EPA/452/B-02-001

Section 1

Introduction

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Chapter 1

Background

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Contents

1.1 Role of Cost in Setting of Regulations

Cost has an important role in setting many state and federal air pollution control regulations. The extent of this role varies with the type of regulation. Some types of regulations, such as Maximum Achievable Control Technology (MACT) standards, explicitly use costs in determining their stringency. This use may involve a balancing of costs and environmental impacts, costs and dollar valuation of benefits, or environmental impacts and economic consequences of control costs. Other types of regulations (e.g., National Ambient Air Quality Standards), use cost analysis to choose among alternative regulations with the same level of stringency. For these regulations, the environmental goal is determined by some set of criteria which do not include costs. However, regulators use cost-effectiveness analysis to determine the minimum cost way of achieving the goal.

For some regulations, cost influences enforcement procedures or requirements for demonstration of progress towards compliance with an air quality standard. For example, the size of any monetary penalty assessed for noncompliance as part of an enforcement action must include the cost of the controls that were not installed by the noncompliant facility. For regulations without a fixed compliance schedule, demonstration of reasonable progress towards the goal is sometimes tied to the cost of attaining the goal on different schedules.

Cost is also a vital input to the EPA's standard setting and regulatory processes. Through various Executive Orders and acts, EPA has been charged with performing a number of detailed economic and benefit-cost analyses on each proposed rulemaking to assess their economic efficiency and assure the public the best possible regulation has been chosen from among alternative regulations. Cost also plays an input role in determining the economic impact of each regulatory alternative on sensitive populations, small businesses, employment, prices, and market and industry structure.

This Manual provides up-to-date information on point source and stationary area source air pollution controls for volatile organic compounds (VOCs), particulate matter (PM), oxides of nitrogen (NO_X), and some acid gasses (primarily SO_2 and HCl). It is not a source of information for non-stationary area (e.g. emissions from fugitive dust sources, agricultural sources) and mobile sources. Furthermore, this Manual does not directly address the controls needed to control air pollution at electrical generating units (EGUs) because of the differences in accounting for utility sources. Electrical utilities generally employ the EPRI Technical Assistance Guidance (TAG) as the basis for their cost estimation processes.[1] Finally, new and emerging technologies are not generally within the scope of this Manual. The control devices included in this Manual are generally well established devices with a long track record of performance.

[1]This does not mean that this Manual is an inappropriate resource for utilities. In fact, many power plant permit applications use the Manual to develop their costs. However, comparisons between utilities and across the industry generally employ a process called "levelized costing" that is different from the methodology used here.

1.2 Purpose of the Manual

The objectives of this Manual are two-fold: (1) to provide guidance to industry and regulatory authorities for the development of accurate and consistent costs (capital costs, operating and maintenance expenses, and other costs) for air pollution control devices, and (2) to establish a standardized and peer reviewed costing methodology by which all air pollution control costing analyses can be performed. To perform these objectives, this Manual, for the last twenty-five years, has compiled up-to-date information for "add-on" (downstream of an air pollution source) air pollution control systems and provided a comprehensive, concise, consistent, and easy-to-use procedure for estimating and (where appropriate) escalating these costs. Over time, the accessability of this Manual and its ease of use has significantly increased. Its early editions were only available in hard copy by request, mailed from the EPA's Office of Air Quality Planning and Standards in Research Triangle Park, North Carolina. Later editions became available electronically; first through the EPA's Technology Transfer network (TTN) bulletin board in the early nineties, later as a fully accessible series of documents on the Internet through the Agency's Clean Air Technology Center. The Manual is a living document, evolving continuously to meet the changing needs of its customers, and now, with supporting programs for the personal computer such as the CO$T-AIR spreadsheets and the Air Compliance Advisor that streamline and simplify the input of site-specific information, the Manual is even more accessible and important.

As always, to achieve its objectives, the Manual provides detailed engineering information that reflects the latest innovations in the industry and costing information that is up-to-date and relevant. The accuracy of the information in the Manual works at two distinct levels. From a regulatory standpoint, the Manual estimating procedure rests on the notion of the "study" (or rough order of magnitude - ROM) estimate, nominally accurate to within ± 30%. This type of estimate is well suited to estimating control system costs intended for use in regulatory development because they do not require detailed site-specific information necessary for industry level analyses. While more detailed data are available to the regulator, those data are generally proprietary in nature (which limits their ability to be published), costly to gather, and too time consuming to quantify. Therefore, for regulatory analysis purposes, study estimates offer sufficient detail for an assessment while minimizing its costs. The Manual and its supporting programs are also well suited to customization by industrial sources to provide more accurate assessments of control cost sizing and cost that can be used for scoping level decision making and planning purposes. While such customized analyses are by definition of greater accuracy than the generic study level analysis of the regulator, the Agency does not make any claim for a greater accuracy than the study level's nominal ±30 percent.

