor source baseline date expand the available increment just as increases before the minor source baseline date consume increment.

The creditable increase of an existing stack height or the application of any other creditable dispersion technique may affect increment consumption or expansion in the same manner as an actual emissions increase or decrease. That is, the effects that a change in the effective stack height would have on ground level pollutant concentrations generally should be factored into the increment analysis. For example, this would apply to a raised stack height occurring in conjunction with a modification at a major stationary source prior to the minor source baseline date, or to any changed stack height occurring after the minor source baseline date. It should be noted, however, that any increase in a stack height, in order to be creditable, must be consistent with the EPA's stack height regulations; credit cannot be given for that portion of the new height which exceeds the height demonstrated to be the good engineering practice (GEP) stack height.

Increment consumption (and expansion) will generally be based on changes in actual emissions reflected by the normal source operation for a period of 2 years. However, if little or no operating data are available, as in the case of permitted emission units not yet in operation at the time of the increment analysis, the potential to emit must be used instead. Emissions data requirements for modeling increment consumption are described in *Section IV.D.4*. Further guidance for identifying increment-consuming sources (and emissions) is provided in *Section IV.C.2*.

II.F BASELINE DATE AND BASELINE AREA CONCEPTS -- EXAMPLES

An example of how a baseline area is established is illustrated in *Figure C-1*. A major new source with the potential to emit significant amounts of SO₂ proposes to locate in County C. The applicant submits a complete PSD application to the appropriate reviewing agency on October 6, 1978. (The trigger date for SO₂ is August 7, 1977.) A review of the State's SO₂ attainment designations reveals that attainment status is listed by individual counties in the state. Since County C is designated attainment for SO₂, and the source proposes to locate there, October 6, 1978 is established as the minor source baseline date for SO₂ for the entire county.

Dispersion modeling of proposed SO₂ emissions in accordance with approved methods reveals that the proposed source's ambient impact will exceed 1 ug/m³ (annual average) in Counties A and B. Thus, the same minor source baseline date is also established throughout Counties A and B. Once it is triggered, the minor source baseline date for Counties A, B and C establishes the time after which all emissions changes affect the available increments in those three counties.

Although SO₂ impacts due to the proposed emissions are above the significance level of 1 µg/m³ (annual average) in the adjoining State, the proposed source does not establish the minor source baseline date in that State. This is because, as mentioned in Section II.C of this chapter, baseline areas are intrastate areas only.

The fact that a PSD source's emissions cannot trigger the minor source baseline date across a State's boundary should not be interpreted as precluding the applicant's emissions from consuming increment in another State. Such increment-consuming emissions (e.g., SO₂ emissions increases resulting from a physical change or a change in the method of operation at a

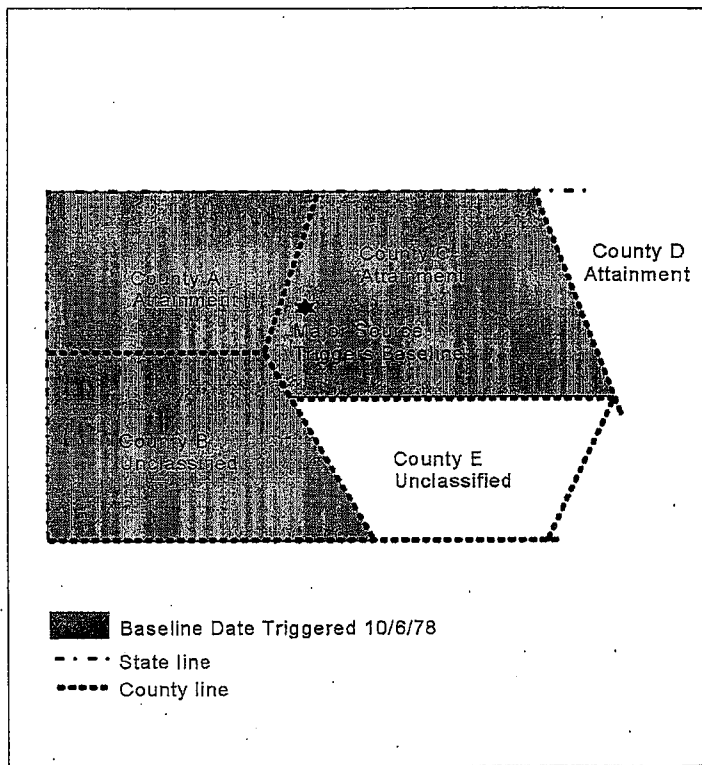


Figure C-1. Establishing the Baseline Area.

major stationary source after January 6, 1975) that affect another State will consume increment there even though the minor source baseline date has not been triggered, but are not considered for increment-consuming purposes until after the minor source baseline date has been independently established in that State.

A second example, illustrated in *Figure C-2*, demonstrates how a baseline area may be redefined. Assume that the State in the first example decides that it does not want the minor source baseline date to be established in the western half of County A where the proposed source will not have a significant annual impact (i.e., $1 \mu\text{g}/\text{m}^3$, annual average). The State, therefore, proposes to redesignate the boundaries of the existing section 107 attainment area, comprising all of County A, to create two separate attainment areas in that county. If EPA agrees that the available data support the change, the redesignations will be approved. At that time, the October 6, 1978 minor source baseline date will no longer apply to the newly-established attainment area comprising the western portion of County A.

If the minor source baseline date has not been triggered by another PSD application having a significant impact in the redesignated western portion of County A, the SO_2 emissions changes occurring after October 6, 1978 from minor point, area, and mobile sources, and from nonconstruction-related activities at all major stationary sources in this area will be transferred into the baseline concentration. In accordance with the major source baseline date, construction-related emissions changes at major point sources continue to consume or expand increment in the western portion of County A which is no longer part of the original baseline area.

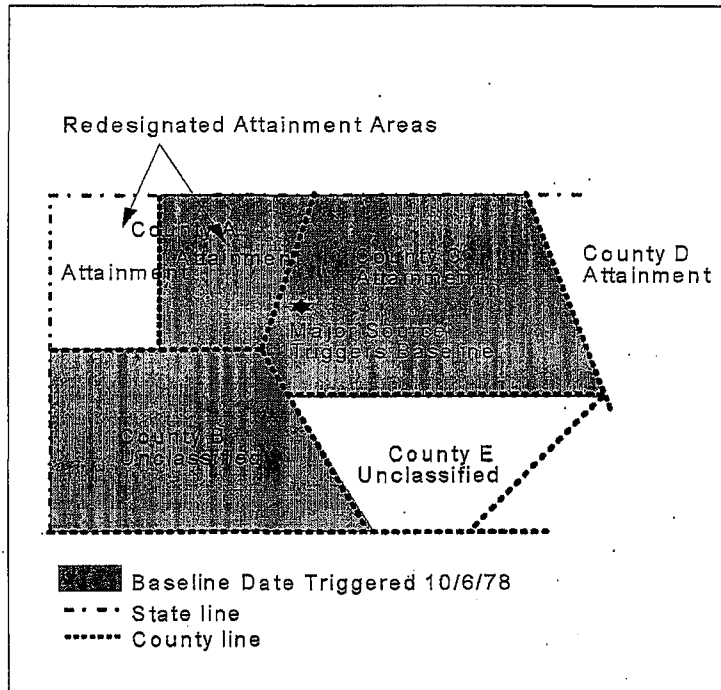


Figure C-2. Redefining the Baseline Area.

III. AMBIENT DATA REQUIREMENTS

An applicant should be aware of the potential need to establish and operate a site-specific monitoring network for the collection of certain ambient data. With respect to *air quality data*, the PSD regulations contain provisions requiring an applicant to provide an ambient air quality analysis which may include pre-application monitoring data, and in some instances post-construction monitoring data, for any pollutant proposed to be emitted by the new source or modification. In the absence of available monitoring data which is representative of the area of concern, this requirement could involve the operation of a site-specific air quality monitoring network by the applicant. Also, the need for *meteorological data*, for any dispersion modeling that must be performed, could entail the applicant's operation of a site-specific meteorological network.

Pre-application data generally must be gathered over a period of at least 1 year and the data are to represent at least the 12-month period immediately preceding receipt of the PSD application. Consequently, it is important that the applicant ascertain the need to collect any such data and proceed with the required monitoring activities as soon as possible in order to avoid undue delay in submitting a complete PSD application.

III.A PRE-APPLICATION AIR QUALITY MONITORING

For any criteria pollutant that the applicant proposes to emit in significant amounts, continuous ambient monitoring data may be required as part of the air quality analysis. If, however, either (1) the predicted ambient impact, i.e., the highest modeled concentration for the applicable averaging time, caused by the proposed significant emissions increase (or significant net emissions increase), or (2) the existing ambient pollutant concentrations are less than the prescribed significant monitoring value (see *Table C-3*), the permitting agency has discretionary authority to exempt an applicant from this data requirement.

TABLE C-3. SIGNIFICANT MONITORING CONCENTRATIONS

Pollutant	Air Quality Concentration ($\mu\text{g}/\text{m}^3$) and Averaging Time	
Carbon monoxide	575	(8-hour)
Nitrogen dioxide	14	(Annual)
Sulfur dioxide	13	(24-hour)
Particulate Matter, TSP	10	(24-hour)
Particulate Matter, PM-10	10	(24-hour)
Ozone	<i>a</i>	
Lead	0.1	(3-month)
Asbestos	<i>b</i>	
Beryllium	0.001	(24-hour)
Mercury	0.25	(24-hour)
Vinyl chloride	15	(24-hour)
Fluorides	0.25	(24-hour)
Sulfuric acid mist	<i>b</i>	
Total reduced sulfur (including H ₂ S)	<i>b</i>	
Reduced sulfur (including H ₂ S)	<i>b</i>	
Hydrogen sulfide	0.2	(1-hour)

a No significant air quality concentration for ozone monitoring has been established. Instead, applicants with a net emissions increase of 100 tons/year or more of VOC's subject to PSD would be required to perform an ambient impact analysis, including pre-application monitoring data.

b Acceptable monitoring techniques may not be available at this time. Monitoring requirements for this pollutant should be discussed with the permitting agency.

The determination of the proposed project's effects on air quality (for comparison with the significant monitoring value) is based on the results of the dispersion modeling used for establishing the impact area (see Section IV.B of this chapter). Modeling by itself or in conjunction with available monitoring data should be used to determine whether the existing ambient concentrations are equal to or greater than the significant monitoring value. The applicant may utilize a screening technique for this purpose, or may elect to use a refined model. Consultation with the permitting agency is advised before any model is selected. Ambient impacts from existing sources are estimated using the same model input data as are used for the NAAQS analysis, as described in section IV.D.4 of this chapter.

If a potential threat to the NAAQS is identified by the modeling predictions, then continuous ambient monitoring data should be required, even when the predicted impact of the proposed project is less than the significant monitoring value. This is especially important when the modeled impacts of existing sources are uncertain due to factors such as complex terrain and uncertain emissions estimates.

Also, if the location of the proposed source or modification is not affected by other major stationary point sources, the assessment of existing ambient concentrations may be done by evaluating available monitoring data. It is generally preferable to use data collected within the area of concern; however, the possibility of using measured concentrations from representative "regional" sites may be discussed with the permitting agency. The PSD Monitoring Guideline provides additional guidance on the use of such regional sites.

