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GUIDELINES FOR ESTIMATING AND APPLYING RULE EFFECTIVENESS FOR OZONE/CO STATE IMPLEMENTATION PLAN BASE YEAR INVENTORIES

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Ozone and Carbon Monoxide Branch
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U.S. Environmental Protection Agency
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ADDENDUM

After preparation of this document, EPA decided to recommend additional flexibility in accounting for rule effectiveness (RE) in the development of base year emission inventories. This addendum provides guidance regarding that flexibility.

METHODS FOR ACCOUNTING FOR RULE EFFECTIVENESS FOR VOLATILE ORGANIC COMPOUND (VOC) SOURCES

A State or local agency that prepares VOC emission inventories may account for rule and control effectiveness by methods other than those specified in this document. Deviations from methods in document must meet the following criteria, as well as criteria specified in "Documentation and Concurrence," below:

--In evaluating rule effectiveness under a method that deviates from the guideline, the State should consider:

--The overall capture and control efficiency generally available from the kind of capture and control equipment being assessed;

--Any stack test/performance evaluation that was performed on the capture and control equipment;

--The rated capture and control efficiency (from manufacturer's specifications or literature);

-- The kinds of activities that affect the determination of day-to-day performance of the capture and control equipment that are listed in the questionnaires that are contained in the guideline document (e.g., ease of determining compliance, type of control equipment, frequency and quality of inspections, level of training of inspectors).

--The State or local agency should provide a way of determining which sources have applied control to avoid having planners "recontrol" already controlled sources.

METHODS FOR ACCOUNTING FOR RULE EFFECTIVENESS FOR SOURCES OF OXIDES OF NITROGEN AND CARBON MONOXIDE

Rule effectiveness must be considered for sources of oxides of nitrogen and carbon monoxide where such sources are covered by rules or regulations in the State implementation plan (SIP). If a State or local agency does not use either the questionnaire method or the Stationary Source Compliance Division (SSCD) protocol, that agency should develop its own method for assessing RE and should not rely solely on the 80 percent default value.

In evaluating rule effectiveness under such a method, the State should consider the kinds of activities that are listed in the questionnaires that are contained in the guideline document (e.g., ease of determining compliance, type of control equipment, frequency and quality of inspections, competence of inspectors). Methods for accounting for rule effectiveness different from the methods in the document must also meet the criteria specified in "Documentation and Concurrence," below.

RARE CATASTROPHIC OR ACCIDENTAL RELEASES

Rare catastrophic or accidental releases may be inventoried in a manner deemed appropriate by the State or local agency; these releases do not necessarily need to be reflected in a rule effectiveness assessment, unless there is a pattern of re-occurrence. The methods developed must meet the criteria specified in "Documentation and Concurrence," below.

DOCUMENTATION AND CONCURRENCE

The above paragraphs describe cases where methods that deviate from the methods in this document may be employed. In developing and using such a method, the following general criteria must be met:

--The Regional Office, in consultation with the EPA Office of Air Quality Planning and Standards, must concur on the method.

--Documentation must be available at the State or local agency for inspection by EPA; documentation does not have to be submitted with emission inventory.

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SECTION 1
INTRODUCTION

Emission inventories are assembled with the intent to provide the most accurate, representative emissions estimates available. The 1990 Clean Air Act Amendments (CAAA) require base year annual and daily actual emission inventories to be gathered as part of the State implementation plan (SIP) for areas not in attainment for the current ozone and/or carbon monoxide (CO) national ambient air quality standards (NAAQS). These estimates are used to support inventory projections, ambient modeling applications, attainment strategy (regulatory) development and subsequent (periodic) inventories.

Prior to the post-1987 SIP requirements, SIP inventories and their applications assumed that regulatory programs for stationary sources were being and would continue to be implemented with full effectiveness, achieving all of the reported, required or intended emission reductions, and maintaining that level over time. However, experience during the decade of the 1980s has shown these regulatory programs to be less than 100 percent effective in achieving the necessary emissions reductions in most areas of the country. This means that SIP's before 1987 typically have understated actual emissions in both the baseline and projected inventories, resulting in lower emission reduction targets than were actually necessary to attain the NAAQS.

To avoid these miscalculations and more accurately estimate actual emissions, consideration shall be made for "rule effectiveness." This document provides guidelines for calculating and applying rule effectiveness in SIP base year inventories. The concepts and procedures discussed herein currently apply to ozone nonattainment area inventories, but will be applicable to SIP inventories for other pollutants as the need arises. This guidance focuses on developing estimates of rule effectiveness (RE) for the inventory that are used to obtain more realistic emission estimates for source categories.

This guidance describes the procedures developed by the Office of Air Quality Planning and Standards (OAQPS) to estimate the effectiveness of existing regulatory programs to achieve emissions control for stationary sources. One approach is the detailed study protocol developed by the Environmental Protection Agency (EPA) Stationary Source Compliance Division (SSCD) involving on-site inspection and testing on a single source category by source category basis. The second approach, developed by the Air Quality Management Division (AQMD), involves answering generic questionnaires using available file information for specific sources and extrapolating the results to other sources in the same source categories. The third option is to use the 80 percent default for estimating RE. The results of

these approaches are to be used to estimate RE for the base year emission inventories being prepared in response to the 1990 CAAA calls for ozone and CO SIP's.

The document is divided into four main sections. The remainder of Section 1 discusses the definitions and roles of various types of effectiveness measures that have historically been referred to as "rule" effectiveness and introduces the concepts covered in this guidance. Section 2 describes the procedures to be used in estimating category-specific RE values for States that choose not to use the 80 percent default. Section 3 contains instructions on how to apply RE to sources in the base year inventories, including a discussion of direct determination of emissions. Section 4 provides RE examples to aid in the calculation of emissions for base year inventories. Appendices A and B contain the point and area source RE questionnaires, respectively; Appendix C illustrates direct determination and Appendix D provides statistical guidelines for sample selection for the point source questionnaire. Appendix E presents typical VOC emissions reductions for Control Techniques Guideline categories.

1.1 BACKGROUND

On November 24, 1987, EPA proposed the post-1987 ozone/CO policy.[1] A key component of this policy was the proposal that States account for the actual effectiveness of both present and future regulatory programs. This measure was termed "rule" effectiveness and represented the actual degree of source compliance. For stationary sources, EPA proposed that a baseline assumption of 80 percent RE should be applied to all regulated source categories in the inventory until a local category-specific evaluation could be completed to ascertain the actual category-specific effectiveness. (This 80 percent default value was initially based on a survey of several states that estimated the actual effectiveness of their emissions rules.)

EPA received numerous comments regarding the RE requirements proposed in that policy. None of the commenters challenged the concept of applying RE in the inventories or of improving the RE of particularly troublesome categories. Many commenters, however, suggested that EPA provide an alternative to the across-the-board 80 percent presumption. The general theme contained in these comments suggested that EPA should allow State and local agencies flexibility in making RE estimates so that regulatory programs showing good compliance rates for certain source categories could receive higher credit than those showing lower compliance rates.[1]

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[1]The issue of the creditability of RE improvements towards meeting reduction goals is not discussed in this document. Creditability will be included in a more general discussion of rule effectiveness in forthcoming guidance.

EPA provided guidance to the States in preparing the new SIPs pursuant to Title I of the CAAA through the Federal Register (General Preamble for Title I Implementation, April 16, 1992). EPA policy requires that base year stationary source inventories of volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon monoxide (CO) be adjusted for RE, using either the 80 percent default value or the results from one of the procedures described herein.

1.2 MEANING OF RULE EFFECTIVENESS

RE reflects the ability of a regulatory program to achieve all the emission reductions that could have been achieved by *full compliance* with the applicable regulations at *all sources* at *all times*. The precise degree to which all affected sources comply with a particular regulation over time is virtually impossible to ascertain without continuously monitoring emissions at all sources. RE can be estimated, however, by evaluating the success of a regulatory program at a few sources and extrapolating the results to others.

RE requires an understanding of a source's uncontrolled emissions and the control placed on that source, rather than the controlled emissions. As demonstrated in Section 4, the RE value is applied to adjust the control efficiency and is not applied to the emission estimate directly. For example, 80 percent RE means the control effectiveness is actually 80 percent of the estimated control efficiency; it does not mean that actual emissions are 20 percent greater than estimated.

The appropriate method for determining and using RE depends upon the purpose for the determination: compliance, program or inventory. RE discussed outside the particular purpose may be generically referred to as control effectiveness. The following three common uses for a control effectiveness estimate have historically been called rule effectiveness:

- Identifying and addressing weaknesses in control strategies and regulations related to compliance and enforcement activities (more accurately called *Compliance Effectiveness*)
- Defining or refining the control strategy necessary to achieve the required emissions reductions designated in the CAAA (more accurately called *Program* or *SIP Design Effectiveness*)
- Improving the accuracy or representativeness of emission estimates across a nonattainment area (hereafter called *Rule Effectiveness*)

Each user needs to determine the effectiveness of rules and controls in reducing emissions to the desired level as it relates

to the specific purpose. For example, SIP planners are concerned with the ability of the SIP strategy to meet specific ambient pollutant targets. Compliance personnel are interested in the relationship between actual and permissible emissions for a particular source or source category. Inventory personnel need to know the expected exceedance of emissions from the base estimate. This document concentrates on RE; Program and Compliance Effectiveness will be addressed in subsequent guidance.

1.3 RULE EFFECTIVENESS FOR BASE YEAR INVENTORIES

The inventory *RE* is an adjustment to estimated emissions data to account for emissions underestimates due to compliance failures and the inability of most inventory techniques to include these failures in an emission estimate. The RE adjustment accounts for known underestimates due to noncompliance with existing rules, control equipment downtime or operating problems and process upsets. The result is a best estimate of actual base year emissions, leading to more reliable estimates of expected emission reductions and control measure effectiveness in future years. EPA requires that base year SIP inventories apply and report RE.[3]

Base year inventory RE considers that emission changes brought on by growth, production changes, etc. are artifacts that should be excluded when determining RE. RE simply adjusts the estimated emissions for the effects of noncompliance. By definition, all source categories for which a regulation exists should have an RE value between zero and 100 percent (*i.e.*, source categories for which no regulation exists would have no RE factor associated with them). To say that a particular regulation was 100 percent effective would mean that the regulatory agency could ensure complete and continual compliance at all sources covered by the regulation, with no incidence of control equipment failure or process upset at any source and no sources evading control requirements. To say that a regulation was zero percent effective would mean that no sources in the category had made any effort to comply with the applicable regulation. *RE cannot be less than zero or greater than 100 by definition.*

The connection between SIP rules and actual emissions reductions is that State or local agencies must assume that there will be less than 100 percent compliance of rules in the absence of other information. Otherwise, rules will not actually achieve the intended reductions mandated in Section 182(b)(1) of the CAAA: 15 percent over 6 years and 3 percent per year thereafter until attainment is reached.

1.4 FACTORS AFFECTING RULE EFFECTIVENESS

There is no succinct mathematical formula that adequately accounts for the many different variables influencing RE, although it can be thought of as a complex function of the following types of factors: the nature of the regulation, the nature of techniques used to comply with the regulation, the performance of each source in complying with the regulation, and the performance of the implementing agency in enforcing the regulation. Table 1-1 lists specific examples of each type of factor. The list is not exhaustive, however, it demonstrates the large number and wide variety of factors that affect RE.

1.5 CALCULATING AND APPLYING RULE EFFECTIVENESS

The remainder of this document explains the calculation of RE values and the adjustment of base year emissions for RE. Every base year SIP inventory must apply RE according to the guidelines set forth herein. The process of examining and applying RE entails the basic steps listed in Table 1-2. These steps are explained in detail in the following chapters.

TABLE 1-1. FACTORS INFLUENCING RULE EFFECTIVENESS

Nature of the Regulation

- possible ambiguity or deficiencies in wording
- level of detail of recordkeeping required
- level of complexity of compliance determination
- inadequate test methods

Nature of Techniques Used to Comply With Regulation

- level of confidence in long-term capabilities of control technique (*i.e.*, whether the emissions control is prone to failure or degradation even with adequate attention)
- complexity of control technique (*i.e.*, likelihood that operator error or variability in operator technique could affect compliance)
- potential for fugitive emissions not ducted to control device (*i.e.*, adequacy of emissions capture system)

Performance of Source in Complying With Regulation

- trained individual responsible for complying with environmental regulations
- schedule for maintenance and inspection of control equipment
- adequacy of recordkeeping practices (*i.e.*, can compliance be determined from available records?)
- ensurance of compliance over time, considering the previous record of process upsets or control equipment malfunction
- timeliness of response to notices of violation

Performance of Implementing Agency in Enforcing Regulation

- attention and resources directed at this source or source category
- communications effort, with respect to compliance requirements
- completeness of data maintained on file
- thoroughness in training inspection personnel
- timeliness and thoroughness of inspections
- adequacy of follow-up on noncomplying sources

TABLE 1-2. APPLYING RE IN BASE YEAR SIP INVENTORIES

Step	Considerations
Determine relevant emissions categories	Source categories which are subject to emission controls (*i.e.*, there is a rule in place) during the *year of inventory* should be considered.
Identify *exempt* sources	Emissions from sources with uncontrolled, directly determined or permanently eliminated emissions are *exempt* from adjustment for RE.
Calculate a RE value (%) for each relevant category	Agencies calculate RE values derived from an SSCD study, the questionnaires included in this guidance or the default value. Questionnaires require a survey of sources in the categories identified in the first step.
Calculate control efficiency for each affected source	A reasonable estimate of the emissions control efficiency for each source is essential to the RE calculation. This efficiency may be measured or estimated based on the control device or estimated based on the rule in place.
Calculate base year emissions (adjusted for RE)	Emissions are adjusted for RE as described in this document using uncontrolled emissions, control efficiency and the RE value; these emissions are the SIP base year emissions.
Document RE calculations	When submitting the SIP inventory, agencies should document the procedures and calculations made to show that RE has been appropriately addressed, including criteria used to exempt sources.