The Manual offers an additional, benefit to its users. When industry uses the Manual and its support programs to determine its control costs for permitting purposes, and the regulator uses the Manual (and its support programs) to validate industry's permit, the approval process can be faster and less expensive. With a common peer reviewed costing methodology used by

all parties, regulators and permitting authorities can minimize the time it takes to perform a permit review because the honest application of the methodology set out in this Manual by both industry and the regulator should provide results that are roughly similar. Differences in conclusions are reduced to a comparison of input parameters, rather than a protracted debate on the veracity of alternative models. This internal consistency allows industry and the regulatory community to work in partnership to bring industrial growth on line faster and produce needed pollution abatement sooner.

1.3 Organization of the Manual

This Manual is a revision of the fifth edition of the OAQPS Control Cost Manual, [1] which, in turn, was a revision of the edition completed in 1990. This sixth edition of the Manual includes sizing and costing procedures and data for the same eight types of add-on control devices and three kinds of auxiliary equipment available in the fifth edition, but beyond the necessary revisions, updates, and expansions of each of these chapters, the Manual has made a number of revolutionary changes.

As with earlier editions, this edition has been issued in self-contained chapters. Each chapter addresses a logically separate topic, which can be either of a general nature (e.g., this introduction) or of a more specific, equipment-oriented nature (e.g., fabric filters). To fully assess the sizing and cost of a particular air pollution control device, you only have to access one chapter - with one exception. For auxiliary equipment common to many different pollution control devices, that information has not been repeated in each chapter. Instead, auxiliary equipment is handled as a separate set of chapters in the section immediately following this introduction. The chapters which comprise this portion of the Manual are listed in Table 1.1, alongside the portions of the 1990 Manual they replace.

Each of these stand-alone chapters contains a:

- Process description, where the types, uses, and operating modes of the equipment item and (if applicable) its auxiliaries are discussed;
- Sizing (design) procedure, which enables one to use the parameters of the pollution source (*e.g.*, gas volumetric flow rate) to size the equipment item(s) in question;
- Capital and annual costing procedure and data for the equipment and suggested factors to use in estimating these costs from equipment design and operational (*e.g.*, operating hours) parameters. These costs are presented in both graphical and equation forms wherever possible.
- Example problems to illustrate the sizing and costing procedures presented in the chapter.

Table 1.1: Comparison of the the OAQPS Control Cost Manual (5th Edition) and the EPA Air Pollution Control Cost Manual (6th Edition)

Sixth Edition Section/Chapter	Title	Fifth Edition Chapter
Section 1	**Introduction**	
Chapter 1	Background	1
Chapter 2	Cost Estimation: Concepts and Methodology	2
Section 2	**Generic Equipment and Stacks**	
Chapter 1	Hoods, Ductwork, and Stacks	10
Chapter 2	Fans, Pumps, and Motors [2]	
Chapter 3	Permanent Total Enclosures [2]	
Chapter 4	Monitors [1]	
Section 3	**VOC Controls**	
Section 3.1	**VOC Recapture Controls**	
Chapter 1	Carbon Adsorbers	4
Chapter 2	Refrigerated Condensers	8
Section 3.2	**VOC Destruction Controls**	
Chapter 1	Flares	7
Chapter 2	Incinerators	3
Section 4	**NO_x Controls**	
Section 4.1	**NO_x Combustion Controls**	
Chapter 1	Fuel Switching [2]	
Chapter 2	Low NOx Burners and other Combustion Controls [2]	
Chapter 3	Steam/Water Injection [2]	
Chapter 4	Natural Gas Reburn [2]	
Section 4.2	**NO_x Post-Combustion**	
Chapter 1	Selective Non-Catalytic Reduction [1]	
Chapter 2	Selective Catalytic Reduction [1]	
Chapter 3	Non-Selective Catalytic Reduction [2]	
Section 5	**SO_2 and Acid Gas Controls**	
Section 5.1	**Pre-Combustion Controls**	
Chapter 1	Fuel Substitution [2]	
Section 5.2	**Post-Combustion Controls**	
Chapter 1	Wet Scrubbers for Acid Gas	9
Chapter 2	Wet and Dry Scrubbers for SO_2 [2]	
Section 6	**Particulate Matter Controls**	
Chapter 1	Baghouses and Filters	5
Chapter 2	Wet Scrubbers for PM [2]	
Chapter 3	Electrostatic Precipitators	6
Chapter 4	Inertial Impactors [2]	
Section 7	**Mercury Controls** [2]	

[1]New Chapter

[2]Planned Chapter

Finally, each chapter is supported by supplemental programs that streamline and expand upon the information in the Manual:

- for control cost analyses, we developed a series of Lotus spreadsheets (filename: COST.AIR.ZIP), that have been installed on the CATC website, allow the user to size and cost any of the control devices covered in the Manual, plus several others (e.g., venturi scrubbers) that are planned for future inclusion in the Manual; and

- further automating the costing procedure and offering important engineering information, we have also developed a highly automated program, the Air Compliance Advisor, which, following the input of detailed site-specific information on the facility, offers sizing and costing information on all potential controls.