Once a determination is made by the permitting agency that ambient monitoring data must be submitted as part of the PSD application, the requirement can be satisfied in one of two ways. First, under certain conditions, the applicant may use existing ambient data. To be acceptable, such data must be judged by the permitting agency to be representative of the air quality for the area in which the proposed project would construct and operate. Although a State or local agency may have monitored air quality for

several years, the data collected by such efforts may not necessarily be adequate for the preconstruction analysis required under PSD. In determining the representativeness of any existing data, the applicant and the permitting agency must consider the following critical items (described further in the PSD Monitoring Guideline):

- *monitor location;*
- *quality of the data; and*
- *currentness of the data.*

If existing data are not available, or they are judged not to be representative, then the applicant must proceed to establish a site-specific monitoring network. The EPA strongly recommends that the applicant prepare a monitoring plan before any actual monitoring begins. Some permitting agencies may require that such a plan be submitted to them for review and approval. In any case, the applicant will want to avoid any possibility that the resulting data are unacceptable because of such things as improperly located monitors, or an inadequate number of monitors. To assure the accuracy and precision of the data collected, proper quality assurance procedures pursuant to *Appendix B of 40 CFR Part 58* must also be followed. The recommended minimum contents of a monitoring plan, and a discussion of the various considerations to be made in designing a PSD monitoring network, are contained in the PSD Monitoring Guideline.

The PSD regulations generally require that the applicant collect 1 year of ambient data (EPA recommends 80 percent data recovery for PSD purposes). However, the permitting agency has discretion to accept data collected over a shorter period of time (but in no case less than 4 months) if a complete and adequate analysis can be accomplished with the resulting data. Any decision to approve a monitoring period shorter than 1 year should be based on a demonstration by the applicant (through historical data or dispersion modeling) that the required air quality data will be obtained during a time period, or periods, when maximum ambient concentrations can be expected.

For a pollutant for which there is no NAAQS (i.e., a noncriteria pollutant), EPA's general position is not require monitoring data, but to base the air quality analysis on modeled impacts. However, the permitting agency may elect to require the submittal of air quality monitoring data for noncriteria pollutants in certain cases, such as where:

- *a State has a standard for a non-criteria pollutant;*
- *the reliability of emissions data used as input to modeling existing sources is highly questionable; and*
- *available models or complex terrain make it difficult to estimate air quality or the impact of the proposed or modification.*

The applicant will need to confer with the permitting agency to determine whether any ambient monitoring may be required. Before the agency exercises its discretion to require such monitoring, there should be an acceptable measurement method approved by EPA or the appropriate permitting agency.

With regard to particulate matter, where two different indicators of the pollutant are being regulated, EPA considers the PM-10 indicator to represent the criteria form of the pollutant (the NAAQS are now expressed in terms of ambient PM-10 concentrations) and TSP is viewed as the non-criteria form. Consequently, EPA intends to apply the pre-application monitoring requirements to PM-10 primarily, while treating TSP on a discretionary basis in light of its noncriteria status. Although the PSD increments for particulate matter are still based on the TSP indicator, modeling data, not ambient monitoring data, are used for increment analyses.

Ambient air quality data collected by the applicant must be presented in the PSD application as part of the air quality analysis. Monitoring data collected for a criteria pollutant may be used in conjunction with dispersion modeling results to demonstrate NAAQS compliance. Each PSD application involves its own unique set of factors, i.e., the integration of measured ambient data and modeled projections. Consequently, the amount of data to be

used and the manner of presentation are matters that should be discussed with the permitting agency.

III.B POST-CONSTRUCTION AIR QUALITY MONITORING

The PSD Monitoring Guideline recommends that post-construction monitoring be done when there is a valid reason, such as (1) when the NAAQS are threatened, and (2) when there are uncertainties in the data bases for modeling. Any decision to require post-construction monitoring will generally be made after the PSD application has been thoroughly reviewed. It should be noted that the PSD regulations do not require that the significant monitoring concentrations be considered by the permitting agency in determining the need for post-construction monitoring.

Existing monitors can be considered for collecting post-construction ambient data as long as they have been approved for PSD monitoring purposes. However, the location of the monitors should be checked to ascertain their appropriateness if other new sources or modifications have subsequently occurred, because the new emissions from the more recent projects could alter the location of points of maximum ambient concentrations where ambient measurements need to be made.

Generally, post-construction monitoring should not begin until the source is operating near intended capacity. If possible the collection of data should be delayed until the source is operating at a rate equal to or greater than 50 percent of design capacity. The PSD Monitoring Guideline provides, however, that in no case should post-construction monitoring be delayed later than 2 years after the start-up of the new source or modification.

Post-approval ozone monitoring is an alternative to pre-application monitoring for applicants proposing to emit VOC's if they choose to accept nonattainment preconstruction review requirements, including LAER, emissions and air quality offsets, and statewide compliance of other sources under the same ownership. As indicated in Table C-3, pre-application monitoring for

ozone is required when the proposed source or modification would emit at least 100 tons per year of volatile organic compounds (VOC). Note that this emissions rate for VOC emissions is a surrogate for the significant monitoring concentration for the pollutant ozone (see *Table C-3*). Under 40 CFR 52.21(m)(1)(vi), post-approval monitoring data for ozone is required (and cannot be waived) in conjunction with the aforementioned nonattainment review requirements when the permitting agency waives the requirement for pre-application ozone monitoring data. The post-approval period may begin any time after the source receives its PSD permit. In no case should the post-approval monitoring be started later than 2 years after the start-up of the new source or modification.

III.C METEOROLOGICAL MONITORING

Meteorological data is generally needed for model input as part of the air quality analysis. It is important that such data be representative of the atmospheric dispersion and climatological conditions at the site of the proposed source or modification, and at locations where the source may have a significant impact on air quality. For this reason, site specific data are preferable to data collected elsewhere. On-site meteorological monitoring may be required, even when on-site air quality monitoring is not.

The *PSD Monitoring Guideline* should be used to establish locations for any meteorological monitoring network that the applicant may be required to operate and maintain as part of the preconstruction monitoring requirements. That guidance specifies the meteorological instrumentation to be used in measuring meteorological parameters such as wind speed, wind direction, and temperature. The *PSD Monitoring Guideline* also provides that the retrieval of valid wind/stability data should not fall below 90 percent on an annual basis. The type, quantity, and format of the required data will be influenced by the specific input requirements of the dispersion modeling techniques used in the air quality analysis. Therefore, the applicant will need to consult with the permitting agency prior to establishing the required network.

Additional guidance for the collection and use of on-site data is provided in the PSD Monitoring Guideline. Also, the EPA documents entitled On-Site Meteorological Program Guidance for Regulatory Modeling Applications (Reference 3), and Volume IV of the series of reports entitled Quality Assurance Handbook for Air Pollution Measurement Systems (Reference 4), contain information required to ensure the quality of the meteorological measurements collected.

IV. DISPERSION MODELING ANALYSIS

Dispersion models are the primary tools used in the air quality analysis. These models estimate the ambient concentrations that will result from the PSD applicant's proposed emissions in combination with emissions from existing sources. The estimated total concentrations are used to demonstrate compliance with any applicable NAAQS or PSD increments. The applicant should consult with the permitting agency to determine the particular requirements for the modeling analysis to assure acceptability of any air quality modeling technique(s) used to perform the air quality analysis contained in the PSD application.

IV.A OVERVIEW OF THE DISPERSION MODELING ANALYSIS

The dispersion modeling analysis usually involves two distinct phases: (1) a *preliminary analysis* and (2) a *full impact analysis*. The *preliminary analysis* models only the significant increase in potential emissions of a pollutant from a proposed new source, or the significant net emissions increase of a pollutant from a proposed modification. The results of this preliminary analysis determine whether the applicant must perform a full impact analysis, involving the estimation of background pollutant concentrations resulting from existing sources and growth associated with the proposed source. Specifically, the *preliminary analysis*:

- *determines whether the applicant can forego further air quality analyses for a particular pollutant;*
- *may allow the applicant to be exempted from the ambient monitoring data requirements (described in section III of this chapter); and*
- *is used to define the impact area within which a full impact analysis must be carried out.*

The EPA does not require a full impact analysis for a particular pollutant when emissions of that pollutant from a proposed source or modification would not increase ambient concentrations by more than prescribed significant ambient impact levels, including special Class I significance

levels. However, the applicant should check any applicable State or local PSD program requirements in order to determine whether such requirements may contain any different procedures which may be more stringent. In addition, the applicant must still address the requirements for additional impacts required under separate PSD requirements, as described in Chapters D and E which follow this chapter.

A *full impact analysis* is required for any pollutant for which the proposed source's estimated ambient pollutant concentrations exceed prescribed significant ambient impact levels. This analysis expands the preliminary analysis in that it considers emissions from:

- *the proposed source;*
- *existing sources;*
- *residential, commercial, and industrial growth that accompanies the new activity at the new source or modification (i.e., secondary emissions).*

For SO₂, particulate matter, and NO₂, the full impact analysis actually consists of separate analyses for the NAAQS and PSD increments. As described later in this section, the selection of background sources (and accompanying emissions) to be modeled for the NAAQS and increment components of the overall analysis proceeds under somewhat different sets of criteria. In general, however, the full impact analysis is used to project ambient pollutant concentrations against which the applicable NAAQS and PSD increments are compared, and to assess the ambient impact of non-criteria pollutants.

The reviewer's primary role is to determine whether the applicant selected the appropriate model(s), used appropriate input data, and followed recommended procedures to complete the air quality analysis. Appendix C in the *Modeling Guideline* provides an example checklist which recommends a standardized set of data to aid the reviewer in determining the completeness and correctness of an applicant's air quality analysis.

Figure C-3 outlines the basic steps for an applicant to follow for a PSD dispersion modeling analysis to demonstrate compliance with the NAAQS and PSD increments. These steps are described in further detail in the sections which follow.

IV.B DETERMINING THE IMPACT AREA

The proposed project's *impact area* is the geographical area for which the required air quality analyses for the NAAQS and PSD increments are carried out. This area includes all locations where the significant increase in the potential emissions of a pollutant from a new source, or significant net emissions increase from a modification, will cause a significant ambient impact (i.e., equal or exceed the applicable significant ambient impact level, as shown in *Table C-4*). The highest modeled pollutant concentration for each averaging time is used to determine whether the source will have a significant ambient impact for that pollutant.

The *impact area* is a circular area with a radius extending from the source to (1) the most distant point where approved dispersion modeling predicts a significant ambient impact will occur, or (2) a modeling receptor distance of 50 km, whichever is less. Usually the area of modeled significant impact does not have a continuous, smooth border. (It may actually be comprised of pockets of significant impact separated by pockets of insignificant impact.) Nevertheless, the required air quality analysis is carried out within the circle that circumscribes the significant ambient impacts, as shown in *Figure C-4*.