1.6 REFERENCES

1. State Implementation Plans; Approval of Post-1987 Ozone and Carbon Monoxide Plan Revisions for Areas Not Attaining the National Ambient Air Quality Standards; Notice, *Federal Register*, Vol. 52, No. 226, November 24, 1987. pp. 45044-45122.

2. U.S. Environmental Protection Agency, *Procedures for Estimating and Applying Rule Effectiveness in Post-1987 Base Year Emission Inventories for Ozone and Carbon Monoxide State Implementation Plans*, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 1989.

3. U.S. Environmental Protection Agency, *Emission Inventory Requirements for Ozone State Implementation Plans*, EPA-450/4-91-010, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 1991.

SECTION 2
PROCEDURES FOR ESTIMATING CATEGORY-SPECIFIC RE

2.1 DETERMINING SOURCES FOR APPLICATION OF RULE EFFECTIVENESS

Every source subject to an emission control regulation during the inventory period should be considered for application of RE. For many nonattainment areas, the list of Control Techniques Guidelines (CTG) categories (Table 2-1) provides a starting point to identify regulated sources. It is important to include all regulated sources, regardless of whether the regulation had received official EPA approval prior to the inventory period. In some cases sources are exempted from emissions regulations if an emission cap (*e.g.*, 25 tons VOC per year) is not exceeded as defined by the emission control rule. These sources are not necessarily subject to RE, although a State or local agency may choose to include these sources if compliance with the emissions cap is a known problem. Once the affected emissions categories and sources have been identified, each source is reviewed to determine the appropriate RE application.

2.1.1 Excepted Sources

The following sources are exempt from the RE adjustment:

- sources where no controls are required (*i.e.*, the source is unregulated)
- sources for which control is achieved by means of an irreversible process change that eliminates the use of VOC or the potential for CO emissions
- sources for which emissions are calculated by means of a direct determination

For sources that are affected by a rule but are completely uncontrolled, a RE of zero percent should be recorded in the inventory. Sources using an irreversible process change to control emissions should be assumed to be achieving 100 percent RE. When emissions can be calculated by means of a direct determination, RE falls out of the calculation and, thus, is not applicable (*i.e.*, the emissions estimate is not contingent on the effectiveness of controls). For all other types of sources, RE should be applied in a manner consistent with Section 3.

Uncontrolled Sources are exempt from application of RE. RE does not need to be determined for sources that are completely uncontrolled, including cases where the source is making no attempts at compliance (illustrated by the first screening question on the point source questionnaire (Appendix A)). In this situation, a regulation is considered to be totally

TABLE 2-1. SOURCE CATEGORIES COVERED BY EPA CONTROL TECHNIQUES GUIDELINES (CTGs)

Source Category	CTG Group
Categories Predominated by Point Sources	
Gasoline Loading Terminals	I
Gasoline Bulk Plants	I
Fixed Roof Petroleum Tanks	I
Miscellaneous Refinery Sources	I
Surface Coating of:	I
Cans	I
Metal Coils	I
Fabrics	I
Paper Products	I
Automobiles and Light Duty Trucks	I
Metal Furniture	I
Magnet Wire	I
Large Appliances	I
Miscellaneous Metal Parts	II
Flat Wood Paneling	II
Graphic Arts	II
Leaks from Petroleum Refineries	II
External Floating Roof Petroleum Tanks	II
Gasoline Truck Leaks and Vapor Collection	II
Synthetic Pharmaceutical Manufacturing	II
Rubber Tire Manufacturing	II
Equipment Leaks from Natural Gas/Gasoline Processing	III
Plants	III
Manufacture of HDPE, PP, and PS Resins	III
Fugitive Emissions from SOC, Polymer, and Resin	III
Manufacturing Equipment	III
Large Petroleum Dry Cleaners	
SOCMI Air Oxidation Processes	
Categories Predominated by Area Sources	
Service Stations - Stage I	I
Cutback Asphalt	I
Solvent Metal Cleaning	I
Commercial Dry Cleaning	II

ineffective. The RE for such a source would be zero and should be recorded as such in the base year inventory.

Irreversible Process Changes. An irreversible process change (in the context of this guidance) involves a process modification or equipment substitution that completely eliminates solvent use from the production process. Irreversible process changes thus preclude application of RE. Irreversible changes require that the process cannot be quickly or easily reversed. Examples of this would be substituting a hot-melt lamination process for solvent-based adhesives and installing powder coating equipment to replace solvent-based coatings and equipment. In general, the use of "exempt" solvents or compliance coatings[2] would *not* constitute an irreversible process change. Although incorporating these materials into the production process may involve the installation of new equipment or the total redesign of a production line, a total elimination of the potential VOC use is required to be considered irreversible. (EPA recognizes that industries may switch back to old equipment and solvent-based coatings; State and local agencies should exercise judgment in defining irreversibility.) Sources controlling emissions by an irreversible process change should be assigned a RE of 100 percent in the inventory because the nature of the control technique ensures continual compliance over time.

Direct Determination is one in which emissions are calculated directly (*e.g.*, explicit records for each type of coating and/or solvent used) rather than from estimates of uncontrolled emissions and level of control. Any calculation that involves *estimates* of production rates, capture efficiency, transfer efficiency or solvent consumption rates typically does *not* qualify as a direct determination. Due to the importance of direct determination, it is discussed in more detail below.

2.1.2 Direct Determination of Emissions

As previously stated, direct determination means that no RE adjustment is necessary when computing base year emissions. That is, the emission estimate is not affected by a source's compliance or noncompliance with rules. Where an emissions measurement is made with a high degree of certainty, RE adjustment should not apply to that source. When reporting the RE value for these sources, use 100 percent rather than zero or "*not applicable.*"[3] The benefit of directly determining emissions is that an accurate calculation of emissions is made without the inherent uncertainties of compliance and control efficiency.

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[2]Compliance coatings include waterborne, low-solvent (high solids) and powder coatings.

[3]When reporting RE for sources where a rule applies and emissions were directly determined, report 100 percent. This reporting convention will clearly identify to any inventory reviewers that RE was considered for the source.

2.1.2.1 *Criteria for Direct Determination of Emissions*

For an emissions estimate to qualify as a direct determination, it must meet certain criteria. First, emissions have to be calculated from explicit source records. Second, no emissions factors or assumptions (*e.g.*, for solvent content) can be used in the calculation. Generally, if a control device is in place, the estimate does NOT qualify as a direct determination. The most common example of a direct determination of VOC emissions is "mass balance" accounting. The data for the direct determination must be accurate and well-documented. Each region, state or local agency may decide what constitutes an appropriate level of documentation for these data, consistent with EPA guidelines stated in Section 2.1.2.4. Supporting documentation for emissions estimates must be maintained by the State.

2.1.2.2 *Example of Direct Determination*

Table 2-2 shows two methods, both mass balance, that would qualify as direct determination under the current guidelines. Both situations imply that detailed records are available to the source and/or the air pollution control agency.

TABLE 2-2. DIRECT DETERMINATION SCENARIOS

Process	Method Description	Comment
Bulk Storage/ Solvent Use	Solvent Metering (mass balance)	1) Requires documentation by the source 2) Generally applies to inks, coatings and solvents
Solvent Use	Accounting (mass balance)	1) Requires documentation by the source (adequate paper trail such as purchasing records) 2) Assumes 100 percent evaporation 3) Solvent content may be determined by test or using manufacturers' records

To illustrate direct determination, consider a manufacturing facility with a product coating operation achieving compliance by using low-solvent or waterborne coatings in lieu of control equipment. Emissions are directly determined and calculated by the following method:

Step 1 determine coating and solvent usage over time (*e.g.*, a typical month during the ozone season) from detailed plant records;

Step 2 use manufacturer's specifications to obtain solvent content of all coatings used;

Step 3 for each coating used, calculate amount of solvent used over time by multiplying usage (gal/month) by actual solvent content (lbs VOC/gal coating), as supplied by the manufacturer;

Step 4 calculate the total amount of solvent used over time by adding the amount in each coating and the amount of raw solvent used for cleanup and dilution (lbs VOC/month);

Step 5 assume that all solvent used was emitted to the atmosphere at some point within the plant unless manifests indicate that some amount was shipped offsite as waste or the source can document that some portion was incorporated into the product; and

Step 6 calculate emissions in lbs VOC/day by dividing total solvent emitted (lbs VOC/month) by number of working days in that month (days/month).

Appendix C illustrates this example in more detail.

Another example of direct determination is that estimated by some type of continuous emission monitoring (CEM) equipment. If used, such equipment must be capable of determining mass balance emissions over extended periods of time, and provisions must be made for malfunction in the CEM equipment itself.

2.1.2.3 *Major Classes of Emissions Estimation Techniques*

Table 2-3 lists the major classes of emissions estimation techniques and their potential for classification as a direct determination. Some classes are discussed in detail, although the salient points are contained in the table.

Stack tests/emissions tests are generally excluded as direct determinations because they are emissions "snapshots" rather than an accurate assessment of emissions over time. As such, stack tests are source-specific emission factors. However, such tests

TABLE 2-3. EMISSION ESTIMATION METHODS

Method	AIRS[1] Code	Applicability to Direct Determination
Stack Test/ Emissions Test	1	Stack or emissions tests represent a "snapshot" of emissions at a single point in time and are *not* considered direct determinations. However, results of one or more emissions tests, used in conjunction with frequent tests of control device performance and a complete analysis of capture as well as control efficiency, may be considered as a direct determination in certain cases.
CEM	1	Continuous emissions monitoring (CEM) for VOC and/or CO is theoretically possible. CEM would preclude any RE adjustment provided the CEM equipment is operating properly throughout the estimation period.
Mass Balance	2	Mass balance is the technique usually considered for direct determination, provided adequate documentation of throughput and (VOC) content are available. This technique generally is used for evaporative sources. Use of *estimated* control/capture/transfer efficiencies in a calculation of emissions disqualifies the estimate as directly determined. The effect of regulatory or physical controls can only be estimated from the known inputs and outputs from the process.
AP-42 Emission Factors	3 or 8	*AP-42* emission factors are not direct determinations.
Other (State) Emission Factors	5 or 9	Emission factors in general cannot be considered direct determinations.
Engineering Analysis/ Other Methods	4	Determination based on engineering principles or judgment cannot be direct determination.

[1]Aerometric Information Retrieval System

may be considered as direct determinations in conjunction with *all* of the following other data:

- Records of control equipment function (efficiency and upsets) throughout the period. These include daily records of upsets and periodic (*i.e.*, at least monthly) determinations of actual efficiency and maintenance.

- A detailed and applicable study of capture efficiency. Emissions for processes that emit VOC are frequently estimated at the building vent or control device outlet. These estimates do not account for the control device capture efficiency and emissions which "leak" from the building. These losses can be very significant prior to reaching the control device and must be factored into the emissions estimate.

- Documentation that the emissions test remains applicable to the process and operations at the source.

Mass balance is the common term for estimating emissions based on subtracting the known outputs of the process from the inputs to the process. This is a well-respected method for determining emissions of SO_x from combustion processes based on sulfur inputs to the process and chemical stoichiometry. To determine emissions for VOC, any organics incorporated in the product plus the amount of process fugitives captured (*e.g.*, the amount of recycled solvent) is subtracted from the total VOC (typically solvent) input. No control or capture efficiency is necessary for this calculation. The efficiency of the regulatory or physical control is solely determined on the basis of measured process inputs and outputs. As discussed previously, this measurement process is restricted to documented metering or accounting of inputs and outputs.

Emission factors are not appropriate as direct determinations of emissions because they are not specific to the particular source. Even with the information discussed for emissions tests on capture efficiencies and control device operation, emission factors will not produce an estimate sufficiently reliable to the specific source to qualify as a direct determination.

2.1.2.4 *Documenting Direct Determination*

The local or State air pollution control agency is ultimately responsible for determining the adequacy of documentation and application of directly determined emission estimates. Local and State agencies should maintain records necessary to document direct determinations and should be prepared to produce this documentation upon EPA's request. EPA is not requiring that these records be submitted with the SIP inventory; complete submittal of this information would unnecessarily increase the effort of the submittal process.

The following information illustrates the level of documentation required to support direct determination of surface coating emissions:

- Solvent (VOC) content of each coating type
- Accurate measure of the amount of each coating
- Amount of thinning and cleanup solvent
- Amount of waste solvent disposal offsite
- Adequate oversight of these records by State or local agency

Table 2-4 suggests criteria for meeting and documenting these requirements.

2.2 OVERVIEW OF APPLICABLE APPROACHES FOR DETERMINING RE

In determining an RE value for adjusting the base-year VOC emissions inventory, State and local agencies may elect to (1) use an across-the-board RE presumption of 80 percent for all sources; (2) use the questionnaire approach to determine a category-specific RE value for both point sources and area sources; or (3) use or design a study specific to a category in accordance with the procedure developed by SSCD. The following sections discuss each of these methods for determining RE.

