Final Report

IMPROVEMENT OF THE EMISSION INVENTORY FOR REACTIVE ORGANIC GASES AND OXIDES OF NITROGEN IN THE SOUTH COAST AIR BASIN VOLUME I: MAIN REPORT

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PREFACE

The final report for this study has been designed to permit the reader easy access to specific information of interest. The reader should start by perusing the Executive Summary, which is separately bound, for an overview of efforts to improve the South Coast Air Basin emission inventory. Next, we suggest that the reader check the Table of Contents of this volume, which represents a topical outline of Volumes I and II, to obtain an understanding of the breadth of this study and to locate areas of specific interest.

The reader is directed to the following sections for detailed information on the changes made to the inventory: (1) the Executive Summary; (2) Volume I--Main Report, which discusses the performance of the project; and (3) Volume II--Appendixes, which provide greater detail primarily in the form of tables and listings.

ABSTRACT

The purpose of this study was to improve the quality of the 1979 South Coast Air Basin emission inventory for reactive organic gases and nitrogen oxides. To address this effort, Systems Applications, Inc. as prime contractor, joined with Radian Corporation as subcontractor, to utilize the strengths of each firm in the areas of emission inventory development, emission testing and characterization, process engineering, and data base management. The technical approach of this study team included (1) a review of existing inventory data to identify emission source categories and reactive species most likely to cause uncertainty in predicted photochemical ozone concentrations; (2) a field survey and testing program that provided basic data and information for revising the 1979 inventory; and (3) the generation of an improved ROG and NO_x inventory for the SOCAB that was compatible with the modeling emission data format. Statistical methods were applied in selecting representative facilities for the field survey and testing program. Quality control was practiced throughout the project, particularly with regard to data handling and emission testing. Changes to the inventory were within the overall estimated variation for typical inventory emission totals. Based on the study, the 1979 total inventory of TOG and NO_x emissions was found to be a reasonably accurate representation of the actual basin-wide inventory. Significant changes to both individual source and source category emissions and to ROG speciation were made during the study. The most significant change to the inventory was the addition of new speciation profiles for TOG emissions which resulted in important changes to organic gas reactivity. Twelve recommendations for guiding future activities in the area of emission inventory development are presented in the report.

ACKNOWLEDGMENTS

The development of emission inventories, because of their size, often requires close coordination among a team of specialists. This effort was no exception; several individuals made important contributions to the technical work presented in this report. Most notable among this group for Systems Applications, the prime contractor, are David Souten (Systems Applications program manager), Henry Hogo, and Pradeep Saxena. At Radian Corporation, the subcontractor for this study, we would like to acknowledge James Rouge (Radian program manager) and Dean Delleney. The contributions of all these individuals cannot be overstated. The principal investigators also sincerely appreciate the assistance of several staff members at the ARB and SCAQMD, including the ARB Contract Manager for this study, Joseph Pantalone. We gratefully acknowledge the assistance that the inventory team received from each of these individuals.

We also appreciate the guidance of other members of the technical staff at Systems Applications and Radian, and the efforts of the highly skilled Publications Center staff at Systems Applications.

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DISCLAIMER

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

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ABBREVIATIONS

ABS	Acrylonitrile-butadiene-styrene
AEIS	Automated equipment information system
APED	Activity-process-entrainment-dimension
API	American Petroleum Institute
AQMP	Air quality management plan
ARB	Air Resources Board
ARO	Aromatic
ASTM	American Society for Testing and Materials
BTX	Benzene/toluene/xylene
°C	Degrees Celsius
CARB	Carbonyl
CES	Category of emission source
CO	Carbon monoxide
EDB	Ethylene dibromide
EDP	Electronic data processing
EDS	Emission data system
EIS	Emission inventory system
EPA	Environmental Protection Agency
ETH	Ethylene

°F	Degrees Fahrenheit
FID/PID GC	Flame ionization detector/photo ionization detector gas chromatograph
ft^3	Cubic feet
gal	Gallon
GC/MS	Gas chromatograph/mass spectrometer
GOR	Gas-to-oil ratio
HC	Hydrocarbon
HECD	Hall electroconductivity detector
hp	Horsepower
hr	Hour
IC	Internal combustion
ID	Identification
°K	Degrees Kelvin
kg/hr	Kilogram per hour
lb	Pound
m	Meter
MBTH	3-methyl-2-benzo-thiazolinone hydrazone hydrochloride
MED	Modeling emission data
mg-C/ml	Milligrams of carbon per milliliter
min	Minute
ml	Milliliter
NF	Normalization factor

NO	Nitric oxide
No.	Number
NO_x	Nitrogen oxide
NO_2	Nitrogen dioxide
OH	Hydroxyl
OIC	Old inventory category
OLE	Olefin
PAR	Paraffin
PM	Particulate matter
PNA	Polynuclear aromatic hydrocarbon
ppm	Part per million
ppthv-C	Parts of carbon per thousand by volume
R	Ranking
ROG	Reactive organic gas
SAROAD	Storage and retrieval of aerometric data
SCAQMD	South Coast Air Quality Management District
SCC	Source classification code
SCE	Southern California Edison
SCF	Standard cubic feet
SIC	Standard industrial classification
SOCAB	South Coast Air Basin
SO_x	Sulfur oxide
TAD	Turnaround document

TOC	Total organic compound
TOG	Total organic gas
TSP	Total suspended particulate
USGS	United States Geological Survey
UTM	Universal transverse mercator
VOC	Volatile organic compound
WF	Weighting factor
wk	Week
WROG	Weighted reactive organic gas
yr	Year

1 INTRODUCTION

This report describes a major study performed by Systems Applications and Radian Corporation, and sponsored by the Air Resources Board (ARB), to improve the quality of emission estimates and associated characteristics (e.g., spatial location and speciation profiles) of the original 1979 California South Coast Air Basin (SOCAB) emission inventory. The primary motivation for the study involved improvement in the precision of emission estimates of reactive organic gases (ROG) and nitrogen oxides (NO_x) to better reflect actual emissions of organic gases and NO_x for use in ongoing and future modeling of photochemically reactive pollutants. The research study involved analysis and enhancement of the gridded Modeling Emission Data (MED) inventory prepared from the ARB and South Coast Air Quality Management District (SCAQMD) data bases.