Initially, for each pollutant subject to review an impact area is determined for every averaging time. The impact area used for the air quality analysis of a particular pollutant is the largest of the areas determined for that pollutant. For example, modeling the proposed SO₂ emissions from a new source might show that a significant ambient SO₂ impact occurs out to a distance from the source of 2 kilometers for the annual averaging period;

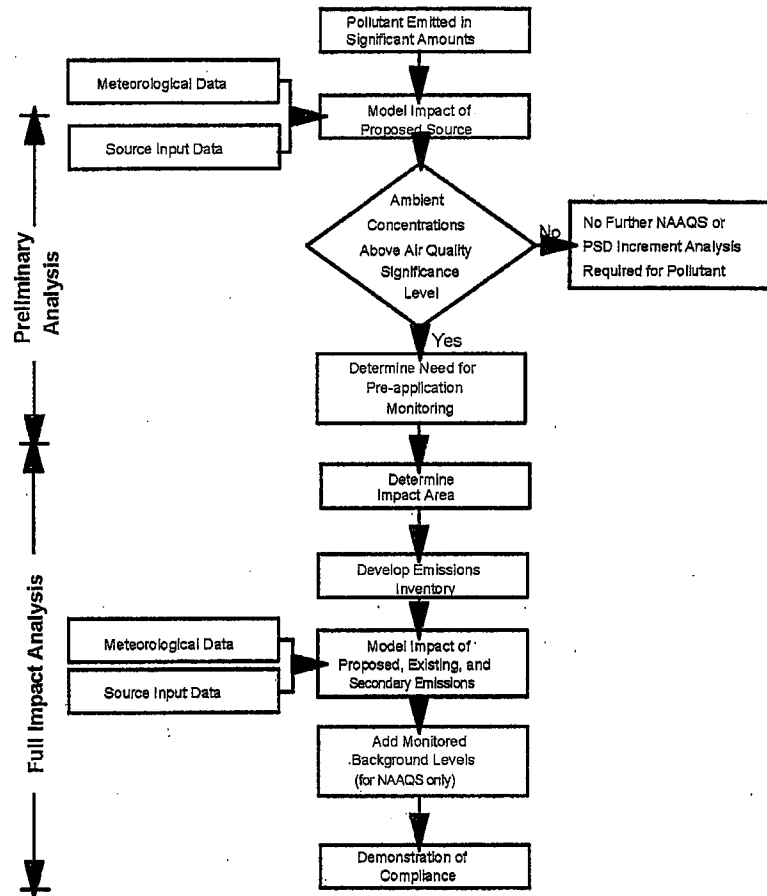


Figure I-C-3. Basic Steps in the Air Quality Analysis,
(NAAQS and PSD Increments)

TABLE C-4.

SIGNIFICANCE LEVELS FOR AIR QUALITY IMPACTS IN CLASS II AREAS^a

Pollutant	Annual	24-hour	8-hour	3-hour	1-hour
SO ₂	1	5	-	25	-
TSP	1	5	-	-	-
PM-10	1	5	-	-	-
NO _x	1	-	-	-	-
CO	-	-	500	-	2,000
O ₃	-	-	-	-	^b

^a This table does not apply to Class I areas. If a proposed source is located within 100 kilometers of a Class I area, an impact of 1 $\mu\text{g}/\text{m}^3$ on a 24-hour basis is significant.

^b No significant ambient impact concentration has been established. Instead, any net emissions increase of 100 tons per year of VOC subject to PSD would be required to perform an ambient impact analysis.

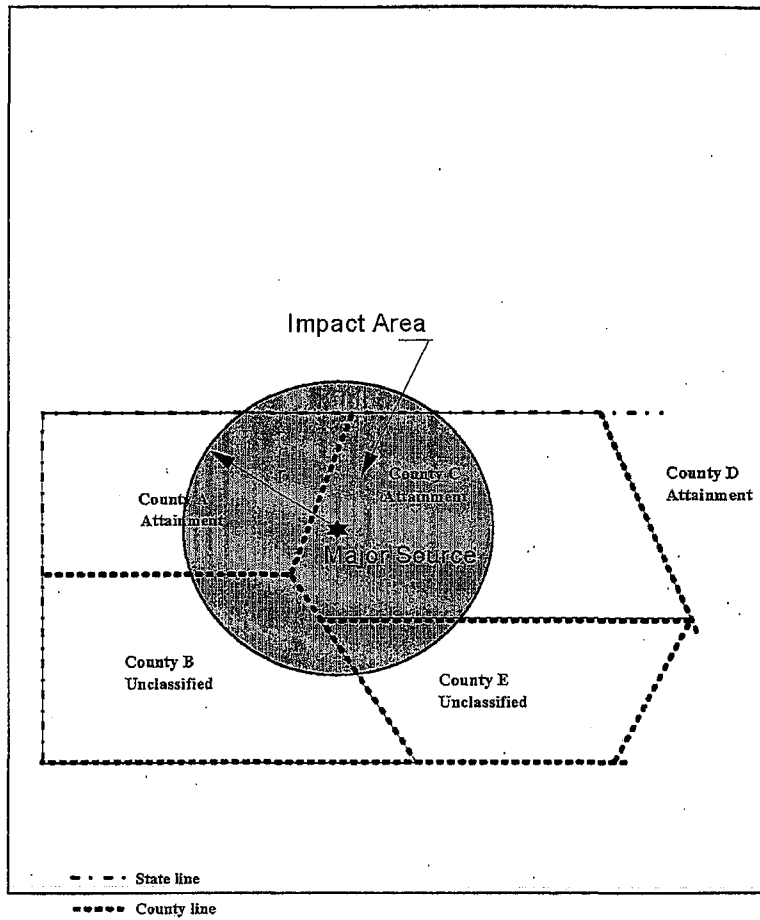


Figure C-4. Determining the Impact Area.

4.3 kilometers for the 24-hour averaging period; and 3.8 kilometers for the 3-hour period. Therefore, an impact area with a radius of 4.3 kilometers from the proposed source is selected for the SO₂ air quality analysis.

In the event that the maximum ambient impact of a proposed emissions increase is below the appropriate ambient air quality significance level for all locations and averaging times, a full impact analysis for that pollutant is not required by EPA. Consequently, a preliminary analysis which predicts an insignificant ambient impact everywhere is accepted by EPA as the required air quality analysis (NAAQS and PSD increments) for that pollutant. *[NOTE: While it may be shown that no impact area exists for a particular pollutant, the PSD application (assuming it is the first one in the area) still establishes the PSD baseline area and minor source baseline date in the section 107 attainment or unclassifiable area where the source will be located, regardless of its insignificant ambient impact.]*

For each applicable pollutant, the determination of an impact area must include all stack emissions and quantifiable fugitive emissions resulting from the proposed source. For a proposed modification, the determination includes contemporaneous emissions increases and decreases, with emissions decreases input as negative emissions in the model. The EPA allows for the exclusion of temporary emissions (e.g., emissions occurring during the construction phase of a project) when establishing the impact area and conducting the subsequent air quality analysis, if it can be shown that such emissions do not impact a Class I area or an area where a PSD increment for that pollutant is known to be violated. However, where EPA is not the PSD permitting authority, the applicant should confer with the appropriate permitting agency to determine whether it allows for the exclusion of temporary emissions.

Once defined for the proposed PSD project, the impact area(s) will determine the scope of the required air quality analysis. That is, the impact area(s) will be used to

- *set the boundaries within which ambient air quality monitoring data may need to be collected,*
- *define the area over which a full impact analysis (one that considers the contribution of all sources) must be undertaken, and*
- *guide the identification of other sources to be included in the modeling analyses.*

Again, if no significant ambient impacts are predicted for a particular pollutant, EPA does not require further NAAQS or PSD increment analysis of that pollutant. However, the applicant must still consider any additional impacts which the proposed source may have concerning impairment on visibility, soils and vegetation, as well as any adverse impacts on air quality related values in Class I areas (see Chapters D and E of this part).

IV.C SELECTING SOURCES FOR THE PSD EMISSIONS INVENTORIES

When a full impact analysis is required for any pollutant, the applicant is responsible for establishing the necessary inventories of existing sources and their emissions, which will be used to carry out the required NAAQS and PSD increment analyses. Such special emissions inventories contain the various source data used as input to an applicable air quality dispersion model to estimate existing ambient pollutant concentrations. Requirements for preparing an emissions inventory to support a modeling analysis are described to a limited extent in the Modeling Guideline. In addition, a number of other EPA documents (e.g., References 5 through 11) contain guidance on the fundamentals of compiling emissions inventories. The discussion which follows pertains primarily to identifying and selecting existing sources to be included in a PSD emissions inventory as needed for a full impact analysis.

The permitting agency may provide the applicant a list of existing sources upon request once the extent of the impact area(s) is known. If the

list includes only sources above a certain emissions threshold, the applicant is responsible for identifying additional sources below that emissions level which could affect the air quality within the impact area(s). The permitting agency should review all required inventories for completeness and accuracy.

IV.C.1 THE NAAQS INVENTORY

While air quality data may be used to help identify existing background air pollutant concentrations, EPA requires that, at a minimum, all nearby sources be explicitly modeled as part of the NAAQS analysis. The Modeling Guideline defines a "nearby" source as any point source expected to cause a significant concentration gradient in the vicinity of the proposed new source or modification. For PSD purposes, "vicinity" is defined as the impact area. However, the location of such nearby sources could be anywhere within the impact area or an annular area extending 50 kilometers beyond the impact area. (See *Figure C-5*.)

In determining which existing point sources constitute nearby sources, the Modeling Guideline necessarily provides flexibility and requires judgment to be exercised by the permitting agency. Moreover, the screening method for identifying a nearby source may vary from one permitting agency to another. To identify the appropriate method, the applicant should confer with the permitting agency prior to actually modeling any existing sources.

The Modeling Guideline indicates that the useful distance for guideline models is 50 kilometers. Occasionally, however, when applying the above source identification criteria, existing stationary sources located in the annular area beyond the impact area may be more than 50 kilometers from portions of the impact area. When this occurs, such sources' modeled impacts throughout the entire impact area should be calculated. That is, special steps should not be taken to cut off modeled impacts of existing sources at receptors within the applicants impact area merely because the receptors are

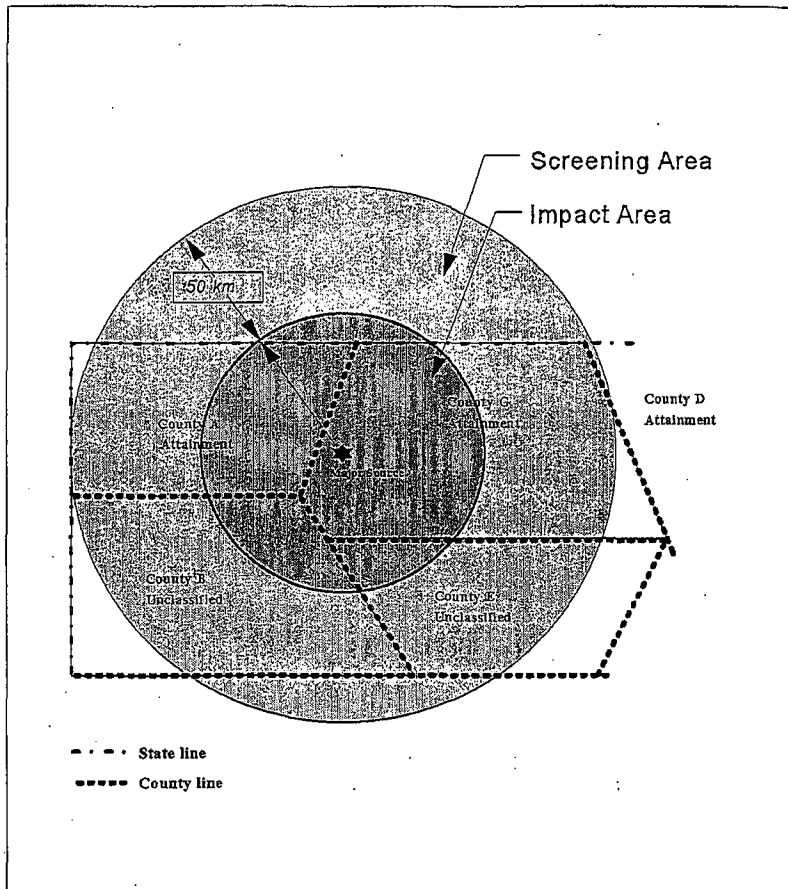


Figure C-5
Defining the Emissions Inventory Screening Area.

located beyond 50 kilometers from such sources. Modeled impacts beyond 50 kilometers should be considered as conservative estimate in that they tend to overestimate the true source impacts. Consequently, if it is found that an existing source's impact include estimates at distances exceeding the normal 50-kilometer range, it may be appropriate to consider other techniques, including long-range transport models. Applicants should consult with the permitting agency prior to the selection of a model in such cases.