2.3 DEFAULT VALUE APPROACH

In general, the 80 percent default RE value is used in the absence of a local category-specific evaluation (*i.e.*, the questionnaire approach or the SSCD study approach). In essence, the 80 percent default value assumes that the ability to use control devices and existing rules to achieve a 100 percent compliance rate is only 80 percent effective. Therefore, the base year emissions inventory must be adjusted by this factor to ensure that the amount of emissions reductions necessary to achieve the CAAA-required reductions in VOC emissions can be met. The RE value should be applied as discussed in Section 2.4, Questionnaire Approach.

A number of surveys were conducted to determine a representative default RE value, one of which was conducted by OAQPS of States in the Regional Oxidant Model Northeast Transport (ROMNET) region. This survey indicated that regulations and controls were approximately 80 percent effective, on average, in achieving the target emissions reductions.

Subsequent examination of the 1989 SSCD studies have allowed OAQPS to reexamine the 80 percent default value. The results of the 1989 SSCD RE studies conducted by States in 7 of the 10 EPA Regions also show an average RE value of approximately 80 percent when averaging the results obtained from three alternate methods (including the method contained in this guidance document) used to calculate RE for the SSCD study. Some of the RE studies

TABLE 2-4. DOCUMENTING DIRECT DETERMINATION FOR SURFACE COATING

SOLVENT (VOC) CONTENT

Document Solvent or VOC Content of Every Coating
- Periodic Testing of Actual Coatings
- Manufacturer's Specifications for Coatings that Include Solvents
- Material Safety Data Sheets (MSDS) with Information on Total VOC Content
- Reflect Coatings in Use during the Inventory Period

Total VOC Emitted = VOC Content x Total Coating Consumed

COATING OR SOLVENT CONSUMPTION

Record Total Coating (or Solvent) Use Regularly
- Daily or Batch by Batch Basis
- Process by Process
- Coating by Coating

Use Purchasing Records if Necessary

Make Records Available during Inspections

Source May Submit Monthly or Quarterly Summaries

THINNING AND CLEANUP SOLVENT

Include Thinner and Cleanup Solvent Consumption
- Daily or Batch by Batch Records
- Monthly or Quarterly Summaries

SOLVENT DISPOSAL/RECYCLE

Give Credit for Offsite Disposal/Treatment
- Submit Waste Transfer Records with Information on Amounts Shipped

ADEQUATE OVERSIGHT

Inspect Regularly

Check Facility's Summary Data against Daily Records during Inspection

Check Records (e.g., Daily Summaries) against Records Kept "on the Floor."

Investigate and Resolve any Discrepancies

indicated values in excess of 100 percent. These values are inappropriate in reviewing inventory RE. Values greater than 100 percent imply that emissions for a category are less than estimated. The causes of "over-compliance" (*i.e.*, decreased production) in these studies are already accounted for in the inventory emissions estimates. Values greater than 100 percent were set equal to 100 percent. The results varied from about 70 to 90 percent, depending on the selected calculation method.

It is difficult to estimate a particular category's RE for a particular area based on a small subset of studies such as the 1989 SSCD RE studies. Where other data are unavailable to estimate category-specific RE, the 80 percent default value is the most appropriate based on the information currently available.

2.4 QUESTIONNAIRE APPROACH

The intent of the questionnaire approach is to determine a *category-specific* RE value to adjust the baseline VOC emissions inventory for less than 100 percent regulatory compliance in a nonattainment area. This approach involves the use of questionnaires designed for both point and area sources and is based on information on file with the source and personnel familiar with the sources included in the study (Appendices A and B). (Sources to be included in the process must pass a preliminary screening test. An RE number is determined for each category in each nonattainment area.)

2.4.1 Level of Effort

The categories representing at least 80 percent of the emissions inventory must be surveyed with the questionnaire. The questionnaires contain a series of generic questions covering various factors which affect the RE determination. These factors include the nature of the regulation, the nature of techniques used to comply with each regulation, the performance of the source in complying with the regulations, and the performance of the implementing agency in enforcing the regulations. The questionnaire is designed to be answered using only available source file information, thus alleviating the need for source inspections. Prior to each source evaluation, the complete source file information is reviewed including reports of previous visits and inspections. Information pertaining to potential deviations or deficiencies in State regulations must also be reviewed prior to taking this approach. In many cases, knowledgeable inventory staff may be able to complete the questionnaires for a single source category in one-half day or less.

2.4.2 Procedure

The procedure involves the use of two generic questionnaires that are based on the factors listed above and in Table 1-1. One questionnaire is used for individual point sources (see Appendix A) and another for area source categories (see Appendix B). Table 2-1 listed source categories for which CTGs have been issued and provides a good starting point for State and local agencies to determine which questionnaire to apply.

Many States contain more than one nonattainment area, raising the issue of whether RE should be estimated on a local or statewide basis. In general, this procedure should be used to determine unique RE estimates for each nonattainment area, except in cases where statewide regulations are implemented by a single agency throughout the State. In this case, all nonattainment areas in the State may employ a single value. The appropriate EPA Regional Office should be contacted for guidance if there is any question of whether local or statewide estimates are appropriate in a particular State.

2.4.2.1 *Identifying Personnel to Perform the Evaluation*

In most cases, representatives from the State or local agency's SIP planning or inventory group and compliance group should oversee the RE evaluations described in this document, but this selection may vary based on the individual agency and personnel experience. (The person conducting each evaluation will be hereafter referred to as the "evaluator.") One of the goals of incorporating RE in the base year inventory is to have planning personnel become more aware of the extent to which sources are complying with SIP regulations and the actual emission reductions that have resulted. The evaluator should enlist the aid of the local inspector(s) most familiar with each source. The role of the EPA Regional Office generally will be to review the results of the individual evaluations and/or the final RE estimates. In specific cases where this arrangement is not satisfactory, States or local agencies may negotiate with the Regional Offices to modify the respective roles.

2.4.2.2 *Preliminary Screening of Sources*

Each point source chosen should be subjected to the preliminary screening test at the beginning of the point source questionnaire. This screening will determine the appropriateness of evaluating RE by means of the questionnaire procedure for the chosen sources. The questionnaire should NOT be used to determine RE for the chosen source if any of the following is true:

- the source is not regulated[4]

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[4]Unregulated sources which are controlled should have equipment downtime, actual operating efficiency and process upsets factored into the emissions estimate, although these sources are not technically subject to RE.

- the source achieves emissions reduction by means of an irreversible process change that completely eliminates VOC from the process

- emissions from the source are calculated by means of a direct determination

Sources for which any of the above is true should be excluded from the questionnaire evaluation and are exempt from the adjustment of emissions for RE. These exclusions were discussed in detail in Section 2.1.1.

2.4.2.3 *Choosing Sources to Evaluate*

State and local agencies choosing to develop category-specific RE estimates may (1) use the questionnaire procedure for ALL regulated stationary source categories in their inventories or (2) use the questionnaire for 80 percent of their emissions inventory and a combination of the default value or SSCD study for the remainder of the emissions. If a State or local agency wishes to use the questionnaire approach for a subset of emission categories, the following conditions must be met. At least 80 percent of the total pollutant-specific emissions (*e.g.*, VOC) must be covered by questionnaires and all categories representing 5 percent or greater of the pollutant-specific emissions must use the questionnaire. Both conditions (80 percent coverage of total point source pollutant emissions and every category representing 5 percent or more of the total point source pollutant emissions) must be met for the questionnaire approach.

The most accurate way to estimate RE for point source categories would be to evaluate all sources in each category for which a regulation exists and average the results. Since this would place an unreasonable burden on resources and time for the agency performing the evaluation, agencies should evaluate RE sources in each category for which a regulation exists according to the following guidance. If there are ten or fewer sources in a category, all sources should be included. If there are more than ten, choose ten at random, complete the questionnaires and determine if the sample size is adequate or needs to be expanded. The point sources should be chosen randomly to avoid biasing the results. To assure statistical accuracy, use the procedure outlined in Appendix D for determining the sample size. (Area sources as defined by the emission inventory will be evaluated by category.)

One possible method for choosing random point sources is for the evaluator to obtain a list of all sources in the local inventory, grouped by source category. These sources should include the numerical identification codes and any other details necessary to obtain the appropriate file information. The evaluator might then enlist the aid of another employee who is unfamiliar with both the sources and the numerical coding system of sources in the air program. This employee would be presented

with a list of only the numerical identification codes, *not* the company names, of all sources in the inventory grouped by source category, and asked to randomly choose a statistically valid sample from the necessary sources in each point source category for which a regulation exists. Alternately, there are many popular software packages (*e.g.*, Lotus®) which are able to generate random numbers with a list of sources.

2.4.2.4 *Sources with Control Efficiencies Greater Than 95 Percent*

Source emissions may be artificially inflated when the 80 percent default value for RE is applied to sources with stated control efficiencies greater than 95 percent. This is of particular concern when dispersion modeling is used. To ensure that emissions estimates are as accurate as possible, EPA has developed three different options to accommodate this situation. Before selecting one of the following options, States should attempt to verify the capture and control efficiencies of these highly-controlled sources.

Option I:

1. Identify sources with stated control efficiencies greater than 95 percent.

2. For these sources, apply the Questionnaire to determine the actual RE for the source. If the Questionnaires cannot be completed by the November 15, 1992 deadline, an adjustment can be made afterwards.[5] In these areas, Option II must be used for the November 15, 1992 inventory submittal.

Option II:

1. Apply the 80 percent default value for RE to the sources with control efficiencies greater than 95 percent in the base-year inventory.

Option III:

1. Identify sources with stated control efficiencies greater than 95 percent.

2. For the 1990 base-year inventory, use option I or II.

3. After submitting the 1990 base-year inventory, develop an alternative questionnaire to determine RE for these highly-controlled sources.

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[5]EPA prefers that adjustments be made prior to the public hearing on the inventory, but no later than any other hearing held on the rate of progress plan and attainment demonstration (see Memorandum of September 29, 1992, Public Hearing Requirements for 1990 Base-Year Emission Inventories for Ozone and CO Nonattainment Areas, from John Calcagni and Bill Laxton to Regional Air Division Directors).

4. Obtain EPA approval for the RE questionnaire.

5. Apply the alternative RE questionnaire to the identified sources.

6. Adjust the base-year emission inventory after the new RE values have been calculated for these sources.[5]

2.4.2.5 *Answering the Questionnaires*

The evaluator should complete one point source questionnaire for each selected point source in the sample that passes the preliminary screening test and one area source questionnaire for each area source category. The questionnaires are designed to be answered using available file information only. No dedicated source inspections are required. The complete file information on a particular source, including reports of previous visits and inspections, should be obtained by the evaluator prior to answering the questionnaire. To answer the questionnaires, the evaluator should confer with the State or local compliance inspector most familiar with the source or source category being evaluated. If an answer cannot be ascertained, the space marked "*unsure*" should be indicated on the questionnaire.

In addition, the evaluator should obtain any information relating to potential deviations or deficiencies in the State or local regulations. The most helpful information would be in the SIP-call follow-up letter sent to the State Air Program Director from the corresponding EPA Regional Air Division Director. This letter delineates specific deficiencies that EPA required to be corrected in response to the SIP-calls for nonattainment areas in that State. Another source of information is the document, *Issues Relating to VOC Regulations, Cutpoints, Deficiencies, and Deviations*, issued on May 25, 1988 by AQMD. The evaluator should confer with the EPA Regional Office to ascertain the most current and applicable information on regulation deficiencies.

2.4.2.6 *Determination of Rule Effectiveness Values*

The answers to the questions on the questionnaires each have a point value associated with them. After answering each question with the most appropriate response, the evaluator should sum the point values of the answers for each section and record the sub-totals and/or totals in the space provided on the last page. Section 3 describes how to apply these RE values in the emission inventory.

Determination of the RE value for point source categories has been revised since the Post-87 RE guideline to make the category value more representative. Formerly, a simple arithmetic average of the questionnaire totals produced the RE value to be used for all sources in that category (*i.e.*, every completed questionnaire received equal weight). The former procedure has been replaced by a revised, emissions-weighted average to accommodate the true effect on category emissions. By using an emissions-weighted

average, the questionnaire RE value better estimates the effects of higher (or lower) RE at large emissions sources on the overall category emissions. Where large emissions sources have better compliance (RE closer to 100 percent) than small emissions sources, emissions for the category will more accurately reflect the effect of the compliance level of the larger facilities.

The questionnaire results should be weighted by *uncontrolled* emissions. This weighting system increases the overall influence of the estimated RE at larger magnitude emitters on the category emissions. The questionnaire results from the surveyed facilities should be treated in the following manner:

$$RE_{category} = \sum_{i=1}^{n} \left[RE_i * \frac{Uncontrolled\ Emissions_i}{\sum_{i=1}^{n} Uncontrolled\ Emissions} \right]$$

where: n is the number of facilities with completed questionnaires

Table 2-5 illustrates the use of this equation and the calculation of the RE value. The State or local agency may be asked by the Regional Office to support RE values calculated from the questionnaires. The State or local agency should be prepared to document the procedures and information used to complete the questionnaires.

2.5 SSCD STUDY APPROACH

2.5.1 Purpose of the Study

The purpose of the SSCD study is to provide the States, local agencies and EPA with criteria and procedures for conducting an RE study or evaluating the degree of source compliance with existing rules. In the context of the SSCD study, RE means the extent to which a rule actually achieves (or has the capability of achieving) desired emission reductions, both in terms of the reductions projected for that rule, and the reductions that would ordinarily be achieved if the rule were properly implemented. Like the questionnaire approach, the SSCD study only applies to the geographic area in which it is conducted. In contrast to the generic questionnaire approach for both point and area sources, each SSCD study is individually designed and applied to a *single point source category*.