Over the years, various agencies have sponsored many studies to improve emission inventories and data bases, particularly for the SOCAB. The fundamental purposes of such work have been (1) to improve the understanding of sources and their emissions and (2) to assist modeling efforts aimed at establishing air quality impacts, appropriate control strategies, and permit conditions. Throughout this work, concerns have arisen that due to uncertainties, emission inventories may not reflect actual emission levels into the atmosphere. Our study sought to improve the SOCAB inventory and, where possible, to enhance all ROG and NO_x inventories in the state (e.g., through better speciation data).

SCOPE OF THE STUDY

Since the purpose of the study was to improve the original SOCAB inventory for use in high-resolution (i.e., detailed spatial and temporal specification) photochemical modeling activities, primary emphasis was given to reducing uncertainty in emissions of reactive organic species. We examined ROG and NO_x emissions from stationary (both point and area) sources. The Systems Applications and Radian study team developed four major tasks for upgrading the MED inventory that included

(1) A review of inventory data and photochemical modeling results to identify those source categories most likely to cause uncertainty in predicted ozone concentrations.

(2) A survey of selected sources in southern California to provide basic information for upgrading emission estimates, operating schedules, source identifications, etc.

(3) A test program for gathering improved data on organic gas speciation.

(4) The development of an improved ROG and NO_x inventory for the SOCAB compatible with the MED inventory format.

The primary product of this project is a revised set of computer files representing the MED inventory. To generate the upgraded set of MED files, a substantial body of data and information was developed during the project. Much of this information, which has been transmitted to the ARB, will also be useful to the state and local control agencies in improving the emission data bases from which the original MED inventory was derived. Moreover, several ARB staff members provided project guidance through frequent meetings, reviews of written summaries for bimonthly meetings, and reviews of monthly status reports.

Several other products have also resulted from this study. In addition to this report and its appendixes, (1) a separately bound Executive Summary; (2) supporting documentation for revisions to the inventory; and (3) the key product of the study--the revised MED computer files comprising the inventory--have been submitted to the ARB Contract Manager.

REPORT ORGANIZATION

Section 2 of this report describes both the study approach and the original 1979 inventory to which modifications were made. Sections 3 through 6 discuss the four study tasks in the order of their performance. A final section contains our conclusions and recommendations. Separately bound appendixes provide further detail in several areas.

2 STUDY APPROACH AND ANALYSIS OF THE 1979 EMISSION INVENTORY

GENERAL PROCEDURES

The general study objectives were to uncover uncertainties and errors in the inventory, and to reduce or eliminate them to improve the quality of the inventory, particularly for photochemical modeling purposes. As noted, we created four tasks to carry out these objectives: selection of source categories for in-depth examination, information gathering through surveys and testing of these categories, and improvement of the inventory using the new information.

The study focused on the 1979 gridded SOCAB inventory for a summer weekday. The major pollutant of interest was ROG and primary attention was given to stationary sources. We updated the inventory wherever possible on the basis of actual 1979 operating conditions; however, actual 1979 emission data could not always be obtained. For example, the gasoline samples analyzed in Task 3 were collected in 1983 and 1984. Nevertheless, the general integrity of the data as representative of 1979 conditions was maintained in the revised inventory.

DESCRIPTION OF THE 1979 SOCAB EMISSION INVENTORY

The two major components of the 1979 MED inventory are the point source and area source files. The point source file was developed primarily on the basis of two data files--the Emission Inventory System (EIS) file and the Electronic Data Processing (EDP) file--that existed at the SCAQMD. The area source file was developed to account for all emission sources not contained in the EIS or EDP files. An understanding of how the 1979 emission inventory was developed is important in recognizing those components of the inventory with significant uncertainties and is valuable during review of the approach that was taken to improve the inventory. Therefore, derivation of EIS and EDP files are described next, followed by a description of how they were combined and supplemented to develop the original 1979 inventory.

Derivation of the EIS and EDP Files

The EIS File

The EIS file contains information on approximately 1000 facilities having the largest emission rates (greater than 20 tons/year of any pollutant) in the SOCAB. The source categorization in the EIS file is quite detailed because emissions from each facility are divided among a number of source classification codes (SCCs).

As part of this study, the data in the 1979 EIS file were checked using the 1979 SCAQMD emission fee data and the total emissions from each facility were found to be fairly accurate. These emission totals are based on actual 1979 activity data (e.g., throughput, fuel consumption, etc.) and, in general, are also based on widely accepted emission factors such as those from the EPA publication AP-42 (EPA, 1983). However, the distribution of these emissions among the various sources and processes that make up the facility was inaccurate in many cases. It appears from our study that these emission totals were distributed using existing SCCs, rather than using newly created SCCs that would make the inventory more consistent with the emission fee data. As a result, we found that the emissions classified by SCC in the EIS file were frequently inaccurate. This inaccuracy, in turn, has a significant effect on the assignment of speciation profiles.

The EDP File

The EDP file stores information on all equipment operating under a permit issued by the SCAQMD. This file contains data on the grid cell location of the facility, permit numbers, emission rates (in pounds per hour), daily and weekly operating schedules, and administrative and enforcement information for approximately 10,000 facilities. Throughput data and emission factors are not recorded, however.

In general, the information contained in the EDP file is not considered by the state and local control agencies to be representative of 1979 conditions. For the most part, these data are updated only when a permit is modified or when special survey data are incorporated into the system. This means that in many cases the emission estimates have not been updated in over ten years. Also, because the emission estimates are made at the time a source is permitted, these estimates are seldom based on actual throughput data for more recent years.