It will be necessary to include in the NAAQS inventory those sources which have received PSD permits but have not yet not begun to operate, as well as any complete PSD applications for which a permit has not yet been issued. In the latter case, it is EPA's policy to account for emissions that will occur at sources whose complete PSD application was submitted as of thirty days prior to the date the proposed source files its PSD application. Also, sources from which secondary emissions will occur as a result of the proposed source should be identified and evaluated for inclusion in the NAAQS inventory. While existing mobile source emissions are considered in the determination of background air quality for the NAAQS analysis (typically using existing air quality data), it should be noted that the applicant need not model estimates of future mobile source emissions growth that could result from the proposed project because the definition of "secondary emissions" specifically excludes any emissions coming directly from mobile sources.

Air quality data may be used to establish background concentrations in the impact area resulting from existing sources that are not considered as nearby sources (e.g., area and mobile sources, natural sources, and distant point sources). If, however, adequate air quality data do not exist (and the applicant was not required to conduct pre-application monitoring), then these "other" background sources are also included in the NAAQS inventory so that their ambient impacts can be estimated by dispersion modeling.

IV.C.2 THE INCREMENT INVENTORY

An emissions inventory for the analysis of affected PSD increments must also be developed. The increment inventory includes all increment-affecting sources located in the impact area of the proposed new source or modification. Also, all increment-affecting sources located within 50 kilometers of the impact area (see *Figure C-5*) are included in the inventory if they, either individually or collectively, affect the amount of PSD increment consumed. The applicant should contact the permitting agency to determine what particular procedures should be followed to identify sources for the increment inventory.

In general, the stationary sources of concern for the increment inventory are those stationary sources with actual emissions changes occurring since the minor source baseline date. However, it should be remembered that certain actual emissions changes occurring before the minor source baseline date (i.e., at major stationary point sources) also affect the increments. Consequently, the types of stationary point sources that are initially reviewed to determine the need to include them in the increment inventory fall under two specific time frames as follows:

After the major source baseline date-

- *existing major stationary sources having undergone a physical change or change in their method of operation; and*
- *new major stationary sources.*

After the minor source baseline date-

- *existing stationary sources having undergone a physical change or change in their method of operation;*
- *existing stationary sources having increased hours of operation or capacity utilization (unless such change was considered representative of baseline operating conditions); and*
- *new stationary sources.*

If, in the impact area or surrounding screening area, area or mobile source emissions will affect increment consumption, then emissions input data for such minor sources are also included in the increment inventory. The change in such emissions since the minor source baseline date (rather than the absolute magnitude of these emissions) is of concern since this change is what may affect a PSD increment. Specifically, the rate of growth and the amount of elapsed time since the minor source baseline date was established determine the extent of the increase in area and mobile source emissions. For example, in an area where the minor source baseline date was recently established (e.g., within the past year or so of the proposed PSD project), very little area and mobile source emissions growth may have occurred. Also, sufficient data (particularly mobile source data) may not yet be available to reflect the amount of growth that has taken place. As with the NAAQS analysis, applicants are not required to estimate future mobile source emissions growth that could result from the proposed project because they are excluded from the definition of "secondary emissions."

The applicant should initially consult with the permitting agency to determine the availability of data for assessing area and mobile source growth since the minor source baseline date. This information, or the fact that such data is not available, should be thoroughly documented in the application. The permitting agency should verify and approve the basis for actual area source emissions estimates and, especially if these estimates are considered by the applicant to have an insignificant impact, whether it agrees with the applicant's assessment.

When area and mobile sources are determined to affect any PSD increment, their emissions must be reported on a gridded basis. The grid should cover the entire impact area and any areas outside the impact area where area and mobile source emissions are included in the analysis. The exact sizing of an emissions inventory grid cell generally should be based on the emissions density in the area and any computer constraints that may exist. Techniques for assigning area source emissions to grid cells are provided in Reference 11. The grid layout should always be discussed with, and approved by, the permitting agency in advance of its use.

IV.C.3 NONCRITERIA POLLUTANTS INVENTORY

An inventory of all noncriteria pollutants emitted in significant amounts is required for estimating the resulting ambient concentrations of those pollutants. Significant ambient impact levels have not been established for non-criteria pollutants. Thus, an impact area cannot be defined for non-criteria pollutants in the same way as for criteria pollutants. Therefore, as a general rule of thumb, EPA believes that an emissions inventory for non-criteria pollutants should include sources within 50 kilometers of the proposed source. Some judgment will be exercised in applying this position on a case-by-case basis.

IV.D MODEL SELECTION

Two levels of model sophistication exist: screening and refined dispersion modeling. Screening models may be used to eliminate more extensive modeling for either the preliminary analysis phase or the full impact analysis phase, or both. However, the results must demonstrate to the satisfaction of the permitting agency that all applicable air quality analysis requirements are met. Screening models produce conservative estimates of ambient impact in order to reasonably assure that maximum ambient concentrations will not be underestimated. If the resulting estimates from a screening model indicate a threat to a NAAQS or PSD increment, the applicant uses a refined model to re-estimate ambient concentrations (of course, the applicant can select other options, such as reducing emissions, or to decrease impacts). Guidance on the use of screening procedures to estimate the air quality impact of stationary sources is presented in EPA's Screening Procedures for Estimating Air Quality Impact of Stationary Sources [Reference 12].

A refined dispersion model provides more accurate estimates of a source's impact and, consequently, requires more detailed and precise input data than does a screening model. The applicant is referred to *Appendix A* of the Modeling Guideline for a list of EPA-preferred models, i.e., *guideline models*. The guideline model selected for a particular application should be the one which most accurately represents atmospheric transport, dispersion,

and chemical transformations in the area under analysis. For example, models have been developed for both simple and complex terrain situations; some are designed for urban applications, while others are designed for rural applications.

In many circumstances the guideline models known as Industrial Source Complex Model Short- and Long-term (ISCST and ISCLT, respectively) are acceptable for stationary sources and are preferred for use in the dispersion modeling analysis. A brief discussion of options required for regulatory applications of the ISC model is contained in the Modeling Guideline. Other guideline models, such as the Climatological Dispersion Model (CDM), may be needed to estimate the ambient impacts of area and mobile sources.

Under certain circumstances, refined dispersion models that are not listed in the Modeling Guideline, i.e., *non-guideline models*, may be considered for use in the dispersion modeling analysis. The use of a non-guideline model for a PSD permit application must, however, be pre-approved on a case-by-case basis by EPA. The applicant should refer to the EPA documents entitled Interim Procedures for Evaluating Air Quality Models (Revised) [Reference 13] and Interim Procedures for Evaluating Air Quality Models: Experience with Implementation [Reference 14]. Close coordination with EPA and the appropriate State or local permitting agency is essential if a non-guideline model is to be used successfully.

IV.D.1 METEOROLOGICAL DATA

Meteorological data used in air quality modeling must be spatially and climatologically (temporally) representative of the area of interest. Therefore, an applicant should consult the permitting authority to determine what data will be most representative of the location of the applicant's proposed facility.

Use of site-specific meteorological data is preferred for air quality modeling analyses if 1 or more years of quality-assured data are available. If at least 1 year of site-specific data is not available, 5 years of meteorological data from the nearest National Weather Service (NWS) station can be used in the modeling analysis. Alternatively, data from universities, the Federal Aviation Administration, military stations, industry, and State or local air pollution control agencies may be used if such data are equivalent in accuracy and detail to the NWS data, and are more representative of the area of concern.

The 5 years of data should be the most recent consecutive 5 years of meteorological data available. This 5-year period is used to ensure that the model results adequately reflect meteorological conditions conducive to the prediction of maximum ambient concentrations. The NWS data may be obtained from the National Climatic Data Center (Asheville, North Carolina), which serves as a clearinghouse to collect and distribute meteorological data collected by the NWS.

IV.D.2 RECEPTOR NETWORK

Polar and Cartesian networks are two types of receptor networks commonly used in refined air dispersion models. A *polar network* is comprised of concentric rings and radial arms extending outward from a center point (e.g., the modeled source). Receptors are located where the concentric rings and radial arms intersect. Particular care should be exercised in using a polar network to identify maximum estimated pollutant concentrations because of the inherent problem of increased longitudinal spacing of adjacent receptors as

their distance along neighboring radial arms increases. For example, as illustrated in *Figure C-6*, while the receptors on individual radials, e.g., *A1, A2, A3...* and *B1, B2, B3...*, may be uniformly spaced at a distance of 1 kilometer apart, at greater distances from the proposed source, the longitudinal distance between the receptors, e.g., *A4* and *B4*, on neighboring radials may be several kilometers. As a result of the presence of larger and larger "blind spots" between the radials as the distance from the modeled source increases, finding the maximum source impact can be somewhat problematic. For this reason, using a polar network for anything other than initial screening is generally discouraged.

A *cartesian network* (also referred to as a rectangular network) consists of north-south and east-west oriented lines forming a rectangular grid, as shown in *Figure C-6*, with receptors located at each intersection point. In most refined air quality analyses, a cartesian grid with from 300 to 400 receptors (where the distance from the source to the farthest receptor is 10 kilometers) is usually adequate to identify areas of maximum concentration. However, the total number of receptors will vary based on the specific air quality analysis performed.

In order to locate the maximum modeled impact, perform multiple model runs, starting with a relatively coarse receptor grid (e.g., one or two kilometer spacing) and proceeding to a relatively fine receptor grid (e.g., 100 meters). The fine receptor grid should be used to focus on the area(s) of higher estimated pollutant concentrations identified by the coarse grid model runs. With such multiple runs the maximum modeled concentration can be identified. It is the applicant's responsibility to demonstrate that the final receptor network is sufficiently compact to identify the maximum estimated pollutant concentration for each applicable averaging period. This applies both to the PSD increments and to the NAAQS.