The principal goals of the SSCD study procedure are: (1) to determine the effectiveness of rules for a specific source category in a specific nonattainment area according to the quantitative criteria set forth in this protocol; and (2) to

TABLE 2-5. EXAMPLE OF WEIGHTED RE VALUE USING QUESTIONNAIRE

Facility	RE from Questionnaire	Uncontrolled Emissions	Weight Factor[1]	Weighted RE[2]	RE Value for Facility[3]
A	100%	500	0.42	0.42	100%
B	60%	100	0.08	0.05	60%
C	80%	75	0.06	0.05	80%
D	80%	200	0.17	0.13	80%
E	85%	50	0.04	0.04	85%
F	90%	30	0.03	0.02	90%
G	65%	120	0.10	0.07	65%
H	75%	35	0.03	0.02	75%
I	95%	25	0.02	0.02	95%
J	80%	60	0.05	0.04	80%
TOTAL		1,195	1.00	0.86	
CATEGORY RE VALUE[4]					86%

[1] Weight factor equals facility's uncontrolled emissions over total uncontrolled.
[2] Weighted RE equals facility's RE from questionnaire times weight factor.
[3] Use the RE value from the facility-specific questionnaire response for that facility.
[4] All facilities not included in the survey sample are assigned the category value.

identify specific implementation problems which need to be addressed by the State, local and EPA compliance and enforcement staff in order to achieve greater RE in the future.

2.5.2 Summary of the SSCD Study Approach Procedures

The SSCD study prescribes inspections, emissions tests and agency audits to compare actual measured emissions to "allowable" emissions under the existing rules(s). The difference represents the degree of compliance with the rules (*i.e.*, the RE in achieving emissions reductions). The study requires that the source sample size from a single source category be determined statistically, with considerations given to the allocation of personnel for inspections.

The SSCD study approach consists of a two-phase study including (1) an office investigation and (2) a field inspection at the source. Each study initiated by a State or local agency

must receive approval from the EPA Regional Office and Headquarters. In general, the field inspection involves determining the compliance status of a representative number of sources in a nonattainment area through the calculation of emissions and the determination of the percent effectiveness of current regulations. Sources included in the study are inspected unannounced. The elements of the field inspection include the following: (1) rule application evaluation, (2) State inspection procedures evaluation, (3) compliance determinations, (4) emissions quantification, (5) quality assurance, and (6) inventory evaluation. An inspection checklist is developed and used for each source. The checklist is comprised of three sections which are (1) inventory verification, (2) regulatory applicability, and (3) inspections procedures evaluation. All applicable regulations and policies pertaining to the sources under study are identified and the compliance status of the sources with SIP rules is determined, differentiating between procedural and emission requirements. The office investigation phase provides a further analysis of program implementation elements not susceptible to a comprehensive evaluation during a field inspection.

The study identifies problems which can be corrected, processes corrective action options, and comments on advantages and disadvantages of each option. Within one year following the study, a follow-up audit is conducted to determine whether corrective actions were implemented. Finally, the SSCD study includes an inventory demonstration for the selected source category which includes the following elements: (1) field investigation follow-ups if inventory discrepancies evolve; and (2) a search for potentially omitted sources including a survey of source exemption applicability and a ground survey to locate unregistered sources.

2.5.3 Calculating RE from an SSCD Study

The SSCD study approach may be applied *only* to a single source category for which a given study is designed. The result of each study is a category-specific RE estimate for a particular geographic area and category. States and local agencies may need to determine if previously existing SSCD study results remain valid or if the study is outdated due to industry or regulatory changes. Only studies deemed valid for the inventory period may be used. To apply the result for SIP purposes, the calculation must reflect this context.

The percentage effectiveness calculations will be based on a comparison of actual emissions to the allowable emissions for sources included in the study. These emissions must be documented as part of the field investigation phase of the study, and the calculations must be based on emissions testing, sampling and usage data identified for each source during the investigation.

Percentage effectiveness for base year inventory applications should be calculated according to the procedure listed below. Compute separately the total allowable and actual emissions for all sources on the day of the inspection or source test. The following equation should be used:

RE Inventory Method (for SIP inventory purposes)

$$\% RE = \frac{Baseline - Actual}{Baseline - Allowable} \times 100$$

If the baseline cannot be determined, the following equation, which calculates the baseline from allowable emissions and the control efficiency, is used:

$$\% RE = \frac{\frac{Allowable}{1 - Control\ Efficiency^{6}} - Actual}{\frac{Allowable}{1 - Control\ Efficiency} - Allowable} \times 100$$

where:

Baseline = base year inventory (before control)

Actual = emissions determined during course of study from mass balance, stack testing, CAA Section 114 responses, inspections and/or production records review

Allowable = emissions determined from SIP requirements

Control Efficiency = control efficiency defined in the CTG

- This method considers what emission reductions were actually achieved and evaluates performance in terms of the magnitude of excess emissions.
- This method should be applied in any study where the results will be used to modify the 80 percent rule effectiveness assumption.

Users requiring more information should consult SSCD guidance on the RE approach.

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[6]Control Efficiency calculations are shown in Section 3.2.1.

2.6 USING RESULTS FROM SSCD STUDIES, QUESTIONNAIRES AND THE DEFAULT

The procedural approaches to determine RE using the questionnaire and the SSCD study are vastly different. Figure 2-1 shows a summary comparison of the questionnaire approach (Appendices A and B) versus the SSCD study approach. The shaded boxes represent common steps.

The State or local agency may use the questionnaire approach or may apply the default value across the entire inventory. Where an SSCD study result is used or all source categories are not covered by the questionnaires, a combination of methods must be used to complete the inventory. Table 2-6 lists the combinations available to the State and local agencies when an SSCD study is used or the questionnaire approach does not cover all categories.

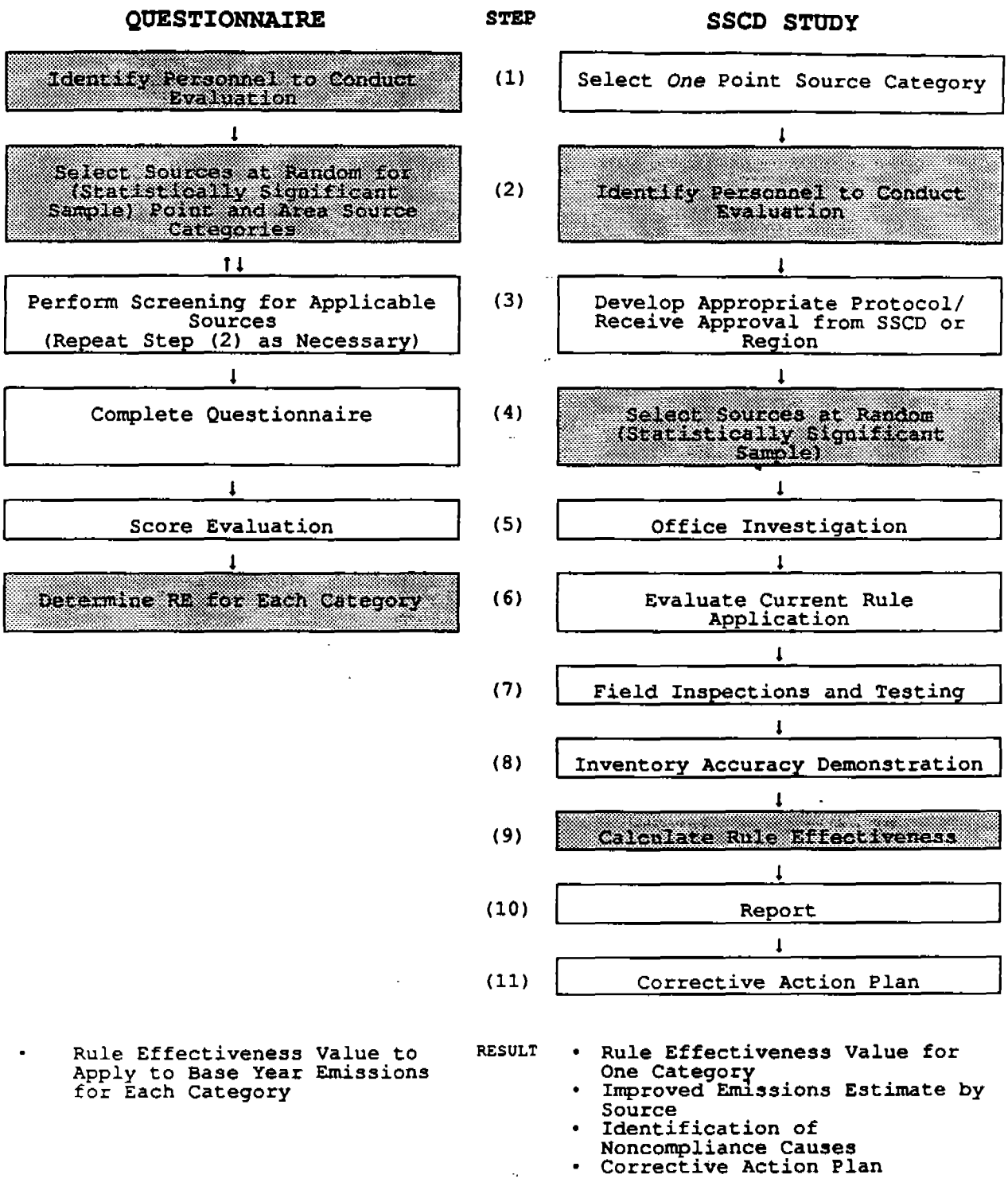

Figure 2-1. Comparison of the questionnaire and SSCD study.

TABLE 2-6. COMBINING SSCD STUDY AND QUESTIONNAIRE APPROACHES

RE Value Based on...	Approach for Other Categories
SSCD Study	Other categories may be analyzed based on questionnaires or the 80% default value may be applied.
Questionnaires	Remaining categories may use the 80% default value provided the minimum criteria for applying questionnaire defined in Section 2.4.2.3 are met.

SECTION 3
APPLICATION OF RULE EFFECTIVENESS IN BASE YEAR INVENTORIES

3.1INTRODUCTION

This section provides guidance on the application of RE to emissions inventories and presents the emissions calculation procedure. RE must be applied to base year SIP inventories for ozone precursors and CO, specifically to sources of VOC, NO_x and CO. Previous SIP inventories considered only VOC and the majority of current applications will still be for VOC sources. (Since few emission regulations for non-mobile sources of NO_x and CO existed in 1990, RE is currently not an issue for these pollutants for base year 1990 inventories. If these pollutants are regulated in the future, RE will need to be applied in subsequent inventories.)

RE factors are to be applied for the purpose of more accurately representing actual emissions. While local RE values may be *determined* on a source category basis, these same factors should be *applied* in the inventory on a source-by-source basis. Applying RE factors to individual sources will increase the emissions indicated for most sources; therefore, it is important for air pollution control specialists to understand that the RE estimates determined by the above procedure are to be used for emission inventory purposes only.

3.2 CALCULATING RULE-AFFECTED EMISSIONS

Determination of rule-affected emissions requires three inventory data elements: (1) the RE value (percent); (2) overall control efficiency; and (3) estimated uncontrolled emissions. Before applying RE, the relevant sources must be identified as described in Section 2. Once an RE percentage has been determined for each source category and a source has been determined to be subject to RE, the emissions from that point or area source are adjusted. If the questionnaire approach was used, apply the individual questionnaire RE scored for sources surveyed by the questionnaire; apply the calculated category RE value to the sources in the category which were not surveyed. The calculation is done source by source at the emissions calculation step (typically the *segment* or process level in the Aerometric Information Retrieval System (AIRS) for point sources and category by category for area sources.

The following equation is used to calculate rule-affected emissions:

$$RE\ Emissions = Uncontrolled\ Emissions \times (1 - (\ Control\ Efficiency \times RE\ ))$$

where RE and control efficiency are expressed as fractions. The equation clearly demonstrates that RE accounts for the effectiveness of the control.

Section 2 discussed the derivation of the RE value. Control efficiency and uncontrolled emissions are typical emissions inventory elements. Uncontrolled emissions may have to be backcalculated from the estimated controlled emissions. For example, source tests may account for the control in place. Control efficiency is a required SIP data element for control devices, but control efficiency for RE includes both physical and regulatory controls.

3.2.1 Control Efficiency

Regulatory controls are emissions limits implemented through either regulatory or physical means. A solely regulatory control is typically an emission rate limitation unrelated to a control device. For example, an industrial coating operation may be limited to using a coating of no more than 2.0 lbs VOC per gallon coating. The control efficiency is based on the difference between the total solvent used prior to the regulation and post-regulation.

A physical control is a control device such as an incinerator or carbon adsorber used to reduce emissions from a process. Control efficiency may be reported on the basis of manufacturer's specifications or emissions testing. To be reliable, capture efficiency, actual operating conditions and process and/or device upsets must be included when estimating emissions. These variables may be factored into a single average control efficiency or emissions may be estimated for each different operational mode (refer to emission inventory guidance).