Development of the Original 1979 Inventory

The EIS and EDP data bases were merged to generate a comprehensive inventory for the SOCAB. Because data in the EDP file for sources emitting more than 20 tons/year were duplicated in the EIS file, and because EIS data were considered superior for emission inventory purposes by the agencies, the EIS file was used to generate the inventory for the larger sources. The EDP file was used to generate emissions for all remaining permitted sources. Ultimately, the data in these district files were compiled in the ARB's Emission Data System (EDS) before conversion to the MED format.

After reviewing the emission sources covered by the EIS/EDP files that were entered as point sources into EDS, area source categories were developed and an emission file of the complete inventory was created. Several agency and outside-party reviews of the draft 1979 inventory then took place and changes were made in an iterative process. (For further details on the development of the inventory, the reader is referred to ARB, 1982a, 1982b, 1981; SCAQMD, 1982a, 1982b, 1981a, 1981b, 1980; SCAQMD, SCAG, and ARB, 1981; Stredler, Sonnichsen, and Taback, 1979; Oliver, Hogo, and Saxena, 1983; and Bradley, Johns, Tate, and Yotter, 1984).

COMPOSITION OF THE MED FILES

The original 1979 SOCAB inventory was received at Systems Applications in June 1983 and included computerized data files in MED format comprising roughly 35,000 lines of code and emission rates for total organic gases (TOG), NO_x, carbon monoxide (CO), and sulfur oxides (SO_x). Particulate matter emission estimates were also available from the agencies but were not transmitted. Although the goal of the project was to update ROG and NO_x emissions, some revisions were also made to CO and SO_x emissions for cases in which such changes were straightforward. The first activity required for using these data was to read, summarize, diagnose, and format the computerized information.

There are seven MED computer files that make up the MED data base. The first two files contain point source and area source emissions; the format of these emission files is shown in Table 2-1. The third file identifies organic gas speciation profiles according to individual species and weight percents; the profiles are corrected for molecular weight so that all profiles are expressed consistently. The fourth file contains profile names and numbers as well as species fractions for NO_x and SO_x. File five provides the correspondence between SCCs and their speciation profiles. The sixth file, known as the chemical file, identifies organic species and their SAROAD codes and molecular weights. The seventh file contains stack

TABLE 2-1. Format of the MED emission data files.

Field	Begin Column	Type and Length	Description
1	1	A8	Scenario
2	9	I4	SIC
3	13	A8	SCC (for point sources; area sources use CES codes)
4	21	I3	I (grid cell)
5	24	I3	J (grid cell)
6	27	I2	Year
7	29	I2	Month
8	31	I2	Day
9	33	I2	Begin hour
10	35	I2	End hour
11	37	I9	Facility ID
12	46	I5	Stack ID
13	51	I2	County
14	53	I3	Air basin
15	56	F5.0	Elevation (meters above ground)
16	61	F10.1	CO (kg/hr)
17	71	F10.1	NO_x (kg/hr)
18	81	F10.1	SO_x (kg/hr)
19	91	F10.1	TOG (kg/hr)
20	101	F10.1	TSP (kg/hr)

parameters for selected point sources in the inventory. For purposes of simplicity, these MED files are often thought of in terms of three categories: emission files, organic gas speciation files, and the stack data file. This set of files, as revised, represents the key product of this study and has been returned to the ARB in the same format in which it was received. No revisions were made to the stack data file.

Of the seven MED files, the two emission files comprise the major part of the MED data base. The point source file identifies emission rates for each emission point in the air basin by SIC/SCC (standard industrial classification code/source classification code). For example, 2911/1-02-006-01 represents an external combustion boiler burning natural gas at a petroleum refinery. Emissions from the point source file are often divided into an elevated and a low-level point source file for modeling purposes. The second emission file represents smaller emission points that were aggregated into common area source categories. There are approximately 200 area source categories listed in the file by category of emission source (CES) number; for example, CES 47449 represents gasoline exhaust from residential utility equipment. Emission levels for each category are identified by grid cell. Area sources are commonly divided into two files--non-motor-vehicle area sources and on-road motor vehicles.

The speciation of TOG emissions is based on the 8-digit SCC code for point sources and on the 5-digit CES code for area sources. For reporting purposes in this project, we subsequently placed species in the five reactive carbon-bond classes using a version of the carbon-bond chemical package. These five reactive classes of organics are

Olefins
Paraffins
Aromatics
Carbonyls
Ethylene

The emission totals presented in this report include emissions from sources located within the SOCAB, which covers Orange County and portions of Los Angeles, Riverside, and San Bernardino counties. The grid region consists of 5-kilometer-square cells, and the data are representative of source operations for an average summer weekday in 1979. In addition, emissions from all sources are disaggregated into hourly increments.

Using another file known as "category," individual emission points and source categories in the inventory can be reported in several ways:

Activity-process-entrainment-dimension (APED) codes
SIC/SCC code
CES code
Control code

This level of detail permits emissions to be categorized in many different ways, which in turn helped us to identify and analyze the various components of the inventory. During the inventory development process, we categorized sources and examined emission summaries using the following codes:

Activity--related to the product or objective of a source, such as "fabricated metal manufacturing."

Process--related to the equipment or process employed by a source, such as "boilers and heaters."

Old inventory category (OIC)--a more generic system for categorizing sources that relates to commonly used names, such as "dry cleaning" and "trains".

Control--related to the control measure affecting the emissions from a source, such as "automobile assembly line surface coating."

Table 2-2 presents 1979 SOCAB emission totals in OIC format as received from the ARB. Note that on-road motor vehicle emissions, which were not examined during this project, are excluded from this table. Thus, "total emissions" in the table do not reflect the sum of emissions from all categories of sources in the region. This convention of reporting emissions only for stationary and off-road mobile sources is consistent with the project's focus and is followed throughout this report. Also for reporting purposes, TOG and ROG emissions are expressed by weight equivalent of methane, NO_x emissions are expressed by weight equivalent of nitrogen dioxide, and SO_x emissions are expressed by weight equivalent of sulfur dioxide.

TABLE 2-2. Original emission data by OIC code.