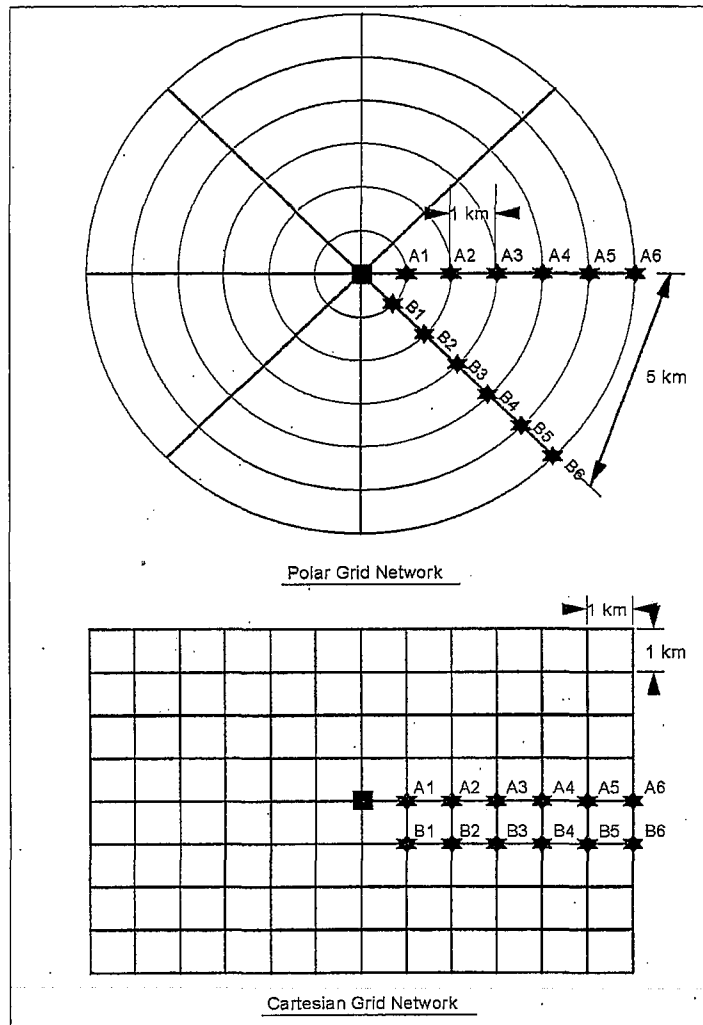


Figure C-6. Examples of Polar and Cartesian Grid Networks.

Some air quality models allow the user to input discrete receptors at user-specified locations. The selection of receptor sites should be a case-by-case determination, taking into consideration the topography, the climatology, the monitor sites, and the results of the preliminary analysis. For example, receptors should be located at:

- *the fenceline of a proposed facility;*
- *the boundary of the nearest Class I or nonattainment area;*
- *the location(s) of ambient air monitoring sites; and*
- *locations where potentially high ambient air concentrations are expected to occur.*

In general, modeling receptors for both the NAAQS and the PSD increment analyses should be placed at ground level points anywhere except on the applicant's plant property if it is inaccessible to the general public. Public access to plant property is to be assumed, however, unless a continuous physical barrier, such as a fence or wall, precludes entrance onto that property. In cases where the public has access, receptors should be located on the applicant's property. It is important to note that ground level points of receptor placement could be over bodies of water, roadways, and property owned by other sources. For NAAQS analyses, modeling receptors may also be placed at elevated locations, such as on building rooftops. However, for PSD increments, receptors are limited to locations at ground level.

IV.D.3 GOOD ENGINEERING PRACTICE (GEP) STACK HEIGHT

Section 123 of the Clean Air Act limits the use of dispersion techniques, such as merged gas streams, intermittent controls, or stack heights above GEP, to meet the NAAQS or PSD increments. The GEP stack height is defined under Section 123 as "the height necessary to insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash.

eddies or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles." The EPA has promulgated stack height regulations under 40 CFR Part 51 which help to determine the GEP stack height for any stationary source.

Three methods are available for determining "GEP stack height" as defined in 40 CFR 51.100(ii):

- *use the 65 meter (213.5 feet) de minimis height as measured from the ground-level elevation at the base of the stack;*
- *calculate the refined formula height using the dimensions of nearby structures (this height equals $H + 1.5L$, where H is the height of the nearby structure and L is the lesser dimension of the height or projected width of the nearby structure); or*
- *demonstrate by a fluid model or field study the equivalent GEP formula height that is necessary to avoid excessive concentrations caused by atmospheric downwash, wakes, or eddy effects by the source, nearby structures, or nearby terrain features.*

That portion of a stack height in excess of the GEP height is generally not creditable when modeling to develop source emissions limitations or to determine source impacts in a PSD air quality analysis. For a stack height less than GEP height, screening procedures should be applied to assess potential air quality impacts associated with building downwash. In some cases, the aerodynamic turbulence induced by surrounding buildings will cause stack emissions to be mixed rapidly toward the ground (downwash), resulting in higher-than-normal ground level concentrations in the vicinity of the source. Reference 12 contain screening procedures to estimate downwash concentrations in the building wake region. The Modeling Guideline recommends using the Industrial Source Complex (ISC) air dispersion model to determine building wake effects on maximum estimated pollutant concentrations.

For additional guidance on creditable stack height and plume rise calculations, the applicant should consult with the permitting agency. In addition, several EPA publications [References 15 through 19] are available for the applicant's review.

IV.D.4 SOURCE DATA

Emissions rates and other source-related data are needed to estimate the ambient concentrations resulting from (1) the proposed new source or modification, and (2) existing sources contributing to background pollutant concentrations (NAAQS and PSD increments). Since the estimated pollutant concentrations can vary widely depending on the accuracy of such data, the most appropriate source data available should always be selected for use in a modeling analysis. Guidance on the identification and selection of existing sources for which source input data must be obtained for a PSD air quality analysis is provided in *section IV.C*. Additional information on the specific source input data requirements is contained in EPA's *Modeling Guideline* and in the users' guide for each dispersion model.

Source input data that must be obtained will depend upon the categorization of the source(s) to be modeled as either a point, area or line source. Area sources are often collections of numerous small emissions sources that are impractical to consider as separate point or line sources. Line sources most frequently considered are roadways.

For each stationary point source to be modeled, the following minimum information is generally necessary:

- *pollutant emission rate (see discussion below);*
- *stack height (see discussion on GEP stack height);*
- *stack gas exit temperature, stack exit inside diameter, and stack gas exit velocity;*
- *dimensions of all structures in the vicinity of the stack in question;*
- *the location of topographic features (e.g., large bodies of water, elevated terrain) relative to emissions points; and*
- *stack coordinates.*

A source's *emissions rate* as used in a modeling analysis for any pollutant is determined from the following source parameters (where MMBtu means "million Btu's heat input"):

- *emissions limit* (e.g., lb/MMBtu);
- *operating level* (e.g., MMBtu/hour); and
- *operating factor* (e.g., hours/day, hours/year).

Special procedures, as described below, apply to the way that each of these parameters is used in calculating the emissions rate for either the proposed new source (or modification) or any existing source considered in the NAAQS and PSD increment analyses. *Table C-5* provides a summary of the point source emissions input data requirements for the NAAQS inventory.

For both NAAQS and PSD increment compliance demonstrations, the *emissions rate* for the proposed new source or modification must reflect the maximum allowable operating conditions as expressed by the federally enforceable *emissions limit*, *operating level*, and *operating factor* for each applicable pollutant and averaging time. The applicant should base the emissions rates on the results of the BACT analysis (see *Chapter B, Part I*). *Operating levels* less than 100 percent of capacity may also need to be modeled where differences in stack parameters associated with the lower operating levels could result in higher ground level concentrations. A value representing less than continuous operation (8760 hours per year) should be used for the *operating factor* only when a federally enforceable operating limitation is placed upon the proposed source. [NOTE: It is important that the applicant demonstrate that all modeled emission rates are consistent with the applicable permit conditions.]

TABLE C-5 POINT SOURCE MODEL INPUT DATA (EMISSIONS) FOR NAAQS COMPLIANCE DEMONSTRATIONS

Averaging Time	Emission Limit (#/MMBtu) ¹	X	Operating Level (MMBtu/hr) ¹	X	Operating Factor (e.g., hr/yr, hr/day)
Proposed Major New or Modified Source					
Annual and quarterly	Maximum allowable emission limit or Federally enforceable permit		Design capacity or Federally enforceable permit condition		Continuous operation (i.e., 8760 hours) ²
Short term (24 hours or less)	Maximum allowable emission limit or Federally enforceable permit limit		Design capacity or Federally enforceable permit condition ³		Continuous operation (i.e., all hours of each time period under consideration) (for all hours of the meteorological data base) ²
Nearby Background Source(s) ⁴					
Annual and quarterly	Maximum allowable emission limit or Federally enforceable permit		Actual or design capacity (whichever is greater), or Federally enforceable permit condition		Actual operating factor averaged over the most recent 2 years ⁵
Short term	Maximum allowable emission limit or Federally enforceable permit limit		Actual or design capacity (whichever is greater), or Federally enforceable permit condition ³		Continuous operation (i.e., all hours of each time period under consideration) (for all hours of the meteorological data base) ²
Other Background Source(s) ⁴					
Annual and quarterly	Maximum allowable emission limit or Federally enforceable permit limit		Annual level when actually operating, averaged over the most recent 2 years ⁵		Actual operating factor averaged over the most recent 2 years ⁵
Short term	Maximum allowable emission limit or Federally enforceable permit limit		Annual level when actually operating, averaged over the most recent 2 years ⁵		Continuous operation (i.e., all hours of each time period under consideration) (for all hours of the meteorological data base) ²

¹ Terminology applicable to fuel burning sources; analogous terminology (e.g., #/throughput) may be used for other types of sources.

² If operation does not occur for all hours of the time period of consideration (e.g., 3 or 24 hours) and the source operation is constrained by a Federally enforceable permit condition, an appropriate adjustment to the modeled emission rate may be made (e.g., if operation is only 8:00 a.m. to 4:00 p.m. each day, only these hours will be modeled with emissions from the source. Modeled emissions should not be averaged across non-operating time periods).

³ Operating levels such as 50 percent and 75 percent of capacity should also be modeled to determine the load causing the highest concentration.

⁴ Includes existing facility to which modification is proposed if the emissions from the existing facility will not be affected by the modification. Otherwise use same parameters as for major modification.

⁵ Unless it is determined that this period is not representative.

⁶ Generally, the ambient impacts from non-nearby background sources can be represented by air quality data unless adequate data do not exist.

For those existing point sources that must be explicitly modeled, i.e., "nearby" sources (see *section IV.C.1* of this chapter), the NAAQS inventory must contain the maximum allowable values for the *emissions limit*, and *operating level*. The *operating factor* may be adjusted to account for representative, historical operating conditions only when modeling for the annual (or quarterly for lead [Pb]) averaging period. In such cases, the appropriate input is the actual operating factor averaged over the most recent 2 years (unless the permitting agency determines that another period is more representative). For short-term averaging periods (24 hours or less), the applicant generally should assume that nearby sources operate continuously. However, the *operating factor* may be adjusted to take into account any federally enforceable permit condition which limits the allowable hours of operation. In situations where the actual *operating level* exceeds the design capacity (considering any federally enforceable limitations), the actual level should be used to calculate the *emissions rate*.

If other background sources need to be modeled (i.e., adequate air quality data are not available to represent their impact), the input requirements for the *emissions limit* and *operating factor* are identical to those for "nearby" sources. However, input for the *operating level* may be based on the annual level of actual operation averaged over the last 2 years (unless the permitting agency determines that a more representative period exists).

The applicant must also include any quantifiable fugitive emissions from the proposed source or any nearby sources. Fugitive emissions are those emissions that cannot reasonably be expected to pass through a stack, vent, or other equivalent opening, such as a chimney or roof vent. Common quantifiable fugitive emissions sources of particulate matter include coal piles, road dust, quarry emissions, and aggregate stockpiles. Quantifiable fugitive emissions of volatile organic compounds (VOC) often occur at components of process equipment. An applicant should consult with the permitting agency to determine the proper procedures for characterizing and modeling fugitive emissions.

When building downwash affects the air quality impact of the proposed source or any existing source which is modeled for the NAAQS analysis, those impacts generally should be considered in the analysis. Consequently, the appropriate dimensions of all structures around the stack(s) in question also should be included in the emissions inventory. Information including building heights and horizontal building dimensions may be available in the permitting agency's files; otherwise, it is usually the responsibility of the applicant to obtain this information from the applicable source(s).