Application of the RE value is straightforward where the control is a physical device (*e.g.*, a carbon adsorber) with an estimated efficiency (*e.g.*, 95 percent). When the control is due to a rule implementation (*e.g.*, coatings restricted to no more than 3 lbs VOC per gallon), it is more difficult to determine the "control efficiency" of that rule. *However, there is no distinction between regulatory and physical controls for the purpose of applying RE.*

EPA recognizes that a control efficiency inherent in a regulation (*e.g.*, an emission limit such as lbs VOC per gallon coating) may be difficult to determine. In these cases the best option is to determine emissions before and after a regulation was adopted from existing source records. This may be impossible if a source was never in operation or inventoried prior to rule adoption or if process changes have made such comparisons meaningless. A second option is to use the control efficiency estimate used in the development of the CTG or State/local rule.

Questions have been raised regarding the control provided by rules specifying types of storage tanks for petroleum product storage. The best way to calculate control efficiencies for storage tanks is to calculate emissions per unit product based on the *AP-42* equations before (*e.g.*, a fixed-roof tank) and after (*e.g.*, an external floating roof tank) rule adoption. This course may be both resource and time intensive. Representative control efficiencies for gasolines and distillate oil from Table 3-1 may be used instead of detailed, tank-by-tank calculations. These values have been derived based on a wide variety of tank sizes and throughputs which indicate that emissions per unit product from a tank type are principally dependent on the vapor pressure of the contents, not tank size.

TABLE 3-1. DEFAULT PETROLEUM STORAGE TANK CONTROL EFFICIENCIES

Material Stored	Before Rule Condition	After Rule Condition	Default Control Efficiency
Gasoline RVP7 to RVP10	Fixed Roof	External Floating Roof	95%
Distillate No. 2	Fixed Roof	External Floating Roof	91%
Gasoline RVP7 to RVP10	Fixed Roof	Internal Floating Roof	98%
Distillate No. 2	Fixed Roof	Internal Floating Roof	92%
Gasoline RVP7 to RVP10	External Floating Roof	Internal Floating Roof	60%
Distillate No. 2	External Floating Roof	Internal Floating Roof	20%

Where a regulatory or inherent control efficiency must be determined to apply RE, the inventory preparer should consider and use the procedures listed below to make this determination. These procedures are listed in order of preference and reliability:

1) Make a "before and after regulation" determination based on historical inventory records for each affected source or the category.

2) If (1) is not possible, refer to the local SIP development documentation that supports the planned or expected control level anticipated from the

regulations(s) applicable to the category. Use this control level as the control efficiency for sources covered by the rule(s).

3) As a final resort, refer to Appendix E to estimate the expected control effectiveness for CTG categories. This listing has been developed from CTG summaries and is only to be used to approximate control efficiencies for RE application where no other data are available. This listing presents ranges in some cases; use the lower end of the range unless other justification can be documented. Where the upper end of the range is 100 percent, this value cannot be used except where direct determination or irreversible process change can be documented. **EPA has not determined the validity or reliability of these control efficiencies for this purpose.**

3.2.2 AIRS Coding

The AIRS/Facility Subsystem (AFS) and the AIRS Area and Mobile Source (AMS) are capable of storing RE values and applying RE to the point and area source inventories, respectively. The procedure involves setting the "SIP Rule in Place" field to "Y," "B," "M" or "R." These codes designate Yes, BACT, MACT and RACT, respectively. [Note: While the field is called "SIP Rule in Place," this refers to any rule that is in place in the inventory area that is expected to reduce emissions, regardless of whether or not the rule is part of the SIP.] Any source with these codes and a nonzero control efficiency will be expected to have an RE value. (Remember that directly determined emissions sources have a 100 percent RE.) For emissions calculated using an emission factor, process or throughput rate, and control efficiency, AIRS can automatically calculate the RE emissions adjustment. Outside the AIRS system, these calculations will have to be performed as previously described.

When coding AIRS or other inventory transactions, all regulated sources where the regulation has an impact on the estimated emissions should have an RE entry in the estimated emissions. State and local agencies should code RE values according to the type of sources (Table 3-2):

- For sources making no attempt at compliance, RE should be 0 percent
- Directly determined or irreversible processes that eliminate solvent (VOC) emissions should be coded as 100 percent
- All other regulated sources should be coded with a value between 0 and 100 percent

TABLE 3-2. CODING RE IN ELECTRONIC INVENTORY SUBMITTALS

RE Determination	Coded RE Value
Uncontrolled Source	0%
Irreversible Process Change	100%
Direct Determination	100%
Questionnaire	Weighted score from questionnaire (%)
SSCD Study	Study results using SIP inventory calculation (%)
Default	80%

3.3 DOCUMENTING RULE EFFECTIVENESS FOR THE SIP SUBMITTAL

Rule effectiveness must be documented in the SIP inventory submittal, consistent with OAQPS *Emissions Inventory Requirements*,[2,3] the *Quality Review Guidelines*,[4] and the individual Inventory Preparation Plans (IPPs). These requirements include a discussion of how rule effectiveness was incorporated into the inventory. States should clearly annotate summary emissions tables as either adjusted or unadjusted for rule effectiveness. Emission estimates will be reviewed to ensure appropriate application of Rule Effectiveness in the base year inventories. Any deviations from OAQPS guidance on RE should be discussed in the submittal.

3.4 REFERENCES

1. Memorandum from David Winkler and David Zimmerman, TRC Environmental Corporation, to Gerri Pomerantz, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, "Control Effectiveness: Petroleum Product Storage Tanks." August 13, 1992.

2. U.S. Environmental Protection Agency, *Emission Inventory Requirements for Ozone State Implementation Plans*, EPA-450/4-91-010, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 1991.

3. U.S. Environmental Protection Agency, *Emission Inventory Requirements for Carbon Monoxide State Implementation Plans*, EPA-450/4-91-011, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 1991.

4. U.S. Environmental Protection Agency, *Quality Review Guidelines for 1990 Base Year Emission Inventories*, EPA-454/R-92-007, Office of Air Quality Planning and Standards, Research Triangle Park, NC, August 1992.

SECTION 4
EXAMPLE CALCULATIONS

The following examples illustrate how to include RE in the emissions calculations for several types of facilities. Most of these examples are presented on a daily emissions basis. Typically, emissions are first calculated on an annual basis. RE actually applies to both annual and daily estimates; EPA emission inventory guidance discusses the calculation of daily estimates from annual estimates.

4.1 POINT SOURCES

4.1.1 Bulk Terminals (Loading Racks)

Calculation based on a device control efficiency and RE questionnaire results.

A petroleum products bulk terminal distributes motor gasoline and distillate fuels (heating oils, etc.). In 1990, the facility distributed 110,000,000 gallons of gasoline and 54,000,000 gallons of distillate fuels. The loading racks used to transfer the fuels use refrigerated vapor recovery units (RVUs) to control emissions. The control efficiency for RVUs is greater than 90 percent as determined by an approved EPA method. The equipment is checked annually unless obvious problems require earlier inspections, and records of all repairs are maintained for agency review. The facility is inspected triennially, with the most recent inspection occurring 3 years ago. Emission factors for gasoline and distillate fuel loading loss have been determined to be 8.5 and 0.02 pounds VOC per thousand gallons, respectively. A questionnaire was completed for this facility and a RE of 78 percent was estimated for this facility (overall 82 percent for the category). *What emissions should be reported for this facility?*

Answer: Compute the loading losses for gasoline and distillate. Emissions are based on emission factors and therefore must include RE. Use the facility-specific RE rather than the category estimate.

Base Data for Loading Losses

	Gasoline	Distillate
Throughput (gallons)	110,000,000	54,000,000
Emission Factor	8.5 lbs VOC/10^3 gal	0.02 lbs VOC/10^3 gal
Control Efficiency (*AP-42*)	>90%	>90%
Rule Effectiveness	78%	78%

$$Emissions = Emission\ Factor \quad Activity\ Level \times (1 - (Control\ Efficiency \times RE))$$

A. Gasoline Loading Losses

$$Emissions = 8.5\ lbs\ VOC/10^3\ gal \times 110{,}000{,}000\ gal \times (1 - (0.90 \times 0.78))$$
$$= 278{,}630\ lbs\ VOC$$

B. Distillate Fuel Loading Losses

$$Emissions = 0.02\ lbs\ VOC/10^3\ gal \times 54{,}000{,}000\ gal \times (1 - (0.90 \times 0.78))$$
$$= 321.8\ lbs\ VOC$$

C. Total Emissions (from Loading Losses)

$$Total\ Emissions = Gasoline\ Emissions + Distillate\ Emissions$$
$$= 278{,}630 + 321.8\ lbs\ VOC$$
$$= 278{,}952\ lbs\ VOC$$
$$= 139\ tons\ VOC$$

4.1.2 Beverage Can Coating

Calculation based on an effective control efficiency in the absence of a control device, solids equivalency determination and RE questionnaire results.

A beverage can coater has been required to use high-solids coatings for its interior can coating. The plant personnel follow a weekly maintenance routine. The facility was last inspected in June for compliance evaluation, with the last previous inspection occurring three years ago. The following coating and process characteristics have been determined.

The coater previously used 50 gallons per day of interior can coating. The coating had a density of 9 pounds per gallon. The coating was 60 percent solvent (by weight); the solvent was 100 percent VOC with a density of 8 pounds per gallon. The coater is required to use a new coating that does not exceed 3 pounds of VOC per gallon of coating. The manufacturer reports a density of 10 pounds of coating per gallon of reformulated coating. No change in production volume of coated cans has occurred, but the coating consumption (in gallons per day) is not reported in this year's inventory. This facility was not included among the questionnaires, but the category average RE is 84 percent. *What emissions should be reported in the inventory?*

Answer: In most categories, control efficiencies and RE are applied to uncontrolled plant emissions resulting in RE emissions. Since the end result of coating is the application of the solid fraction of the coating, control efficiencies for coatings are calculated as the reduction

in emissions related to the coating solids only. Thus, the first step in estimating the control efficiency for this example is to estimate VOC emissions per volume of solids.

Old Coating

$$\text{Solvent Volume Fraction} = \text{Coating Density} \times \frac{\text{Solvent Weight Fraction}}{\text{Solvent Density}}$$

$$= \frac{(9 \text{ lbs of coating/gal coating}) \times (0.60 \text{ lbs solvent/lbs coating})}{8 \text{ lbs solvent/gal coating}}$$

$$= 67.5\%$$

$$\text{Solids Required} = \text{Coating Consumption} \times (1 - \text{Solvent Volume Fraction})$$

$$= (50 \text{ gal coating/day}) \times (1 - 0.675)$$

$$= 16.25 \text{ gal solids/day}$$

$$\text{Emissions} = \text{Coating Consumption} \times \text{Solvent Volume Fraction} \times \text{Solvent Density} \times \text{Solvent VOC Fraction}$$

$$= 50 \text{ gal coating/day} \times 0.675 \text{ gal solvent/gal coating} \times 8 \text{ lbs solvent/gal solvent} \times 1.00 \text{ lbs VOC/lbs solvent}$$

$$= 270 \text{ lbs VOC/day}$$

$$\text{Emissions per Volume Solid} = \frac{\text{VOC Emissions}}{\text{Solids Required}}$$

$$= \frac{270 \text{ lbs VOC/day}}{16.25 \text{ gal Solids/day}}$$

$$= 16.6 \text{ lbs VOC/gal Solids}$$

New Coating

$$\text{Solvent Volume Content} = \frac{\text{VOC Content of Coating}}{\text{Solvent Density}}$$

$$= \frac{3 \text{ lbs VOC/gal Coating}}{8 \text{ lbs VOC/gal Solvent}}$$

$$= 0.375 \text{ gal Solvent/gal Coating}$$

$$= 37.5\%$$

$$\text{Solids Volume Content} = 1 - \text{Solvent Content of Coating}$$
$$= 1 - 0.375$$
$$= 0.625 \text{ gal Solids/gal Coating}$$
$$= 62.5\%$$

$$\text{Coating Required} = \frac{\text{Solids Required}}{\text{Solids Volume Content}}$$

$$= \frac{16.25 \text{ gal Solids/day}}{0.625 \text{ gal Solids/gal Coating}}$$

$$= 26.0 \text{ gal Coating/day}$$

$$\text{Emissions} = \text{Coating Required} \quad \text{Solvent (VOC) Content of Coating}$$
$$= 26.0 \text{ gal Coating/day} \quad 3 \text{ lbs VOC/gal Coating}$$
$$= 78.0 \text{ lbs VOC/day}$$

$$\text{Emissions per Volume Solids} = \frac{\text{Emissions}}{\text{Required Solids}}$$

$$= \frac{78.0 \text{ lbs VOC/day}}{16.25 \text{ gal Solids/day}}$$

$$= 4.80 \text{ lbs VOC/gal Solids}$$

Now that the emissions rates per gallon of solids have been determined, the control efficiency and emissions may be determined.

$$\text{Control Efficiency} = \left(1 - \frac{\text{Controlled (New Coating) Emissions per Volume of Solids}}{\text{Uncontrolled (Old Coating) Emissions per Volume of Solids}}\right)$$

$$= \left(1 - \frac{4.80 \text{ lbs VOC/gal Solids}}{16.6 \text{ lbs VOC/gal Solids}}\right)$$

$$= 71.1\%$$

$$\text{Emissions} = \text{Solids Required} \times \text{Uncontrolled VOC/gal Solids} \times (1 - (\text{Control Efficiency} \times RE))$$

$$= 16.25 \text{ gal Solids/day} \times 16.6 \text{ lbs VOC/gal Solids} \times (1 - (0.711 \times 0.84))$$

$$= 109 \text{ lbs VOC/day}$$

(This is an illustrative case. In an actual inventory, emissions from the exterior coating would also be calculated.)

4.1.3 Paper Coating Facility

Calculation based on direct determination of emissions.