(Tons per day)

CODE	SOURCE NAME	TOG	ROG	CO	NOX	SOX
100	FUEL COMBUSTION	0.00	0.00	0.00	0.00	0.00
110	AGRICULTURAL	0.00	0.00	0.00	0.03	0.00
120	OIL AND GAS PRODUCTION	3.79	0.66	1.07	7.48	0.10
130	PETROLEUM REFINING	11.05	4.67	3.68	59.35	6.21
140	OTHER MANUFACTURING/INDUSTRIAL	7.35	3.03	71.13	62.41	16.04
150	ELECTRIC UTILITIES	12.03	8.41	14.21	136.36	89.38
160	OTHER SERVICES AND COMMERCE	3.75	0.82	2.07	25.25	1.64
170	RESIDENTIAL	1.84	0.67	1.75	27.30	0.05
199	OTHER	15.78	2.11	12.73	43.92	0.66
200	WASTE BURNING	0.00	0.00	0.00	0.00	0.00
210	AGRICULTURAL DEBRIS	0.06	0.02	0.76	0.00	0.00
220	RANGE MANAGEMENT	0.00	0.00	0.00	0.00	0.00
230	FOREST MANAGEMENT	0.00	0.00	0.00	0.00	0.00
240	INCINERATION	0.16	0.04	0.43	0.42	3.39
299	OTHER	0.00	0.00	0.34	0.00	0.00
300	SOLVENT USE	0.00	0.00	0.00	0.00	0.00
310	DRY CLEANING	11.60	8.20	0.00	0.00	0.00
320	DEGREASING	33.94	23.15	0.00	0.13	0.00
330	ARCHITECTURAL COATING	88.91	87.98	0.00	0.00	0.00
340	OTHER SURFACE COATING	141.40	138.71	0.38	0.39	0.04
350	ASPHALT PAVING	32.28	22.83	0.00	0.00	0.00
360	PRINTING	12.40	12.04	0.01	0.13	0.00
370	DOMESTIC	46.26	39.63	0.00	0.00	0.00
380	INDUSTRIAL SOLVENT USE	23.16	22.64	0.00	0.02	0.00
399	OTHER	2.03	1.88	0.00	0.00	0.00
400	PETROLEUM PROCESS, STORAGE & TRANSFER	0.00	0.00	0.00	0.00	0.00
410	OIL AND GAS EXTRACTION	56.86	40.45	0.00	0.11	0.00
420	PETROLEUM REFINING	55.51	49.13	15.82	13.30	56.81
430	PETROLEUM MARKETING	372.18	84.02	0.00	0.03	0.00
499	OTHER	12.43	10.84	0.02	0.08	0.00
500	INDUSTRIAL PROCESSES	0.00	0.00	0.00	0.00	0.00
510	CHEMICAL	10.60	7.89	2.57	0.50	2.16
520	FOOD AND AGRICULTURAL	10.03	8.28	0.25	0.35	0.02
560	MINERAL PROCESSES	1.11	0.75	6.97	4.27	3.10
570	METAL PROCESSES	4.31	2.26	164.61	5.64	10.90
580	WOOD AND PAPER	0.13	0.09	0.00	0.07	0.00
599	OTHER	4.11	3.88	0.01	0.49	0.03
600	MISC PROCESSES	0.00	0.00	0.00	0.00	0.00
610	PESTICIDE APPLICATION	15.34	13.07	0.00	0.00	0.00
620	FARMING OPERATIONS	137.34	15.73	0.00	0.00	0.00
630	CONSTRUCTION AND DEMOLITION	0.00	0.00	0.00	0.00	0.00
640	ENTRAINED ROAD DUST - PAVED	0.00	0.00	0.00	0.00	0.00
650	ENTRAINED ROAD DUST - UNPAVED	0.00	0.00	0.00	0.00	0.00
660	UNPLANNED FIRES	85.95	47.77	499.94	10.77	0.00
680	SOLID WASTE LANDFILL	1638.83	18.16	0.00	0.00	0.00
699	OTHER	13.31	9.42	0.13	0.67	0.09
700	ON ROAD VEHICLES	0.00	0.00	0.00	0.00	0.00
710	LIGHT DUTY PASSENGER	0.00	0.00	0.00	0.00	0.00
720	LIGHT AND MEDIUM DUTY TRUCKS	0.00	0.00	0.00	0.00	0.00
730	HEAVY DUTY GAS TRUCKS	0.00	0.00	0.00	0.00	0.00

TABLE 2-2 (concluded)

CODE	SOURCE NAME	TOG	ROG	CO	NOX	SOX
740	HEAVY DUTY DIESEL TRUCKS	0.00	0.00	0.00	0.00	0.00
750	MOTORCYCLES	0.00	0.00	0.00	0.00	0.00
800	OTHER MOBILE	0.00	0.00	0.00	0.00	0.00
810	OFF ROAD VEHICLES	31.04	26.07	108.70	8.22	0.87
820	TRAINS	6.53	5.98	10.04	21.09	2.14
830	SHIPS	1.78	1.63	3.51	12.70	17.37
850	AIRCRAFT - GOVERNMENT	0.17	0.17	1.53	0.49	0.07
860	AIRCRAFT - OTHER	19.56	18.94	83.79	11.99	1.12
870	MOBILE EQUIPMENT	24.07	19.56	160.87	73.27	5.36
880	UTILITY EQUIPMENT	12.42	10.39	110.97	1.66	0.05
900	UNSPECIFIED SOURCES	0.00	0.00	0.00	0.00	0.00
TOTAL		2962.42	771.98	1278.27	528.90	217.61

3 TASK 1: IDENTIFICATION OF SOURCE CATEGORIES FOR FURTHER STUDY

The purpose of Task 1 was to identify those source categories that cause the largest potential uncertainty in downwind ozone predictions. The product of Task 1 formed the basis for the remaining tasks, in which sources were surveyed and tested. The improvements made to the emission inventory for these categories accomplished the study objective of reducing uncertainty in specific emission estimates.