Sources should not automatically be excluded from downwash considerations simply because they are located outside the impact area. Some sources located just outside the impact area may be located close enough to it that the immediate downwashing effects directly impact air quality in the impact area. In addition, the difference in downwind plume concentrations caused by the downwash phenomenon may warrant consideration within the impact area even when the immediate downwash effects do not. Therefore, any decision by the applicant to exclude the effects of downwash for a particular source should be justified in the application, and approved by the permitting agency.

For a PSD increment analysis, an estimate of the amount of increment consumed by existing point sources generally is based on increases in actual emissions occurring since the minor source baseline date. The exception, of course, is for major stationary sources whose actual emissions have increased (as a result of construction) before the minor source baseline date but on or after the major source baseline date. For any increment-consuming (or increment-expanding) emissions unit, the actual *emissions limit*, *operating level*, and *operating factor* may all be determined from source records and other information (e.g., State emissions files), when available, reflecting actual source operation. For the annual averaging period, the change in the actual *emissions rate* should be calculated as the difference between:

- *the current average actual emissions rate*, and
- *the average actual emissions rate as of the minor source baseline date (or major source baseline date for major stationary sources).*

In each case, the average rate is calculated as the average over previous 2-year period (unless the permitting agency determines that a different time period is more representative of normal source operation).

For each short-term averaging period (24 hours and less), the change in the actual emissions rate for the particular averaging period is calculated as the difference between:

- the current maximum actual emissions rate, and
- the maximum actual emissions rate as of the minor source baseline date (or major source baseline date for applicable major stationary sources undergoing construction before the minor source baseline date).

In each case, the maximum rate is the highest occurrence for that averaging period during the previous 2 years of operation.

Where appropriate, air quality impacts from fugitive emissions and building downwash are also taken into account for the PSD increment analysis. Of course, they would only be considered when applicable to increment-consuming emissions.

If the change in the actual emissions rate at a particular source involves a change in stack parameters (e.g., stack height, gas exit temperature, etc.) then the stack parameters and emissions rates associated with both the baseline case and the current situation must be used as input to the dispersion model. To determine increment consumption (or expansion) for such a source, the baseline case emissions are input to the model as negative emissions, along with the baseline stack parameters. In the same model run, the current case for the same source is modeled as the total current emissions associated with the current stack parameters. This procedure effectively calculates, for each receptor and for each averaging time, the difference between the baseline concentration and the current concentration (i.e., the amount of increment consumed by the source).

Emissions changes associated with area and mobile source growth occurring since the minor source baseline date are also accounted for in the

increment analysis by modeling. In many cases state emission files will contain information on area source emissions or such information may be available from EPA's AIRS-NEDS emissions data base. In the absence of this information, the applicant should use procedures adopted for developing state area source emission inventories. The EPA documents outlining procedures for area source inventory development should be reviewed.

Mobile source emissions are usually calculated by applying mobile source emissions factors to transportation data such as vehicle miles travelled (VMT), trip ends, vehicle fleet characteristics, etc. Data are also required on the spatial arrangement of the VMT within the area being modeled. Mobile source emissions factors are available for various vehicle types and conditions from an EPA emissions factor model entitled MOBILE4. The MOBILE4 users manual [Reference 20] should be used in developing inputs for executing this model. The permitting agency can be of assistance in obtaining the needed mobile source emissions data. Oftentimes, these data are compiled by the permitting agency acting in concert with the local planning agency or transportation department.

For both area source and mobile source emissions, the applicant will need to collect data for the minor source baseline date and the current situation. Data from these two dates will be required to calculate the increment-affecting emission changes since the minor source baseline date.

IV.E THE COMPLIANCE DEMONSTRATION

An applicant for a PSD permit must demonstrate that the proposed source will not cause or contribute to air pollution in violation of any NAAQS or PSD increment. This compliance demonstration, for each affected pollutant, must result in one of the following:

- *The proposed new source or modification will not cause a significant ambient impact anywhere.*

If the significant net emissions increase from a proposed source would not result in a significant ambient impact anywhere, the applicant is usually not required to go beyond a preliminary analysis in order to make the necessary showing of compliance for a particular pollutant. In determining the ambient impact for a pollutant, the highest estimated ambient concentration of that pollutant for each applicable averaging time is used.

- *The proposed new source or modification, in conjunction with existing sources, will not cause or contribute to a violation of any NAAQS or PSD increment.*

In general, compliance is determined by comparing the predicted ground level concentrations (based on the full impact analysis and existing air quality data) at each model receptor to the applicable NAAQS and PSD increments. If the predicted pollutant concentration increase over the baseline concentration is below the applicable increment, and the predicted total ground level concentrations are below the NAAQS, then the applicant has successfully demonstrated compliance.

The modeled concentrations which should be used to determine compliance with any NAAQS and PSD increment depend on 1) the type of standard, i.e., deterministic or statistical, 2) the available length of record of meteorological data, and 3) the averaging time of the standard being analyzed. For example, when the analysis is based on 5 years of National Weather Service meteorological data, the following estimates should be used:

- for deterministically based standards (e.g., SO₂), the highest, second-highest short term estimate and the highest annual estimate; and
- for statistically based standards (e.g., PM-10), the highest, sixth-highest estimate and highest 5-year average estimate.

Further guidance to determine the appropriate estimates to use for the compliance determination is found in *Chapter 8* of the Modeling Guideline for SO₂, TSP, lead, NO₂, and CO; and in EPA's PM-10 SIP Development Guideline [Reference 21] for PM-10.

When a violation of any NAAQS or increment is predicted at one or more receptors in the impact area, the applicant can determine whether the net emissions increase from the proposed source will result in a significant ambient impact at the point (receptor) of each predicted violation, and at the time the violation is predicted to occur. The source will not be considered to cause or contribute to the violation if its own impact is not significant at any violating receptor at the time of each predicted violation. In such a case, the permitting agency, upon verification of the demonstration, may approve the permit. However, the agency must also take remedial action through applicable provisions of the state implementation plan to address the predicted violation(s).

- *The proposed new source or modification, in conjunction with existing sources, will cause or contribute to a violation, but will secure sufficient emissions reductions to offset its adverse air quality impact.*

If the applicant cannot demonstrate that only insignificant ambient impacts would occur at violating receptors (at the time of the predicted violation), then other measures are needed before a permit can be issued. Somewhat different procedures apply to NAAQS violations than to PSD increment violations. For a NAAQS violation to which an applicant contributes significantly, a PSD permit may be granted only if sufficient emissions reductions are obtained to compensate for the adverse ambient impacts caused by the proposed source. Emissions reductions are considered to compensate for the proposed source's adverse impact when, at a minimum, (1) the modeled net

concentration, resulting from the proposed emissions increase and the federally enforceable emissions reduction, is less than the applicable significant ambient impact level at each affected receptor, and (2) no new violations will occur. Moreover, such emissions reductions must be made federally enforceable in order to be acceptable for providing the air quality offset. States may adopt procedures pursuant to federal regulations at 40 CFR 51.165(b) to enable the permitting of sources whose emissions would cause or contribute to a NAAQS violation anywhere. The applicant should determine what specific provisions exist within the State program to deal with this type of situation.

In situations where a proposed source would cause or contribute to a PSD increment violation, a PSD permit cannot be issued until the increment violation is entirely corrected. Thus, when the proposed source would cause a new increment violation, the applicant must obtain emissions reductions that are sufficient to offset enough of the source's ambient impact to avoid the violation. In an area where an increment violation already exists, and the proposed source would significantly impact that violation, emissions reductions must not only offset the source's adverse ambient impact, but must be sufficient to alleviate the PSD increment violation, as well.

V. AIR QUALITY ANALYSIS -- EXAMPLE

This section presents a hypothetical example of an air quality analysis for a proposed new PSD source. In reality, no two analyses are alike, so an example that covers all modeling scenarios is not possible to present. However, this example illustrates several significant elements of the air quality analysis, using the procedures and information set forth in this chapter.

An applicant is proposing to construct a new coal-fired, steam electric generating station. Coal will be supplied by railroad from a distant mine. The coal-fired plant is a new major source which has the potential to emit significant amounts of SO₂, PM (particulate matter emissions and PM-10 emissions), NO_x, and CO. Consequently, an air quality analysis must be carried out for each of these pollutants. In this analysis, the applicant is required to demonstrate compliance with respect to -

- the *NAAQS* for SO₂, PM-10, NO₂, and CO, and
- the *PSD increments* for SO₂, TSP, and NO₂.

V.A DETERMINING THE IMPACT AREA

The first step in the air quality analysis is to estimate the ambient impacts caused by the proposed new source itself. This preliminary analysis establishes the impact area for each pollutant emitted in significant amounts, and for each averaging period. The largest impact area for each pollutant is then selected as the impact area to be used in the full impact analysis.

To begin, the applicant prepares a modeling protocol describing the modeling techniques and data bases that will be applied in the preliminary analysis. These modeling procedures are reviewed in advance by the permitting agency and are determined to be in accordance with the procedures described in the Modeling Guideline and the stack height regulations.

Several pollutant-emitting activities (i.e., emissions units) at the source will emit pollutants subject to the air quality analysis. The two main boilers emit particulate matter (i.e., particulate matter emissions and PM-10 emissions), SO₂, NO_x, and CO. A standby auxiliary boiler also emits these pollutants, but will only be permitted to operate when the main boilers are not operating.

Particulate matter emissions and PM-10 emissions will also occur at the coal-handling operations and the limestone preparation process for the flue gas desulfurization (FGD) system. Emissions units associated with coal and limestone handling include:

- *Point sources--the coal car dump, the fly ash silos, and the three coal baghouse collectors;*
- *Area sources--the active and the inactive coal storage piles and the limestone storage pile; and*
- *Line sources--the coal and limestone conveying operation.*

The emissions from all of the emissions units at the proposed source are then modeled to estimate the source's area of significant impact (impact area) for each pollutant. The results of the preliminary analysis indicate that significant ambient concentrations of NO₂ and SO₂ will occur out to distances of 32 and 50 kilometers, respectively, from the proposed source. No significant concentrations of CO are predicted at any location outside the fenced-in property of the proposed source. Thus, an impact area is not defined for CO, and no further CO analysis is required.

Particulate matter emissions from the coal-handling operations and the limestone preparation process result in significant ambient TSP concentrations out to a distance of 2.2 kilometers. However, particulate matter emissions from the boiler stacks will cause significant TSP concentrations for a distance of up to 10 kilometers. Since the boiler emissions of particulate matter are predominantly PM-10 emissions, the same impact area is used for both TSP and PM-10.

This preliminary analysis further indicates that pre-application monitoring data may be required for two of the criteria pollutants, SO₂ and NO₂, since the proposed new source will cause ambient concentrations exceeding the prescribed significant monitoring concentrations for these two pollutants (see *Table C-3*). Estimated concentrations of PM-10 are below the significant monitoring concentration. The permitting agency informs the applicant that the requirement for pre-application monitoring data will not be imposed with regard to PM-10. However, due to the fact that existing ambient concentrations of both SO₂ and NO₂ are known to exceed their respective significant monitoring concentrations, the applicant must address the pre-application monitoring data requirements for these pollutants.