A paper coater uses only coatings specified by the manufacturer to contain 2.9 pounds VOC per gallons, less water, to comply with the RACT limit. Coating usage at the plant is documented to be 100 gallons, less water, per day and no additional solvents are used. This information was confirmed during the annual inspection. The RE for this source category has been determined to be 70 percent based on the RACT reduction calculated for the category. *What emissions should be reported in the inventory?*

Answer: Emissions from this plant can be calculated by means of a direct determination, because the solvent concentration is determined based on the manufacturer's specification and the coating use is documented daily, thus RE does not need to be applied.

Emissions = VOC content of coating x Coating usage

= 2.9 lbs VOC/gal coating less water x 100 gal coating less water/day

= 290 lbs VOC/day

4.1.4 Metal Furniture Coating

Calculation based on transfer and control efficiencies and the default RE value.

A large metal furniture manufacturer applied 326 gallons of coating solids on its furniture each day (*i.e.*, it actually sprays more, but only 326 gallons of solids are actually deposited the products). The coating it uses contains 35 percent by volume solids (65 percent VOC). The solvent used weighs 7.33 pounds per gallon. The facility uses high-volume, low-pressure (HVLP) spray equipment to achieve an 85 percent transfer efficiency (TE). The facility has also installed RACT to achieve an estimated 82 percent emissions reduction. The default RE has been applied to this source category (80 percent). *What emissions should be reported in the inventory?*

Answer: Uncontrolled emissions should be determined by calculating the amount of coating solids applied and the amount of coating applied. Controlled emissions are based on the RACT emissions reduction and the default RE.

$$\text{Total solids sprayed} = \frac{326 \text{ gal solids/day}}{0.85 \text{ TE}} = 384 \text{ gal solids/day}$$

$$\text{Total coating applied} = \frac{\text{gal solids/day}}{\text{\% solids}} = \frac{384 \text{ gal solids/day}}{0.35 \text{ gal solids/gal coating}}$$

$$= 1{,}096 \text{ gal coating/day}$$

$$\text{Uncontrolled Emissions} = \frac{\text{gal coating}}{\text{day}} \times \text{\% solvent} \times \frac{\text{lbs VOC}}{\text{gal VOC}}$$

$$\text{Uncontrolled Emissions} = (1{,}096 \text{ gal coating/day})\ (0.65)\ (7.33 \text{ lbs VOC/gal VOC})$$

$$= 5{,}227 \text{ lbs VOC/day}$$

$$\text{Emissions} = \text{Uncontrolled Emissions} \times (1 - (\text{Control Efficiency} \times \text{RE}))$$

$$= 5{,}227 \frac{\text{lbs VOC}}{\text{day}} \times (1 - (0.82)(0.80))$$

$$= 1{,}798 \frac{\text{lbs VOC}}{\text{day}}$$

4.1.5 Automobile Assembly Plant

Calculation based on a device control efficiency, and solvent-use recordkeeping and RE questionnaire results.

An assembly plant that coats automobile parts uses 150 gallons per day of coatings containing 5.5 pounds VOC per gallon. An additional 10 gallons of solvent, with a density of 7.1 pounds VOC per gallon, is used for cleanup each day. Emissions are controlled by a carbon adsorber that demonstrated a 90 percent capture and control efficiency during a recent test. The plant keeps substantial records of coating and solvent usage, but no data on control device operation and/or maintenance (O&M). The RE for this source category has been determined to be 75 percent based on questionnaire responses. *What emissions should be reported in the inventory?*

Answer: It may appear that emissions can be calculated by means of a direct determination due to the good coating and solvent records at the source. However, the presence of

a control device precludes direct determination of emissions. Therefore, RE needs to be included in the emissions calculation.

Uncontrolled Emissions = (150 *gal Coating/day* x 5.5 *lbs VOC/gal Coating*)

+ (10 *gal Solvent/day* x 7.1 *lbs VOC/gal Solvent*)

= 825 *lbs VOC/day* + 71 *lbs VOC/day*

= 896 *lbs VOC/day*

Emissions = *Uncontrolled Emissions* x (1 - (*Control Efficiency* x *RE*))

= 896 *lbs VOC/day* x (1 - (0.90)(0.75))

= 291 *lbs VOC/day*

4.1.6 Large Appliance Coating

Calculation based on an irreversible process change and direct determination of emissions.

An appliance manufacturer uses 1,200 pounds of a powder coating per day. The coating is applied with electrostatic spray equipment achieving a transfer efficiency of 95 percent. The company also uses 10 gallons of solvent with a density of 7.1 pounds VOC per gallon solvent for daily cleanup operations. The plant keeps detailed records of coating and solvent use. The RE for this source category has been determined to be 75 percent. *What emissions should be reported in the inventory?*

Answer: Powder coating is an irreversible process change, but the cleanup solvent emissions must be calculated.[7] Since there are no controls for the cleanup solvent, but adequate records are kept, a direct determination of emissions can be made:

Emissions = (7.1 *lbs VOC/gal* x 10 *gal/day*)

= 71 *lbs VOC/day*

[7] Powder coating may not always be an irreversible change; the state or local agency should make this determination.

4.1.7 Large Petroleum Dry Cleaner

Calculation based on the expected rule control efficiency, reported controlled emission and the default RE value.

A large petroleum dry cleaner has an estimated controlled emission rate of 200 tons of VOC per year. The RACT control level is 80 percent based on analysis of the rule for the nonattainment area. The plant is in operation 310 days per year. All inventory categories have been assigned the 80 percent default RE value. *What emissions should be reported in the inventory?*

Answer: Emissions should be calculated as follows:

$$\text{Uncontrolled Emissions} = \frac{\text{Controlled Emissions}}{(1-\text{Control Efficiency})}$$

$$= \frac{200 \text{ tons VOC/year}}{(1-0.8)}$$

$$= 1{,}000 \text{ tons VOC/year}$$

$$\text{Daily Emissions} = \text{Uncontrolled emissions} \times (1 - (\text{Control Efficiency} \times \text{RE}))$$

$$= \frac{1{,}000 \text{ tons VOC/yr} \times 2{,}000 \text{ lbs/ton}}{310 \text{ days/yr}} \times (1 - (0.80)(0.80))$$

$$= 2{,}322 \text{ lbs VOC/day}$$

4.1.8 Graphic Arts

Calculation based on multiple sources at one facility, with and without controls.

A printing manufacturer uses two gravure lines at a given facility. The first gravure line (line 1) was uncontrolled in 1990 and did not comply with SIP rules at that time; the second gravure line was controlled by a fume incinerator meeting the State SIP rule. (Line 1 was subsequently upgraded in 1991 to include fume incineration). Plant personnel are required to complete a formal training program on operation and maintenance and follow maintenance guidelines daily. The facility was found out of compliance during the past year due to incineration failure but was back in compliance within 72 hours. A violation notice was placed into the State Agency files. The facility is inspected annually. The device control efficiency for fume incineration was determined to be 95 percent during the previous compliance test. Following a survey using the questionnaire, RE for graphic arts was calculated to be 85 percent.

For line process, 25,000 pounds of ink (12 percent VOC by weight) were used. Other solvents used for viscosity adjustment and cleaning totalled 100,000 pounds (100 percent VOC). A total of 900,000 pounds of ink (60 percent VOC by weight) were used in line 2, while 600,000 pounds of other materials (100 percent of VOC) were used for Line 2. The ink consumption is tracked daily at the press and the VOC content is given by the manufacturer. *What are the annual emissions from this facility with Rule Effectiveness?*

Answer: The two gravure lines must be treated separately. Line 1 had no controls and RE zero because there was no attempt at compliance. The second gravure process (Line 2) is controlled and RE must be applied. For comparison, facility emissions with and without RE are presented.

A. Line 1 Gravure Process (No Controls)

Emissions = Ink Emissions + Other Emissions

1. Ink Emissions:

Ink Emissions = Ink Consumed x Ink VOC Fraction
= 25,000 lbs ink x 0.12 lbs VOC/lbs ink
= 3,000 lbs VOC

2. Emissions for Other Solvents:

Other Solvent Emissions = Other Solvents Consumed x Other Solvent VOC Fraction
= 100,000 lbs Other Solvents x 1.00 lbs VOC/lbs Other Solvents
= 100,000 lbs VOC

3. Line 1 Emissions:

Emissions = Ink Emissions + Other Solvent Emissions
= 3,000 lbs VOC + 100,000 lbs VOC
= 103,000 lbs VOC
= 51.5 tons VOC

B. Line 2 Gravure Process

Step 1 – Before Rule Effectiveness

Emissions = (Ink Emissions + Other Solvent Emissions) x (1 - Control Efficiency)

1. Ink Emissions:

Ink Emissions = Ink Consumed x Ink VOC Fraction
= 900,000 lbs Ink x 0.60 lbs VOC/lbs Ink
= 540,000 lbs VOC

2. Emissions from Other Solvents:

Other Solvent Emissions = *Other Solvents Consumed* x *Other Solvent VOC Fraction*
= 600,000 *lbs Solvent* x 1.00 *lbs VOC/lbs Other Solvents*
= 600,000 *lbs VOC*

3. Line 2 Emissions (Before Rule Effectiveness)

Emissions = (*Ink Emissions* + *Other Solvent Emissions*) x (1 - *Control Efficiency*)
= (540,000 *lbs VOC* + 600,000 *lbs VOC*) x (1 - 0.95)
= 57,000 *lbs VOC*
= 28.5 *tons VOC*

Gravure Process (Emissions Accounting for RE)

RE Emissions = (*Ink Emissions* + *Other Solvent Emissions*) x
(1 - (*Control Efficiency* x *RE*))
= (540,000 *lbs VOC* + 600,000 *lbs VOC*) x (1 - (0.95 x 0.85))
= 219,450 *lbs VOC*
= 109.7 *tons VOC*

C. Facility Emissions

Facility Emissions = *Line* 1 *Emissions* + *Line* 2 *RE Emissions*
= 51.5 + 109.7 *tons VOC*
= 161.2 *tons VOC*

4.2 AREA SOURCES

4.2.1 Stage I (Area Source Category)

Calculation based on rule penetration and SSCD study results.

The gasoline throughput for service stations in a nonattainment area is reported to be 400,000 gallons gasoline per day. The uncontrolled Stage I emissions are estimated to be 11.5 pounds VOC per 1,000 gallons. The State regulation requires 95 percent control at each facility and covers about 90 percent of the overall emissions from the category (*i.e.*, rule penetration = 90 percent). The RE for this category has been determined to be 60 percent following an SSCD study conducted by the State agency. *What emissions should be reported in the inventory?*

Answer: RE and penetration should be introduced into the emissions calculation as follows:

Uncontrolled emissions = 400,000 *gal gasoline/day x* 11.5 *lbs VOC*/1,000 *gal gasoline*

= 4,600 *lbs VOC/day*

RE Emissions = *Uncontrolled emissions x* (1 - (*Control Efficiency x RE x Rule Penetration*))

= 4,600 *lbs VOC/day x* (1 - (0.95)(0.60)(0.90))

= 2,240 *lbs VOC/day*

4.2.2 Architectural Coating (Area Source Category)

Calculation based on direct determination of emissions.

The ozone nonattainment area inventory includes architectural surface coating as an area source category. Architectural coatings include surface coating, painting and decorating of architectural structures using water-based and oil-based coatings, cleanup solvents and thinners. The agency describes the following inventory method and emissions data for the category.

Architectural surface coating use (consumption) in the nonattainment area is based on a comprehensive survey of all coating manufacturers and marketers in the nonattainment area. The survey results provided consumption of each type of coating/solvent/thinner and the manufacturers' statement of its solvent content. The survey results are from 1990 and include all coatings, thinners and solvents used in the category. Results are an annual weighted composite VOC emission expressed as pounds VOC per gallon coating (0.46 pounds VOC per gallon) and an estimate of 1,555,322 gallons of coating used in the nonattainment area. What emissions should be reported in the base year inventory and what RE value should be applied?

Answer: Although applied to an area source category, this example follows the traditional point source interpretation of direct determination because it provides (1) an accounting of consumption and (2) use of a known solvent content. However, the inventory procedures are entirely different for area source categories. In this example, a direct determination is based on the mass balance done for the nonattainment area.

Emissions = (0.46 *lbs VOC/gal*) *x* (1,555,322 *gal*)

= 715,448 *lbs VOC/year*

= 358 *tons VOC/year*

APPENDIX A

RULE EFFECTIVENESS QUESTIONNAIRE
POINT SOURCES

RULE EFFECTIVENESS EVALUATION FORM
Point Sources

Source Category _____
Source Name _____
Source Location _____
Source Identifier _____

Choose the one most appropriate response for each question. Answers should be confirmed by information in the State or local agency's files. When the questionnaire has been completed, total the scores to determine RE for the source; the average score for all evaluated sources in a category is the RE for that category.

Preliminary Screening:

1. Is this source currently uncontrolled? _____ No
_____ Yes
(If "yes", choose another source to evaluate, and indicate a RE of 0 percent for this source in the inventory.)

2. Are emissions from this source controlled by an irreversible process change? _____ No
_____ Yes
(If "yes", choose another source to evaluate, and indicate a RE of 100 percent for this source in the inventory.)

3. Have emissions from this source been calculated by means of a direct determination? _____ No
_____ Yes
(If "yes", choose another source to evaluate, do not apply RE to this source, and indicate a RE of 100 percent in the inventory.)[1]

A. Nature of the Regulation

1. Does the regulation contain uncorrected deficiencies (not including record keeping deficiency) as specified in the SIP-call follow-up letter from the EPA Regional Air Division Director to your State Air Program Director?