Because an exhaustive study of the entire emission inventory for the SOCAB was beyond the scope of this work, it was necessary to select from the existing inventory certain source categories judged to contribute the most to the uncertainty in downwind ozone predictions. The original 1979 summer weekday inventory for the SOCAB was employed to carry out this selection process. The inventory was examined at various levels of detail to determine the relative contribution of different components to uncertainty in the inventory. Information thus obtained was used to rank the source categories on the basis of their estimated contribution to uncertainty in downwind ozone predictions. This ranked list was further studied, and a subset was recommended for investigation during the remainder of the project.

The categorization scheme selected for Task 1 was based on the source classification code (SCC--point sources) and the category of emission source (CES--area sources) systems employed in the 1979 data base. Although a simpler scheme based on the activity or process code, for example, would be significantly easier to manipulate, it would not provide a sufficient level of detail for examining source characteristics during Task 1. Similarly, a more detailed scheme, such as the standard industrial classification (SIC) code along with the SCC, would result in an unwieldy number of sources (several thousand for point sources).

THE THREE-STEP APPROACH

Overview

Task 1 was delineated into three steps, as depicted in Figure 3-1. Because the project focused on ozone predictions, we gave greater emphasis

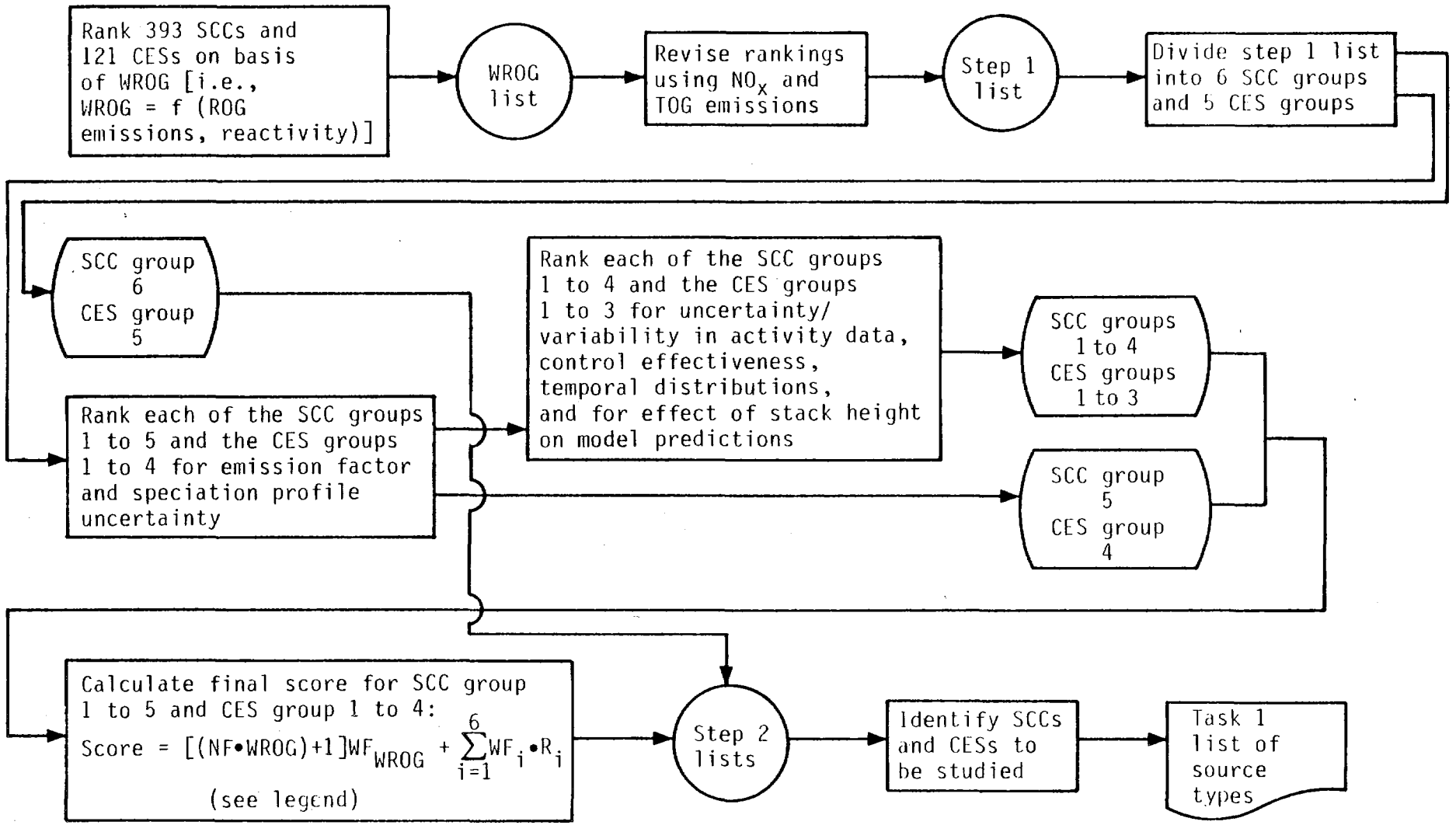

FIGURE 3-1. Diagram of approach to Task 1--source category ranking.

FIGURE 3-1 (concluded)

LEGEND

Source Characteristics (i)

1 = Emission factor

2 = Speciation profile

3 = Activity data

4 = Control effectiveness

5 = Temporal distribution

6 = Stack height

Weighting Factors (WF)

$WF_{WROG} = 15$

$WF_1 = 5$

$WF_2 = 5$

$WF_3 = 3$ for SCC; 4 for CES

$WF_4 = 3$ for SCC; 2 for CES

$WF_5 = 2$

$WF_6 = 1$

Normalization Factors (NF)

$NF = 5 \times 10^{-4}$ for SCC;

2×10^{-4} for CES

Rankings (R)

$R_1 = 1$ to 5

$R_2 = 1$ to 5

$R_3 = 1$ to 5; 0 for SCC Group 5, CES Group 4

$R_4 = 1$ to 5; 0 for SCC Group 5, CES Group 4

$R_5 = 1$ to 5; 0 for SCC Group 5, CES Group 4

$R_6 = 1$ to 5; 0 for SCC Group 5, CES Group 4

(5 = most uncertain)

WROG

Weighted ROG in kilograms/day

to ROG emissions and reactivity in ranking source categories than to other source characteristics. Thus, in Step 1 of Task 1, SCC and CES categories were first ranked on the basis of their ROG emission levels and OH reactivity; the greater the ROG emissions and/or reactivity, the higher the SCC/CES was ranked. Point sources (SCC) and area sources (CES) were ranked separately on the basis of their "weighted ROG" (WROG) values until they were integrated into a single list at the end of Task 1.