Before undertaking a site-specific monitoring program, the applicant investigates the availability of existing data that is representative of air quality in the area. The permitting agency indicates that an agency-operated SO₂ network exists which it believes would provide representative data for the applicant's use. It remains for the applicant to demonstrate that the existing air quality data meet the EPA criteria for data sufficiency, representativeness, and quality as provided in the *PSD Monitoring Guideline*. The applicant proceeds to provide a demonstration which is approved by the permitting agency. For NO₂, however, adequate data do not exist, and it is necessary for the applicant to take responsibility for collecting such data. The applicant consults with the permitting agency in order to develop a monitoring plan and subsequently undertakes a site-specific monitoring program for NO₂.

In this example, four intrastate counties are covered by the applicant's impact area. Each of these counties, shown in *Figure C-7*, is designated attainment for all affected pollutants. Consequently, a NAAQS and PSD

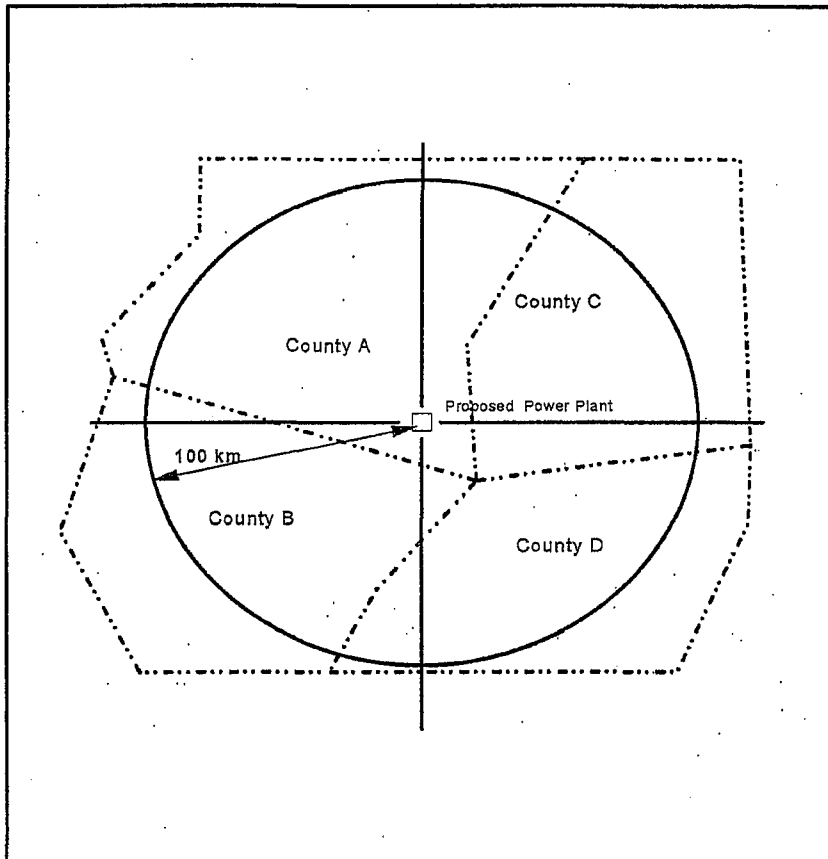


Figure I-C- 7. Counties Within 100 Kilometers of Proposed Source.

analysis must be completed in each county. With the exception of CO (for which no further analysis is required) the applicant proceeds with the full impact analysis for each affected pollutant.

V.B DEVELOPING THE EMISSIONS INVENTORIES

After the impact area has been determined, the applicant proceeds to develop the required emissions inventories. These inventories contain all of the source input data that will be used to perform the dispersion modeling for the required NAAQS and PSD increment analyses. The applicant contacts the permitting agency and requests a listing of all stationary sources within a 100-kilometer radius of the proposed new source. This takes into account the 50-kilometer impact area for SO₂ (the largest of the defined impact areas) plus the requisite 50-kilometer annular area beyond that impact area. For NO₂ and particulate matter, the applicant needs only to consider the identified sources which fall within the specific screening areas for those two pollutants.

Source input data (e.g., location, building dimensions, stack parameters, emissions factors) for the inventories are extracted from the permitting agency's air permit and emissions inventory files. Sources to consider for these inventories also include any that might have recently been issued a permit to operate, but are not yet in operation. However, in this case no such "existing" sources are identified. The following point sources are found to exist within the applicant's impact area and screening area:

- *Refinery A;*
- *Chemical Plant B;*
- *Petrochemical Complex C;*
- *Rock Crusher D;*
- *Refinery E;*
- *Gas Turbine Cogeneration Facility F; and*
- *Portland Cement Plant G.*

A diagram of the general location of these sources relative to the location proposed source is shown in *Figure C-8*. Because the Portland Cement Plant G is located 70 kilometers away from the proposed source, its impact is not considered in the NAAQS or PSD increment analyses for particulate matter. (The area of concern for particulate matter lies within 60 kilometers of the proposed source.) In this example, the applicant first develops the NAAQS emissions inventory for SO₂, particulate matter (PM-10), and NO₂.

V.B.1 THE NAAQS INVENTORY

For each criteria pollutant undergoing review, the applicant (in conjunction with the permitting agency) determines which of the identified sources will be regarded as "nearby" sources and, therefore, must be explicitly modeled. Accordingly, the applicant classifies the candidate sources in the following way:

<u>Pollutant</u>	<u>Nearby sources (explicitly model)</u>	<u>Other Background Sources (non-modeled background)</u>
SO ₂	Refinery A Chemical Plant B Petro. Complex C Refinery E	Port. Cement Plant G
NO ₂	Refinery A, Chemical Plant B Petro. Complex C Gas Turbines F	Refinery E.
Particulate Matter (PM-10)	Refinery A Petro. Complex C Rock Crusher D	Chemical Plant B Refinery E Gas Turbines F

For each nearby source, the applicant now must obtain emissions input data for the model to be used. As a conservative approach, emissions input data reflecting the maximum allowable emissions rate of each nearby source could be used in the modeling analysis. However, because of the relatively

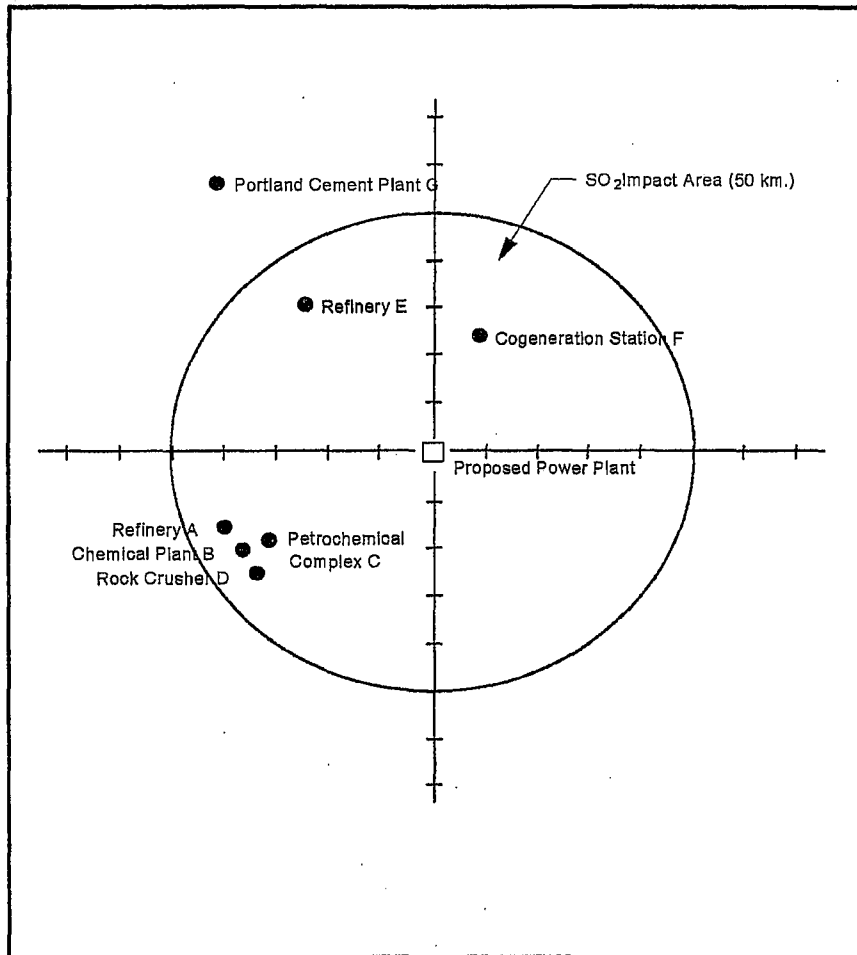


Figure C-8. Point Sources Within 100 Kilometers of Proposed Source.

high concentrations anticipated due to the clustering of sources A, B, C and D, the applicant decides to consider the actual operating factor for each of these sources for the annual averaging period, in accordance with *Table C-5*. For example, for SO₂, the applicant may determine the actual operating factor for sources A, B, and C, because they are classified as nearby sources for SO₂ modeling purposes. On the other hand, the applicant chooses to use the maximum allowable emissions rate for Source E in order to save the time and resources involved with determining the actual operating factors for the 45 individual NO₂ emissions units comprising the source. If a more refined analysis is ultimately warranted, then the actual hours of operation can be obtained from Source E for the purposes of the annual averaging period.

As another example, for particulate matter (PM-10), the applicant may determine the actual annual operating factor for sources A, C, and D, because they are nearby sources for PM-10 modeling purposes. Again, the applicant chooses to determine the actual hours of annual operation because of the relatively high concentrations anticipated due to the clustering of these particular sources.

For each pollutant, the applicant must also determine if emissions from the sources that were not classified as nearby sources can be adequately represented by existing air quality data. In the case of SO₂, for example, data from the existing State monitoring network will adequately measure Source G's ambient impact in the impact area. However, for PM-10, the monitored impacts of Source B cannot be separated from the impacts of the other sources (A, C, and D) within the proximity of Source B. The applicant therefore must model this source but is allowed to determine both the actual operating factor and the actual operating level to model the source's annual impact, in accordance with *Table C-5*. For the short-term (24-hour) analysis the applicant may use the actual operating level, but continuous operation must be used for the operating factor. The ambient impacts of Source E and Source F will be represented by ambient monitoring data.

For the NO₂ NAAQS inventory, the only source not classified as a nearby source is Refinery E. The applicant would have preferred to use ambient data

to represent the ambient impact of this source; however, adequate ambient NO₂ data is not available for the area. In order to avoid modeling this source with a refined model for NO₂, the applicant initially agrees to use a screening technique recommended by the permitting agency to estimate the impacts of Source E.

Air quality impacts caused by building downwash must be considered because several nearby sources (A, B, C, and E) have stacks that are less than GEP stack height. In consultation with the permitting agency, the applicant is instructed to consider downwash for all four sources in the SO₂ NAAQS analysis, because the sources are all located in the SO₂ impact area. Also, after consideration of the expected effect of downwash for other pollutants, the applicant is told that, for NO₂, only Source C must be modeled for its air quality impacts due to downwash, and no modeling for downwash needs to be done with respect to particulate matter.

The applicant gathers the necessary building dimension data for the NAAQS inventory. In this case, these data are available from the permitting agency through its permit files for sources A, B, and E. However, the applicant must contact Source C to obtain the data from that source. Fortunately, the manager of Source C readily provide the applicant this information for each of the 45 individual emission units.