The scope of the Manual has also changed over time. Initially, the Manual provided information on a small number of volatile organic compound (VOC) pollutants that were of primary interest to the abatement of ozone and hazardous air pollutants (HAPs). Over time, the Manual grew to include particulate matter (PM) and some acid gasses. As new pollutants and new devices were added, they were simply added on to the end of the chapter list, which resulted in an unsystematic approach to the discussion of pollution control. Now, in this latest edition of the Manual, we have branched out even farther with new chapters on NO_X post-combustion control devices, planned chapters on NO_X combustion controls, expansion of the acid gas scrubber chapter to include SO_2 more explicitly, and a new chapter for fine particulate controls. To accommodate these new chapters, we have also changed the look of the Manual, rearranging chapters into logical pollutant groupings and restructuring the numbering system to allow for new chapters under each of these pollutant headings. Further discussion of these changes can be found in the next section, below.

1.4 Intended Users of the Manual

The Manual provides comprehensive procedures and data for sizing and costing control equipment. Some of these procedures are based on rigorous engineering principles, such as the material and engineering balances presented for Thermal Incinerators (Section 3, Chapter 2). To fully appreciate and correctly apply these procedures the user must be able to understand them. Moreover, the user has to be able to exercise "engineering judgement" on those occasions when the procedures may need to be modified or disregarded. Typically, engineers and others with strong technical backgrounds possess this kind of knowledge. Hence, this Manual is oriented toward the technical not the non-technical user.

1.5 "Uniqueness" of the Manual

The Manual presents a unique approach to estimating air pollution control system sizing and costing methodologies from other cost-oriented reports, such as:

- The Cost Digest: Cost Summaries of Selected Environmental Control Technologies [2]
- A Standard Procedure for Cost Analysis of Pollution Control Operations [3]
- Handbook: Control Technologies for Hazardous Air Pollutants [4]

Although these reports (as well as many of the MACT Background Information Documents and other standards-supporting documents) contain costs for add-on control systems, they do not duplicate the Manual for one or more of the following reasons: (1) their costs have been based either wholly or partly on data in the previous Manuals; (2) they apply to specific source categories only, whereas the Manual data may be applied generally; (3) their estimating procedures and costs are of less than study estimate quality; or (4) they are not intended for estimating costs used in regulatory development. The Cost Digest, for example, is designed for use by non-technical personnel, contains procedures for making "order-of-magnitude" estimates (± 30% accuracy or worse). A Standard Procedure, conversely, was primarily intended for estimating costs for R&D cases (e.g., demonstration projects), where some site-specific data are available. Further, although the latter report contains a thorough list of equipment installation factors, it contains few equipment costs. The report, Handbook: Control Technologies, used data and estimating procedures from the 1990 Manual to provide sound generalized procedures for estimating costs for various types of control equipment. This edition of the Manual supplements this information. Also, since its inception, the Manual has been extensively used to support Agency regulatory development, state permitting programs, and other activities where current, consistent, and comprehensive control cost data are required.

One additional characteristic of the Manual must also be considered: the Manual is free. While other pollution control cost reports can costs hundreds of dollars, the EPA has always provided this Manual at no cost. This is especially important when we consider the increased use the Manual has received from academic institutions for master's and doctoral work by engineers, environmental engineers, and economists. In summation, the Manual remains a uniquely available, uniquely comprehensive, and uniquely accepted standard in the field of environmental pollution control sizing and costing.

References

[1] OAQPS Control Cost Manual (Fourth Edition), EPA, Office of Air Quality Planning and Standards, Emissions Standards Division, January 1990 (EPA 450/3-90-006 [NTIS/PB90-169954]).

[2] DeWolf, Glenn, et al. (Radian, Inc.), The Cost Digest: Cost Summaries of Selected Environmental Control Technologies, EPA, ORD, Office of Environmental Engineering and Technology, October 1984 (EPA-600/884-010).

[3] Uhl, Vincent W., A Standard Procedure for Cost Analysis of Pollution Control Operations, Volumes I and II, EPA, ORD, Industrial Environmental Research Laboratory, June 1979 (EPA-600/8-79-018a).

[4] Handbook: Control Technologies for Hazardous Air Pollutants, EPA, Office of Research and Development, Air and Energy Engineering Research Laboratory, June 1991 (EPA-625/6-91-014).

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15. SUPPLEMENTARY NOTES

Updates and revises EPA 453/b-96-001, OAQPS Control Cost Manual, fifth edition (in English only)

16. ABSTRACT

In Spanish, this document provides a detailed methodology for the proper sizing and costing of numerous air pollution control devices for planning and permitting purposes. Includes costing for volatile organic compounds (VOCs); particulate matter (PM); oxides of nitrogen (NOx); SO2, SO3, and other acid gasses; and hazardous air pollutants (HAPs).

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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