_____ No (5)
_____ Yes or unsure (0) Score _____

[1] If a source's emissions have been estimated using direct determination, maintain the supporting data and calculations in your files.

2. Does the State require source to keep records sufficient to enable an inspector to determine compliance status?

_____ Yes (5)
_____ No or unsure (0)

Score _____

3. How complex is the determination of compliance? (*If State can verify through detailed records that all necessary compliance determination procedures have been carried out, score 5 points for this question regardless of answer checked below.*)

_____ Determination can be made by looking at facility, as in the case of an equipment standard. (5)
_____ Determination can be made by collecting and analyzing one sample or by evaluating continuous emission monitoring reports. (4)
_____ Stack testing, including capture and control, must be performed to determine compliance. (3)
_____ Determination requires that multiple samples be taken and analyzed and that plant records be evaluated, as in the case of cross-line averaging, time averaging, or other bubbles. (2)

Score _____

B. Nature of Procedures Used to Comply With Regulation

1. This question concerns the relative level of confidence in the long-term performance capabilities intrinsic to different control techniques (e.g., how time in operation and maintenance degradation might affect emissions control). (*Check each technique used at the facility, total the scores assigned to each control, divide by the number of controls and report the average as a single score. If State can verify through detailed records that the source has actually been in continuous compliance at all times during the past two years, score 10 points on this question regardless of control methods used.*)

_____ Floating roof (10)
_____ Thermal incinerator (8)
_____ Vapor balance (8)
_____ Reversible process change (e.g., coating reformulation) (8)
_____ Condensation system (7)
_____ Carbon adsorber (7)
_____ Catalytic incinerator (7)
_____ Other (assign point value $\leq$ 10, as appropriate, relative to above controls) (_)

Score _____

2. Are fugitive emissions that might cause noncompliance a possibility where add-on controls are used (*check one*)?

____	No or not applicable because there is no add-on equipment	(5)
____	No, because they have been shown by an EPA-approved capture efficiency test to be below allowable limits and to be so on a continual basis	(5)
____	Yes or unsure	(0)

Score _____

C. Performance of Source in Complying With Regulation

1. What procedures does the source follow for operation and maintenance (O&M) of the control equipment (*check one*)?

____	Plant personnel complete a formal training program and follow daily written instructions for O&M	(5)
____	Same as above, except no training	(4)
____	Plant personnel follow weekly established O&M routine	(3)
____	Equipment is assumed to be operating correctly unless major malfunction is detected	(1)

Score _____

2. What is the nature of self-monitoring efforts conducted by the plant to assess compliance (*check one*)?

____	Source test (using EPA-approved method)[2] is conducted annually	(5)
____	Sample analysis (using EPA-approved method)[2] is conducted for each ink or coating used	(5)
____	Above tests are performed, but less frequently	(3)
____	None or unsure	(0)

Score _____

3. Does the plant keep records of data (including self-monitoring, O&M, coating usage, etc.) that would allow verification of compliance?

____	Yes	(5)
____	No or unsure	(0)

Score _____

---

[2]For examples of approved test methods, see "Test Methods or Procedures for Group I, II, and III CTG's," *Issues Relating to VOC Regulations, Cutpoints, Deficiencies, and Deviations*, EPA/OAQPS/AQMD/OCMPB/PIS, May 25, 1988.

[3]Ibid.

4a. Has source been found to be out of compliance in the last 12 months? (*If "yes", then answer question 4b; otherwise, skip to Part D*)

____ No (10)
____ Yes or unsure (0)

Score _____

4b. In responding to Notices of Violation, did the source demonstrate compliance within the required time frame? (*Answer this question only if you answered "yes" to question 4a. above*)

____ Yes (5)
____ No or unsure (0)

Score _____

D. Performance of Implementing Agency in Enforcing Regulation

1. Please answer the following questions regarding verification of the source's compliance?

a. Are all permits and abatement orders available?

____ No (0)
____ Yes or not applicable (2)

Score _____

b. Are all applicable requirements identified in the permit (e.g., emission limits, averaging times, compliance schedule, monitoring, recordkeeping, reporting, operation and maintenance, test requirements)?

____ No (0)
____ Yes or not applicable (2)

Score _____

c. Are accurate and complete flow diagrams available for the emission points and control, capture, ventilation and process systems?

____ No (0)
____ Yes or not applicable (2)

Score _____

d. Are all source test and sample analysis results available?

____ No (0)
____ Yes or not applicable (2)

Score _____

e. Are all appropriate control system operating data available?

____ No
____ Yes or not applicable (2)

Score _____

Total Score _____

2. What is the professional background of the person who most frequently inspects this source? (*Choose the one most applicable answer with highest score.*)

____	Has ≥ 3 years of experience in conducting plant inspections	(5)
____	Has engineering degree and has completed formal training program on how to conduct plant inspections	(4)
____	Has engineering degree	(3)
____	Has completed formal training program on how to conduct plant inspections	(3)
____	No training, < 3 years of experience, and no engineering degree	(0)
____	Unsure	(0)

Score _____

3. How many times has source been inspected in the past 24 months? (*Inspections must be confirmed by inspection reports in implementing Agency's file.*)

____	>2 times, unannounced	(10)
____	Once or twice, unannounced	(8)
____	Once or more, with prior notice or unknown if notice given	(6)
____	None or unsure	(0)

Score _____

4. What was the highest level of inspection performed at the source in the last 24 months? (*This must be confirmed by inspection reports in the implementing agency's file.*)

____	Level 4: sampling inspection including preplanned sample collection	(5)
____	Level 3: compliance evaluation	(4)
____	Level 2: walk-through	(2)
____	Level 1: observation from outside	(1)
____	None or unsure	(0)

Score _____

5. Does the agency generally determine compliance by the method(s) specified in the regulation?

____	Yes	(5)
____	No or unsure	(0)

Score _____

6. If this source has been found out of compliance within the last 12 months, has formal documented enforcement action (e.g., consent decrees, variances, court actions, penalties) been taken against the source?

____	Not applicable because source has not been found out of compliance	(5)
____	Yes	(5)
____	No or unsure	(0)

Score _____

7. If source has been found out of compliance within the last 12 months, has a follow up inspection been made to affirm compliance?

____	Not applicable because source has not been found out of compliance	(5)
____	Yes	(5)
____	No or unsure	(0)

Score _____

SCORING:

A: ____ of 15 B: ____ of 15 C: ____ of 25 D: ____ of 45

TOTAL SCORE = _____ of 100 points maximum = RE value for source

APPENDIX B

RULE EFFECTIVENESS QUESTIONNAIRE
AREA SOURCE CATEGORIES

RULE EFFECTIVENESS EVALUATION FORM
Area Source Categories

Source Category _____
Location _____

Choose the one most appropriate response for each question. Answers should be confirmed by information in the State or local agency's files. When the questionnaire has been completed, total the scores to determine RE for the category.

1. Does the regulation contain uncorrected deficiencies as specified in the SIP-call follow-up letter from the EPA Regional Air Division Director to the State Air Program Director?

_____	No	(5)
_____	Yes or unsure	(0)
	Score	_____

2. What has been the nature and extent of source education on requirements of the regulation? *(Check all that apply and sum scores.)*

_____	Individual source mailings on compliance requirements	(7)
_____	Educational opportunities for plant personnel	(7)
_____	General notices in newspapers, trade journals, etc.	(3)
_____	Inform trade association	(3)
_____	None	(0)
	Score	_____

3. What percentage of sources in the inventory typically are spot checked annually (*check one*)?

_____	>30 percent	(20)
_____	10-30 percent	(15)
_____	5-9 percent	(10)
_____	1-4 percent	(5)
_____	<1 percent or don't know	(0)
	Score	_____

4. What percentage of the past year's spot checks indicated compliance (*check one*)?

____	100 percent	(30)
____	90-99 percent	(25)
____	50-89 percent	(20)
____	25-49 percent	(10)
____	1-24 percent	(5)
____	<1 percent or don't know	(0)
____	Not applicable since no spot checks were done	(0)

Score _____

5. Has formal documented enforcement action been taken against sources found to be out of compliance (*check one*)?

____	Not applicable since no inspected sources have been found to be out of compliance	(10)
____	Yes, for all noncomplying sources	(10)
____	Yes, in 50 to 99 percent of the cases	(5)
____	Yes, in < 50 percent of the cases	(2)
____	Never, or don't know	(0)

Score _____

6. Have enforcement actions for sources in this source category been publicized in the media (newspaper, TV, radio, trade journals), either through news stories or paid advertisements (*check one*)?

____	Not applicable since no inspected sources have been found to be out of compliance	(5)
____	Yes, in every case	(5)
____	Yes, in 50 to 99 percent of the cases	(3)
____	Yes, in < 50 percent of the cases	(1)
____	Never, or don't know	(0)

Score _____

7. Have follow-up inspections been made on sources which were found to be out of compliance (*check one*)?

____	Not applicable since no inspected sources have been found to be out of compliance	(10)
____	Yes, in 100 percent of the cases	(10)
____	Yes, in 50 to 99 percent of the cases	(5)
____	Yes, in < 50 percent of the cases	(2)
____	Never, or don't know	(0)

Score _____

TOTAL SCORE: _____ = RE for Area Source Category
(100 points maximum)

APPENDIX C

DIRECT DETERMINATION EXAMPLE

DIRECT DETERMINATION EXAMPLE

The following wood furniture coating scenario illustrates typical emission inventory information that may be collected in the surface coating category. This type of information is used to make and support a direct determination of emissions for an ozone base year SIP inventory.

FACILITY: RITEWAY FURNITURE
100 Commerce Drive
Ozoneville, USA

DESCRIPTION

Riteway Furniture fabricates and paints oak furniture. The plant uses high VOC stains, lacquers, glazes and sealers. This source is covered under the State's applicable RACT rules for wood furniture surface coating. Some of their lines have already been converted to high volume, low pressure (HVLP) spray guns. On average, their coatings range from 5.67 lbs VOC/gallon coating to 6.2 lbs VOC/gallon coating. The State air agency has recommended that other lines be converted to HVLP spray guns and that average coating solvent content be capped at 6.0 lbs VOC (monthly average) for their forthcoming permit amendment.

EMISSION SOURCES

POINT	PROCESS	1990 CONTROL DEVICE	THROUGHPUT
SB-1	Paint Spray Booth	None	(see attached
SB-2	"	None	sheets)
SB-3	"	None	
SB-4	"	None	
SB-5	"	None	

ADDITIONAL INFORMATION

The facility summarizes and submits monthly summary data to the State. Coating and solvent usage (including thinners and cleanup) are tracked as used at the booths, but the spray booths are not counted separately. The facility was inspected in 1990 and the monthly summaries were consistent with their daily records on file at the plant, according to the State compliance enforcement.

The attached sheet is a monthly spreadsheet from Riteway; all twelve are on file at the State agency. The "LBS VOC/GAL" come from manufacturer's specifications for the coatings.

ANSWER: There is sufficient information for direct determination of emissions because the amount of each coating and thinner/cleanup solvent used is tracked and documented regularly for each coating/solvent, the VOC content of these coatings has been provided by the manufacturer and the amount emitted is a mass balance calculation based on these data. In this instance, 100% emission has been assumed. The facility would be expected to document any claims that less than 100% is emitted (*e.g.*, some VOC is incorporated into the product.)

RITEWAY FURNITURE: JANUARY 1990 EMISSION REPORT

MFG NUMBER	DESCRIPTION	A LBS/ GAL	B LBS VOC/ GAL (less water)	C GAL USED	B*C LBS VOC EMITTED
S3-4100	ENGLISH SAP STAIN	6.82	6.81	0.00	0
S7-4057	ANTIQUE ASH SAP STAIN	6.62	6.61	56.00	370
PSA7-2460	OAK/KORN IND.	7.35	7.03	0.00	0
P1-3262	WHITE PRIMER	8.26	6.02	190.00	1,144
PC3-888	ANTIQUE TONER	6.83	6.53	90.00	588
PC7-935	ENGLISH TONER	6.98	6.53	10.00	65
PC8-870	BLUE TONER	7.73	6.41	65.00	417
LS-1582	LACQUER SEALER	7.38	6.05	92.00	557
LS-1728	WASHCOAT	7.10	6.51	30.00	195
PC-1006	PENETRATING WOOD SEAL	7.10	6.51	0.00	0
T-636	MAK	6.81	6.81	0.00	0
WS-2196	CLEAR GLAZE	7.62	4.28	20.00	86
WS5-3503	ASH WIPING STAIN	7.58	4.98	15.00	75
WS7-2589	ANTIQUE GLAZE	8.74	3.88	55.00	213
WS7-3303	OAK/KORN IND.	8.92	3.64	5.00	18
WS7-3465	ENGLISH GLAZE	8.57	3.98	25.00	100
F-2679	50 SHEEN CAT/LACQUER	7.86	5.39	0.00	0
CA-175	CATALYST	8.24	4.12	0.00	0
F-2554	60 SHEEN M/R LACQUER	7.54	5.88	0.00	0
F-2672	60 SHEEN M/R LACQUER	7.92	5.16	320.00	1,651
LE2-3229	WHITE LACQUER	8.27	5.82	35.00	204
07-1189	E/G SHADE	7.04	6.81	0.00	0
08-1190	BLUE SHADE	7.10	6.61	11.00	73
PF7-2251	WATER BASE PUTTY	11.98	0.00	6.00	0
T-1703	GLAZE REDUCER HYSOL 10	7.27	7.27	0.00	0
T-1743	GLAZE REDUCER HYSOL 15	7.42	7.42	0.00	0
T-1665	50/50 CUT HYSOL 10/15	7.35	7.35	130.00	956
T-1769	MINERAL SPIRITS	6.42	6.42	0.00	0
T-1648	LACQUER THINNER	6.63	6.63	105.00	696
T-1647	WASHOFF THINNER	6.61	6.61		0
T-1529	LACQUER RETARDER	7.91	7.91	15.00	119
T-1605	NGR STAIN REDUCER	6.63	6.63		0
T-1622	VM&P NAPTHA	6.23	6.23	55.00	343
UV-505	STRIPCOAT	7.81	5.69		0
				1,330	7,867

ADDITIONAL QUESTIONS ON DIRECT DETERMINATION

Do the following examples constitute direct determination?