V.B.2 THE INCREMENT INVENTORY

An increment inventory must be developed for SO₂, particulate matter (TSP), and NO₂. This inventory includes all of the applicable emissions input data from:

- *increment-consuming sources within the impact area; and*
- *increment-consuming sources outside the impact area that affect increment consumption in the impact area.*

In considering emissions changes occurring at any of the major stationary sources identified earlier (see *Figure C-8*), the applicant must consider actual emissions changes resulting from a physical change or a change in the

method of operation since the major source baseline date, and any actual emissions changes since the applicable minor source baseline date. To identify those sources (and emissions) that consume PSD increment, the applicant should request information from the permitting agency concerning the baseline area and all baseline dates (including the existence of any prior minor source baseline dates) for each applicable pollutant.

A review of previous PSD applications within the total area of concern reveals that minor source baseline dates for both SO₂ and TSP have already been established in Counties A and B. For NO₂, the minor source baseline date has already been established in County C. A summary of the relevant baseline dates for each pollutant in these three counties is shown in *Table C-6*. The proposed source will, however, establish the minor source baseline date in Counties C and D for SO₂ and TSP, and in Counties A, B and D for NO₂.

For SO₂, the increment-consuming sources deemed to contribute to increment consumption in the impact area are sources A, B, C and E. Source B underwent a major modification which established the minor source baseline date (April 21, 1984). The actual emissions increase resulting from that physical change is used in the increment analysis. Source A underwent a major modification and Source E increased its hours of operation after the minor source baseline date. The actual emissions increases resulting from both of these changes are used in the increment analysis, as well. Finally, Source C received a permit to add a new unit, but the new unit is not yet operational. Consequently, the applicant must use the potential emissions increase resulting from that new unit to model the amount of increment consumed. The existing units at Source C do not affect the increments because no actual emissions changes have occurred since the April 21, 1984 minor source baseline

TABLE C-6. EXISTING BASELINE DATES FOR SO₂, TSP,
AND NO₂ FOR EXAMPLE PSD INCREMENT ANALYSIS

Pollutant	Major Source Baseline Date	Minor Source Baseline Date	Affected Counties
Sulfur dioxide	January 6, 1975	April 21, 1984	A and B
Particulate Matter (TSP)	January 6, 1975	March 14, 1985	A and B
Nitrogen Dioxide	February 8, 1988	June 8, 1988	C

date. Building dimensions data are needed in the increment inventory for nearby sources A, B, and E because each has increment-consuming emissions which are subject to downwash problems. No building dimensions data are needed for Source C, however, because only the emissions from the newly-permitted unit consume increment and the stack built for that unit was designed and constructed at GEP stack height.

For NO_2 , only the gas turbines located at Cogeneration Station F have emissions which affect the increment. The PSD permit application for the construction of these turbines established the minor source baseline date for NO_2 (June 8, 1988). Of course, all construction-based actual emissions changes in NO_x occurring after the major source baseline date for NO_2 (February 8, 1988), at any major stationary source affect increment. However, no such emissions changes were discovered at the other existing sources in the area. Thus, only the actual emissions increase resulting from the gas turbines is included in the NO_2 increment inventory.

For TSP, sources A, B, C, and E are found to have units whose emissions may affect the TSP increment in the impact area. Source A established the minor source baseline date with a PSD permit application to modify its existing facility. Source B (which established the minor source baseline date for SO_2) experienced an insignificant increase in particulate matter emissions due to a modification prior to the minor source baseline date for particulate matter (March 14, 1985). Even though the emissions increase did not exceed the significant emissions rate for particulate matter emissions (i.e., 25 tons per year), increment is consumed by the actual increase nonetheless, because the actual emissions increase resulted from construction (i.e., a physical change or a change in the method of operation) at a major stationary source occurring after the major source baseline date for particulate matter. The applicant uses the allowable increase as a conservative estimate of the actual emissions increase. As mentioned previously, Source C received a permit to construct, but the newly-permitted unit is not yet in operation. Therefore, the applicant must use the potential emissions to model the amount of TSP increment consumed by that new unit.

Finally, Source E's actual emissions increase resulting from an increase in its hours of operation must be considered in the increment analysis. This source is located far enough outside the impact area that its effects on increment consumption in the impact area are estimated with a screening technique. Based on the conservative results, the permitting agency determines that the source's emissions increase will not affect the amount of increment consumed in the impact area.

In compiling the increment inventory, increment-consuming TSP and SO₂ emissions occurring at minor and area sources located in Counties A and B must be considered. Also, increment-consuming NO_x emissions occurring at minor, area, and mobile sources located in County C must be considered. For this example, the applicant proposes that because of the low growth in population and vehicle miles traveled in the affected counties since the applicable minor source baseline dates, emissions from area and mobile sources will not affect increment (SO₂, TSP, or NO₂) consumed within the impact area and, therefore, do not need to be included in the increment inventory. After reviewing the documentation submitted by the applicant, the permitting agency approves the applicant's proposal not to include area and mobile source emissions in the increment inventory.

V.C The Full Impact Analysis

Using the source input data contained in the emissions inventories, the next step is to model existing source impacts for both the NAAQS and PSD increment analyses. The applicant's selection of models--ISCST, for short-term modeling, and ISCLT, for long-term modeling--was made after conferring with the permitting agency and determining that the area within three kilometers of the proposed source is rural, the terrain is simple (non-complex), and there is a potential for building downwash with some of the nearby sources.

No on-site meteorological data are available. Therefore, the applicant evaluates the meteorological data collected at the National Weather Service station located at the regional airport. The applicant proposes the use of

5 years of hourly observations from 1984 to 1988 for input to the dispersion model, and the permitting agency approves their use for the modeling analyses.

The applicant, in consultation with the permitting agency, determines that terrain in the vicinity is essentially flat, so that it is not necessary to model with receptor elevations. (Consultation with the reviewing agency about receptor elevations is important since significantly different concentration estimates may be obtained between flat terrain and rolling terrain modes.)

A single-source model run for the auxiliary boiler shows that its estimated maximum ground-level concentrations of SO₂ and NO₂ will be less than the significant air quality impact levels for these two pollutants (see *Table C-4*). This boiler is modeled separately from the two main boilers because there will be a permit condition which restricts it from operating at the same time as the main boilers. For particulate matter, the auxiliary boiler's emissions are modeled together with the fugitive emissions from the proposed source to estimate maximum ground-level PM-10 concentrations. In this case, too, the resulting ambient concentrations are less than the significant ambient impact level for PM-10. Thus, operation of the auxiliary boiler would not be considered to contribute to violations of any NAAQS or PSD increment for SO₂, particulate matter, or NO₂. The auxiliary boiler is eliminated from further modeling consideration because it will not be permitted to operate when either of the main boilers is in operation.

V.C.1 NAAQS ANALYSIS

The next step is to estimate total ground-level concentrations. For the SO₂ NAAQS compliance demonstration, the applicant selects a coarse receptor grid of one-kilometer grid spacing to identify the area(s) of high impact caused by the combined impact from the proposed new source and nearby sources. Through the coarse grid run, the applicant finds that the area of highest estimated concentrations will occur in the southwest quadrant. In order to determine the highest total concentrations, the applicant performs a second model run for the southwest quadrant using a 100-meter receptor fine-grid.

The appropriate concentrations from the fine-grid run is added to the monitored background concentrations (including Source G's impacts) to establish the total estimated SO₂ concentrations for comparison against the NAAQS. The results show maximum SO₂ concentrations of:

- 600 µg/m³, 3-hour average;
- 155 µg/m³, 24-hour average; and
- 27 µg/m³, annual average.

Each of the estimated total impacts is within the concentrations allowed by the NAAQS.

For the NO₂ NAAQS analysis, the sources identified as "nearby" for NO₂ are modeled with the proposed new source in two steps, in the same way as for the SO₂ analysis: first, using the coarse (1-kilometer) grid network and, second, using the fine (100-meter) grid network. Appropriate concentration estimates from these two modeling runs are then combined with the earlier screening results for Refinery E and the monitored background concentrations. The highest average annual concentration resulting from this approach is 85 µg/m³, which is less than the NO₂ NAAQS of 100 µg/m³, annual average.

For the PM-10 NAAQS analysis, the same two-step procedure (coarse and fine receptor grid networks) is used to locate the maximum estimated PM-10 concentration. Recognizing that the PM-10 NAAQS is a statistically-based standard, the applicant identifies the sixth highest 24-hour concentration (based on 5 full years of 24-hour concentration estimates) for each receptor in the network. For the annual averaging time, the applicant averages the 5 years of modeled PM-10 concentrations at each receptor to determine the 5-year average concentration at each receptor. To these long- and short-term results the applicant then added the monitored background reflecting the impacts of sources E and F, as well as surrounding area and mobile source contributions.

For the receptor network, the highest, sixth-highest 24-hour concentration is 127 µg/m³, and the highest 5-year average concentration is

38 $\mu\text{g}/\text{m}^3$. These concentrations are sufficient to demonstrate compliance with the PM-10 NAAQS.

V.C.2 PSD Increment Analysis

The applicant starts the increment analysis by modeling the increment-consuming sources of SO_2 , including the proposed new source. As a conservative first attempt, a model run is made using the maximum allowable SO_2 emissions changes resulting from each of the increment-consuming activities identified in the increment inventory. (Note that this is not the same as modeling the allowable emissions rate for each entire source.) Using a coarse (1-kilometer) receptor grid, the area downwind of the source conglomeration in the southwest quadrant was identified as the area where the maximum concentration increases have occurred. The modeling is repeated for the southwest quadrant using a fine (100-meter) receptor grid network.

The results of the fine-grid model run show that, in the case of peak concentrations downwind of the southwest source conglomeration, the allowable SO_2 increment will be violated at several receptors during the 24-hour averaging period. The violations include significant ambient impacts from the proposed power plant. Further examination reveals that Source A in the southwest quadrant is the large contributor to the receptors where the increment violations are predicted. The applicant therefore decides to refine the analysis by using actual emissions increases rather than allowable emissions increases where needed.

It is learned, and the permitting agency verifies, that the increment-consuming boiler at Source A has burned refinery gas rather than residual oil since start-up. Consequently, the actual emissions increase at Source A's boiler, based upon the use of refinery gas during the preceding 2 years, is substantially less than the allowable emissions increase assumed from the use of residual oil. Thus, the applicant models the actual emissions increase at Source A and the allowable emissions increase for the other modeled sources.

This time the modeling is repeated only for the critical time periods and receptors.

The maximum predicted SO₂ concentration increases over the baseline concentration are as follows:

- 302 $\mu\text{g}/\text{m}^3$, 3-hour average;
- 72 $\mu\text{g}/\text{m}^3$, 24-hour average; and
- 12 $\mu\text{g}/\text{m}^3$, annual average.

The revised modeling demonstrates compliance with the SO₂ increments. Hence, no further SO₂ modeling is required for the increment analysis.

The full impact analysis for the NO₂ increment is performed by modeling Source F--the sole existing NO₂ increment-consuming source--and the proposed new source. The modeled estimates yield a maximum concentration increase of 21 $\mu\text{g}/\text{m}^3$, annual average. This increase will not exceed the maximum allowable increase of 25 $\mu\text{g}/\text{m}^3$ for NO₂.

With the SO₂ and NO₂ increment portions of the analysis complete, the only remaining part is for the particulate matter (TSP) increments. The applicant must consider the effects of the four existing increment-consuming sources (A, B, C, and E) in addition to ambient TSP concentrations caused by the proposed source (including the fugitive emissions). The total increase in TSP concentrations resulting from all of these sources is as follows:

- 28 $\mu\text{g}/\text{m}^3$, 24-hour average; and
- 13 $\mu\text{g}/\text{m}^3$, annual average.

The results demonstrate that the proposed source will not cause any violations of the TSP increments.

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