After the initial ranking of categories using ROG emissions and their reactivity, the rankings of SCCs and CESs were revised in Step 1 on the basis of their NO_x emissions and TOG emissions. The resulting lists, at this stage called the Step 1 lists, were broken into five or six groups of CESs and SCCs for simplified manipulation; Group 1 was the set of CESs or SCCs deserving the most attention. Since not all CESs/SCCs could be studied during the project, the top source categories were planned for examination in Tasks 2 and 3.

In Step 2 of Task 1, six source characteristics were used to ultimately rerank categories in the top four to five groups of the Step 1 lists. The other groups were not examined in Step 2. The uncertainty and variability in the following six characteristics were evaluated:

Speciation profiles

Emission factors

Activity (throughput) data

Control effectiveness

Temporal distributions

Effect of stack height on ozone model predictions

The CESs/SCCs evaluated in Step 2 were ranked on the basis of these six characteristics. The resultant six rankings were then used in conjunction with the Step 1 lists to develop a refined ranking of CESs and SCCs in terms of their potential for causing uncertainty in predicting downwind ozone concentrations. Judgment was employed in determining the relative importance of the Step 1 list and the six characteristics. The Step 1 list was considered the most important element in the final ranking; next in importance were the speciation profile and emission factor uncertainties; the last four characteristics were judged to affect the final ranking to a lesser extent. Figure 3-1 contains the equation used to develop the Step 2 lists.

In Step 3, the results of Step 2 were carefully scrutinized to formulate the final Task 1 list. The CESs/SCCs in the lower groups of the Step 2

lists were reviewed for possible inclusion in the final list. Identification of similar SCCs that could be surveyed as a group was also an important consideration in the selection process. Finally, the contract requirements influenced the final selection for the Task 1 list. The following sections discuss each of the three steps in detail.

Step 1--Emissions and Reactivity Considerations

Past modeling experience has shown that the contribution of a particular source to ozone formation is often directly related to the ROG emissions attributed to that source. Even small uncertainties and variabilities in the emission characteristics of relatively large sources of ROG could, therefore, result in large uncertainties in downwind ozone predictions. However, this relationship has limitations because it does not take into account the differing reactivity of hydrocarbon species. For example, if two sources have identical ROG emission rates, but one source emits all olefins and the other all paraffins, then the former source would have more impact on ozone formation than the latter.

Therefore, we can contrive another scalar, which is a better indicator of a source's impact on ozone formation. This is done by integrating the concept of hydroxyl (OH) reactivity into the ROG emission estimates. Thus, in Step 1 of Task 1, SCC and CES categories were ranked on the basis of their ROG emission levels and "OH reactivity" (the speed with which the hydrocarbon species combines with the OH radical); as their ROG emissions and reactivity increased, the SCC/CES categories were ranked higher on the Step 1 list. The combination of mass emissions and reactivity was known as "weighted ROG" (WROG).

The scientific basis underlying the reactivity of organics is quite complex. The objective of the WROG reactivity classification scheme was to simplify the concept of reactivity by developing a numerical method indicative of the relative contribution of each source to the overall ozone problem. An assumption of this scheme was that no one source dominates the urban atmosphere.

An average hydroxyl reactivity was computed for each SCC/CES on a per-carbon-atom basis using the ROG species profiles and a set of OH rate constants. Because OH rate constants are not known for every ROG species used in the profiles, we grouped species into five reactive classes and used the following set of OH rate constants, expressed as (ppm^{-1} min^{-1}) at 298°K, from an EPA study (Killus and Whitten, 1982).

Reactive Species Classes and OH Rate Constants				
Olefins	Paraffins	Aromatics	Carbonyls	Ethylene
37,000	1300	22,500	13,500	12,000

One advantage of this method is that the species classes also account for the overall chemistry of the SCC/CES and not just the chemistry of the initial emitted species (i.e., the secondary products of the chemistry are also considered).

Next, we determined the relative contribution of each SCC/CES to the total urban reactivity by comparing the individual reactivities to the overall reactivity of the urban mix. The WROG value was then computed by combining the OH reactivity of each SCC/CES with its ROG emission level. The result of this process was two lists of SCCs and CESs ranked on the basis of individual WROG values. After point sources (SCC file) and area sources (CES file) were ranked on the basis of their WROG values, source categories were grouped to facilitate the review of these ranked lists.

Because NO_x also plays an important role in ozone formation, the inclusion of NO_x emissions in the source selection process was also desirable. Another potential limitation in relying on WROG values alone is the possibility that source categories with high TOG emissions and low ROG emissions could be eliminated from consideration. However, if uncertainties in their speciation were reduced, it is possible that these sources could have significant ROG emissions. Therefore, to consider NO_x and TOG emissions in the Step 1 ranking, all source categories in the files were ranked for both NO_x and TOG emission levels. The large emitters of NO_x were then examined for their position in the WROG ranked list. If it was felt that a particular category with high NO_x emissions was ranked too low, it was moved up on the WROG ranked list. This procedure was also repeated for sources with high TOG emissions. In general, we found that most source categories with high TOG emissions also had high WROG scores.