1. The facility used the RACT level (6.0 lbs VOC) to calculate emissions.

   No, an assumed content cannot qualify as a direct determination.

2. The facility used the RACT level to estimate one coating line.

   Four lines could be directly determined, but the single line could not be treated as a direct determination.

3. The facility reported an annual mass balance, but daily records were not available during the inspection.

   The record unavailability would fail the reporting requirements for direct determination.

4. The facility collected waste coating and shipped it offsite as hazardous waste.

   Yes, direct determination could be claimed if the manifests are on file and the solvent portion is quantified. Yes, if this waste is not quantified, but no "credit" is given for the waste. No, if this waste is not documented but is subtracted from the emissions.

5. For the inventory year, this source was not permitted under the regulation.

   This fact has no bearing on direct determination, only the application of Rule Effectiveness.

6. The facility vents spray booth emissions to an incinerator and reports a 96 percent control efficiency and test report (the same mass balance documentation is submitted for uncontrolled emissions).

   With a control device, this calculation is no longer a direct determination and Rule Effectiveness must be applied.

7. The facility reports that 2 lbs VOC are consumed per 100 pieces, and submits monthly reports of production (pieces).

   Rate per unit of production is not suitable for direct determination where the production is not coating or solvent used.

APPENDIX D

DETERMINING SAMPLE SIZE

DETERMINATION OF SAMPLE SIZE

The sample chosen for the RE questionnaire survey should be representative of the relevant category population as a whole. This means that the size of the sample must be statistically adequate to represent that category population. A population mean or proportion is estimated by the corresponding mean or proportion of the sample. In addition to the size of the sample (*i.e.*, the sources for which a questionnaire is completed), it is also necessary to consider the makeup of the sample chosen.

For many applications, the population parameters (*i.e.*, population mean μ and population standard deviation σ) are usually known or can be estimated. In the case of RE, estimating these parameters is the objective of the survey. The population mean can be approximated by the sample mean with some degree of error. In deciding on size of sample for a given survey, several elements must be considered:

- The standard deviation of the population from which the sample is to be drawn. Lacking this information, it can be estimated either from past surveys (if available) from the same population, from an initial survey conducted for this purpose (the first ten sources chosen at random) or from rational considerations of what this population might look like.

- The degree of accuracy "e" one would like to have in the sample data. This is usually defined as an interval and is referred to as the limit of error. The sample mean will usually not be exactly equal to the population mean. The size of this difference is the limit of error "e."

- The degree of confidence α one would like to have to be confident that the population mean is within the limit of error set above.

Thus, if the sample mean is used as an estimate of the population mean μ, we can be $(1 - \alpha) \times 100$ percent confident that the limit of error will be less than a specified amount "e" when the sample size is at least

$$n = \left(\frac{Z_{\alpha/2}\, \sigma}{e} \right)^2$$

where
- n = sample size
- σ = standard deviation of the population
- e = limit of error (usually in the range of 5 to 10 percent of the value of the mean)
- α = confidence level
- $Z_{\alpha/2}$ = index derived from the normal curve corresponding to the desired confidence levels:

α (Percent)	$Z_{\alpha/2}$
90	1.65
95	1.96
99	2.58
99.7	3.00

The following tables were developed using the equation presented above. They show the sensitivity of sample size with respect to the confidence level α, the limit of error e, and the standard deviation of the population from which the sample is to be drawn. There is a trade-off between confidence level and limit of error. The largest sample size provides the highest confidence level and lowest limit of error. In addition, larger sample sizes are required when the standard deviation is larger. Conversely, the smallest sample size provides the lowest confidence level and the highest limit of error. Smaller sample sizes can be used when the standard deviation is lower.

The following example illustrates the use of the tables presented above. Assume that an air pollution control agency is interested in estimating rule effectiveness (RE) in the can coating industry. However, no prior estimates on RE are available from previous research. Lacking such an estimate, the initial survey was conducted on 10 facilities. Results of the initial survey yielded an average RE value of 80 percent with a standard deviation of 8 percent. Assuming a 90 percent confidence limit and a limit of error of 5 percent, the sample size required is obtained from Table 1 and is equal to 7. In this case, the survey for this category would be complete. However, if the standard deviation obtained from the initial survey was 10 percent and the limit of error was 5 percent, the number of facilities required for sampling increases from 7 to 11 facilities, and one more questionnaire would need to be completed. On the other hand, choosing a larger limit of error, 5.5 percent instead of 5 percent, will yield a sample size of 9 facilities instead of 11.

CHOICE OF SAMPLE SIZE

For statistical purposes, the variables affecting the sample size are the limit of error and the confidence level. However, decisions on actual sample size to be used must also include considerations such as available resources and data quality requirements. A decision on what sample size to choose should begin with an estimation of the resources necessary for execution and data analysis. The initial survey of ten randomly-selected facilities can be used for that purpose. The second step in deciding on the size of the sample and the type of survey to be conducted is to determine the resources available to the surveying agency including staff time available for completing the questionnaires. The next step is to determine a sample size

based on the statistical formulas and estimate the resources required to conduct the survey. Those resources are then compared to the resources available to the agency for the purpose of conducting the survey. If the resources needed exceed the available resources, the agency should decide on an affordable sample size. This is achieved by modifying the acceptable limit of error or confidence level or both.

EPA recommends that the 90 percent confidence interval (Table D-1) be used; the suggested sample error is 5 percent, but should not exceed 10 percent. State and local agencies are permitted latitude to choose higher confidence intervals and lower sampling errors. Where these methods are used, the SIP documentation should state the selected error and confidence levels.

TABLE D-1. SENSITIVITY ANALYSIS OF SAMPLE SIZE: CONFIDENCE LEVEL = 90%

Sample Error	Standard Deviation											
	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%
2.5%	2	7	16	28	44	63	85	112	141	174	211	251
3.0%	1	5	11	19	30	44	59	77	98	121	146	174
3.5%	1	4	8	14	22	32	44	57	72	89	108	128
4.0%	1	3	6	11	17	25	33	44	55	68	82	98
4.5%	1	2	5	9	13	19	26	34	44	54	65	77
5.0%	0	2	4	7	11	16	21	28	35	44	53	63
5.5%	0	1	3	6	9	13	18	23	29	36	44	52
6.0%	0	1	3	5	8	11	15	19	25	30	37	44
6.5%	0	1	2	4	6	9	13	16	21	26	31	37
7.0%	0	1	2	4	6	8	11	14	18	22	27	32
7.5%	0	1	2	3	5	7	9	12	16	19	23	28
8.0%	0	1	2	3	4	6	8	11	14	17	21	25
8.5%	0	1	1	2	4	5	7	10	12	15	18	22
9.0%	0	1	1	2	3	5	7	9	11	13	16	19

TABLE D-2. SENSITIVITY ANALYSIS OF SAMPLE SIZE: CONFIDENCE LEVEL = 95%

Sample Error	Standard Deviation											
	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%
2.5%	2	10	22	39	61	89	120	157	199	246	297	354
3.0%	2	7	15	27	43	61	84	109	138	171	207	246
3.5%	1	5	11	20	31	45	61	80	102	125	152	181
4.0%	1	4	9	15	24	35	47	61	78	96	116	138
4.5%	1	3	7	12	19	27	37	49	61	76	92	109
5.0%	1	2	6	10	15	22	30	39	50	61	74	89
5.5%	1	2	5	8	13	18	25	33	41	51	61	73
6.0%	0	2	4	7	11	15	21	27	35	43	52	61
6.5%	0	1	3	6	9	13	18	23	29	36	44	52
7.0%	0	1	3	5	8	11	15	20	25	31	38	45
7.5%	0	1	2	4	7	10	13	17	22	27	33	39
8.0%	0	1	2	4	6	9	12	15	19	24	29	35
8.5%	0	1	2	3	5	8	10	14	17	21	26	31
9.0%	0	1	2	3	5	7	9	12	15	19	23	27

TABLE D-3. SENSITIVITY ANALYSIS OF SAMPLE SIZE: CONFIDENCE LEVEL = 99%

Sample Error	Standard Deviation											
	2%	**4%**	**6%**	**8%**	**10%**	**12%**	**14%**	**16%**	**18%**	**20%**	**22%**	**24%**
2.5%	4	17	38	68	107	153	209	273	345	426	515	613
3.0%	3	12	27	47	74	107	145	189	240	296	358	426
3.5%	2	9	20	35	54	78	107	139	176	217	263	313
4.0%	2	7	15	27	42	60	82	107	135	166	201	240
4.5%	1	5	12	21	33	47	64	84	107	131	159	189
5.0%	1	4	10	17	27	38	52	68	86	107	129	153
5.5%	1	4	8	14	22	32	43	56	71	88	107	127
6.0%	1	3	7	12	18	27	36	47	60	74	89	107
6.5%	1	3	6	10	16	23	31	40	51	63	76	91
7.0%	1	2	5	9	14	20	27	35	44	54	66	78
7.5%	0	2	4	8	12	17	23	30	38	47	57	68
8.0%	0	2	4	7	10	15	20	27	34	42	50	60
8.5%	0	1	3	6	9	13	18	24	30	37	45	53
9.0%	0	1	3	5	8	12	16	21	27	33	40	47

APPENDIX E

DEFAULT CONTROL ASSUMPTIONS FOR CTG CATEGORIES

The attached table lists the CTG categories and the *approximate* control efficiency which the CTG authors identified for the CTG categories. Many of the efficiencies depend on which control method is used and the solvent content. Closer analysis of the CTG documents and references would likely improve the rough estimates provided here. EPA has not determined the validity or reliability of this listing for the purposes of RE.

TABLE E-1. TYPICAL VOC REDUCTION PER FACILITY FOR CTG CATEGORIES BASED ON CTG DOCUMENTS

Category	Low[a] (%)	High[a] (%)	Single Value (%)	Comment
Point Source Categories				
Gasoline Loading Terminals			87	
Bulk Gasoline Plants				
Alternative 1				
Total Plant			22	
All Transfers			27	
Alternative 2				
Total Plant			54	
All Transfers			64	
Alternative 3				
Total Plant			77	
All Transfers			92	
Fixed Roof Petroleum Tanks			90+	
Refinery Processes				
VPS			100	
WS			95	
PUT			98	
Surface Coating				Solvent % and control dependent
Cans	60	100		
Metal Coils	70	98		
Fabric and Vinyl	80	100		
Paper Products	80	99		
Automobiles & Light Duty Trucks				
Prime Coating	80	93		
Top Coating	75	92		
Final Repair Coating	NA			
Metal Furniture	50	99		
Magnetic Wire			90	
Large Appliances	79	95		

(continued)

TABLE E-1. TYPICAL VOC REDUCTION PER FACILITY FOR CTG CATEGORIES BASED ON CTG DOCUMENTS (continued)

Category	Low[a] (%)	High[a] (%)	Single Value (%)	Comment
Misc. Metal Parts				
Process Modification	50	98		
Exhaust Gas Treatment			90+	
Flatwood Paneling	70	90		
Graphic Arts				
Publication Rotogravure			75	
Packaging Rotogravure			65	
Flexographic Printing			60	
Leaks from Petroleum Refineries			62	Based on 15,900 m^3/day
External Floating Roof Tanks	33	99		
Gasoline Truck Leaks & Vapor Collection	NA			
Synthetic Pharmaceutical Manufacturing	NA			
Rubber Tire Manufacturing				
Carbon Adsorption	62	86		
Incineration	59	81		
Water-based Coatings			97	
Leaks from NG/Gasoline Processing Plants			72	Model plants
Mfg. of HDPE, PP, and PS Resins			98	Model Plants
SOC & Polymer Mfg. Equipment Fugitives			36	under RACT
Large Petroleum Dry Cleaners	66	72		
SOCMI Air Oxidation Processes				
Thermal Oxidation			98	With controls above baseline
			53	

(continued)

TABLE E-1. TYPICAL VOC REDUCTION PER FACILITY FOR CTG CATEGORIES BASED ON CTG DOCUMENTS (continued)

Category	Low[a] (%)	High[a] (%)	Single Value (%)	Comment
Area Sources				
Service Stations - Stage I				
Transfer Losses			95+	
Total Facility			50	
Cutback Asphalt			100	
Solvent Metal Cleaning				
Cold Cleaning	50	53		+/- 20%
Open-top Vapor Degreasing	45	60		+/- 15%
CD	25	60		+/- 10%
Perchloroethylene Dry Cleaners	40	70		Carbon Adsorption

[a] Users should select the low value from a range unless another value is justified. One-hundred percent should never be used unless the emissions are directly determined or there has been an irreversible process change.