Tables 3-1 and 3-2 present the results of the Step 1 ranking for point sources (SCCs) and area sources (CESs), respectively. In this report we refer to these tables as the Step 1 lists. Source categories were ranked in descending order, with the highest priority categories appearing at the top of these tables. Emissions of NO_x, TOG, and ROG are also tabulated in kilograms per day.

The method used to promote sources on the basis of their high NO_x or TOG emissions can be illustrated by an example. In Table 3-1, SCC 1-01-005-01 was originally placed between SCCs 4-02-001-99 and 3-08-007-99. However,

TABLE 3-1. Ranking of point source categories on the basis of WROG.

CODE	DESCRIPTION		NOX	TOG	ROG	WROG
AAA57281	SOLID WASTE LANDFILL EVAPORATION		0.00	2145000.00	23700.00	15645.78
31000199	OIL & GAS PRODUCTION- CRUDE- NOT CLASSIFIED	I	0.00	42200.00	35650.00	13401.30
AAA47555	JET EXHAUST- COMMERCIAL AIRCRAFT- TRANSPORTATION		18700.00	16020.00	15600.00	13003.95
40299999	ORGANIC SOLVENT- COATING- UNSPECIFIED		209.10	15320.00	14900.00	7978.32
40200991	ORGANIC SOLVENT- THINNING SOLVENT- GENERAL		0.00	12820.00	12540.00	6674.01
40200101	ORGANIC SOLVENT- COATINGS- PAINT- POLYMERIC HOT AIR DRIED		43.20	7075.00	7075.00	6539.42
40200501	ORGANIC SOLVENT- COATING- ENAMEL- GENERAL		40.00	10170.00	10170.00	6250.89
40200701	ORGANIC SOLVENT- COATING- ADHESIVE- GENERAL		0.00	6702.00	6702.00	6177.32
40200401	ORGANIC SOLVENT- COATING- GENERAL LACQUER		0.00	9124.00	9123.00	5038.95
40200499	ORGANIC SOLVENT- COATING- NOT CLASSIFIED(LAQUER)		0.00	7565.00	7370.00	5617.66
10100501	EX COMB BOILER-ELEC GEN-#1 & #2 DISTILLATE OIL		48310.00	3460.00	3121.00	3093.79
10100401	EX COMB BOILER-ELEC GEN-#6 OIL NORTH FRG		38220.00	2758.00	2488.00	2394.21
30600104	PETRO INDUSTRY- REFINING- GAS FIRED PROCESS HEATERS		32150.00	2226.00	1771.00	1771.10
40300202	PETRO STORAGE- GASOLINE- FLOATING ROOF- WORKING LOSS	II	0.00	7112.00	6027.00	4470.14
40104299	ORGANIC SOLVENT- DEGREASING- COMPOSITE SOLVENT		117.60	6788.00	4709.00	4274.20
30199999	CHEMICAL MFG- FUGITIVE EMISSIONS		366.90	8468.00	5967.00	3611.07
40200199	ORGANIC SOLVENT- COATING- NOT CLASSIFIED(PAINT)		0.00	3446.00	3446.00	3101.04
30800799	RUBBER & PLASTICS- PLASTIC FABRICATION- NOT CLASSIFIED		0.00	2940.00	2940.00	2940.20
49099999	ORGANIC SOLVENT- MISCELLANEOUS- UNSPECIFIED		25.10	6568.00	4814.00	2931.36
40300201	PETRO STORAGE- GASOLINE- FLOATING ROOF- STANDING LOSS		0.00	4560.00	4450.00	2871.95
40200599	ORGANIC SOLVENT- COATING- COMPOSITE		0.00	4489.00	4468.00	2629.52
AAA47605	DIESEL EXHAUST- RAIL SWITCHING		5060.00	2151.00	1952.00	1948.46
20200202	INTERNAL COMBUSTION-INDUSTRIAL-NATURAL GAS-RECIPROCATING		11480.00	7441.00	810.50	617.31
10100601	EX COMB BOILER-ELEC GEN-NATURAL GAS >100 MMBTU/HR		24970.00	1591.00	578.70	342.36
10200602	EX COMB BOILER-INDUSTRIAL-NATURAL GAS 10-100 MMBTU/HR		21570.00	1209.00	439.40	259.95
39000699	INDUSTRIAL PROCESS- NATURAL GAS- NOT CLASSIFIED		1717.00	305.40	111.10	65.70
40200601	ORGANIC SOLVENT- COATING- OVEN- UNSPECIFIED	III	7.20	4.30	4039.00	2346.20
40200601	ORGANIC SOLVENT- COATING- PRIMER- GENERAL		0.00	3635.00	3635.00	2377.99
40500599	PRINTING- INK THINNING SOLVENT- UNSPECIFIED		0.00	3651.00	3651.00	2002.44
40104104	ORGANIC SOLVENT- DRY CLEANING- STODDARD SOLVENT		0.00	5473.00	5473.00	2019.48
40600126	PETRO MARKETING- GASOLINE- TANK TRUCKS- SUBMERGED LOADING		0.00	3195.00	3112.00	2008.52
40200902	ORGANIC SOLVENT- THINNING SOLVENT- ACETONE		0.00	2203.00	2204.00	1919.28
30600805	PETRO INDUSTRY- FUGITIVE- MISCELLANEOUS- SAMPLING/PURGING		667.20	4784.00	4594.00	1899.59
30699999	PETRO INDUSTRY- MISCELLANEOUS- NOT CLASSIFIED		101.30	4352.00	4098.00	1646.46
40200301	ORGANIC SOLVENT- COATING- VARNISH/SHELLAC GENERAL		0.00	2054.00	2054.00	1623.04
40200110	ORGANIC SOLVENT- COATINGS- PAINT- SOLVENT-BASED		0.00	1744.00	1744.00	1610.66
40200910	ORGANIC SOLVENT- THINNING SOLVENT- METHYL ETHYL KETONE		0.00	1800.00	1800.00	1428.68
40500501	PRINTING- ROTOGRAVURE- UNSPECIFIED		0.00	2441.00	2441.00	1378.79
40500301	PRINTING- FLEXOGRAPHIC		10.00	2710.00	2710.00	1299.47
40200799	ORGANIC SOLVENT- COATING- COMPOSITE		0.00	2154.00	2154.00	1262.08
40300103	PETRO STORAGE- GASOLINE- FIXED ROOF TANK- WORKING LOSS		0.00	1992.00	1853.00	1195.97
40300104	PETRO STORAGE- CRUDE- FIXED ROOF TANK- WORKING LOSS		0.00	3769.00	3658.00	1166.94
20200402	INTERNAL COMBUSTION-INDUSTRIAL-DIESEL OIL -TURBINE		600.00	1562.00	1135.00	1135.25
40100399	ORGANIC SOLVENT- COLD CLEANING- NOT SPECIFIED		0.00	1677.00	1165.00	1057.37
AAA57331	GASOLINE EXHAUST- CIVILLIAN AIRCRAFT		91.20	1231.00	1020.00	1040.06
40300204	PETRO STORAGE- CRUDE- FLOATING ROOF- WORKING LOSS		0.00	3293.00	2639.00	1019.62
20100201	INTERNAL COMBUSTION-ELEC GEN- NATURAL GAS-TURBINE		5396.00	3194.00	504.70	504.70
40300152	PETRO STORAGE- DIST OIL- FIXED ROOF TANK- WORKING LOSS	IV	0.00	1520.00	1520.00	934.85
40400111	BULK TERMINALS- GASOLINE RVP10- FLOATING- G/K BBL STANDING LOSS		0.00	1559.00	1519.00	979.02
40399999	PETRO STORAGE- UNSPECIFIED EMISSION		0.00	2078.00	2342.00	699.86
40300199	PETRO STORAGE- NOT CLASSIFIED- FIXED ROOF- WORKING LOSS		0.00	2607.00	2187.00	681.71
30299998	FOOD & AG- FOOD - NOT CLASSIFIED		88.80	1841.00	1709.00	785.95
30600803	PETRO INDUSTRY- FUGITIVE- PUMP SEALS W/O CONTROLS		0.00	2006.00	1915.00	731.62
30601301	PETRO INDUSTRY- CATALYTIC REFORMER- GENERAL		45.60	2792.00	2007.00	771.86
40200210	ORGANIC SOLVENT- COATING- WATER-BASED PAINT GENERAL		0.00	1449.00	1442.00	741.77
40100102	ORGANIC SOLVENT- DRY CLEANING- STODDARD SOLVENT		0.00	1972.00	1972.00	727.65

TABLE 3-1 (continued)

40200803	ORGANIC SOLVENT- COATING- OVEN- >175 F	0.00	1216.00	1216.00	712.34
40600101	PETRO MARKETING- GASOLINE LOADING- TANK CARS/TRUCKS	0.00	1126.00	1096.60	707.53
30101401	CHEMICAL MFG- GENERAL PAINTS- MIXING/HANDLING	0.00	663.70	663.70	612.63
30699998	PETRO INDUSTRY- MISCELLANEOUS- NOT CLASSIFIED	463.20	1617.00	1522.60	611.85
40200810	ORGANIC SOLVENT- COATING- OVEN- GENERAL	0.00	1037.00	1037.00	607.53
40388801	PETRO STORAGE- UNPECIFIED FUGITIVE EMISSION	0.00	1083.00	1532.60	582.71
40200915	ORGANIC SOLVENT- THINNING SOLVENT- LACTOL SPIRITS	0.00	1476.00	1476.00	534.63
40200102	ORGANIC SOLVENT- COATINGS- PAINT- ACETONE	0.00	612.70	612.60	542.15
40200410	ORGANIC SOLVENT- COATING- GENERAL LACQUER	0.00	844.00	843.90	539.16
40300203	PETRO STORAGE- CRUDE- FLOATING ROOF- STANDING LOSS	0.00	1699.00	1303.60	526.24
40288801	ORGANIC SOLVENT- COATING- FUGITIVE- UNSPECIFIED	0.00	575.30	575.20	506.85
30999999	FABRICATED METALS- MISCELLANEOUS- NOT CLASSIFIED	87.30	1182.00	833.60	504.45
20100101	INTERNAL COMBUSTION-ELEC GEN- OIL TURBINE	1407.00	673.50	469.40	469.42
30600201	PETRO INDUSTRY- REFINING- FLUID CATALYTIC CRACKER	8006.00	677.60	363.90	363.80
10200704	EX COMB BOILER-INDUSTRIAL-PROCESS GAS BLAST FURNACE	1507.00	537.70	349.30	349.35
10200403	EX COMB BOILER-INDUSTRIAL- RESIDUAL OIL- <10 MMBTU/HR	3905.00	336.00	303.20	291.75
10200701	EX COMB BOILER-INDUSTRIAL-PROCESS GAS REFINERY	4095.00	383.20	248.90	248.93
30600103	PETRO INDUSTRY- REFINING- OIL FIRED PROCESS HEATERS	2147.00	223.20	201.40	193.82
10200501	EX COMB BOILER-INDUSTRIAL-#1 & #2 DISTILLATE OIL>100 MMBTU/HR	2917.00	190.40	171.60	165.33
20100202	INTERNAL COMBUSTION-ELEC GEN- NATURAL GAS-RECIPROCATING	2627.00	1675.00	184.20	138.91
20200102	INTERNAL COMBUSTION-INDUSTRIAL- OIL- RECIPROCATING	1771.00	188.90	137.30	137.26
31000299	OIL & GAS PRODUCTION- NATURAL GAS- NOT CLASSIFIED	0.00	5779.60	54.56	20.13
40100203	ORGANIC SOLVENT- DEGREASING- PERCHLOROETHYLENE	0.00	2560.60	0.00	0.00
40100202	ORGANIC SOLVENT- DEGREASING- TRICHLOROETHANE	0.00	4980.60	0.00	0.00
40100103	ORGANIC SOLVENT- DRY CLEANING- PERCHLOROETHYLENE	0.00	2965.00	0.00	0.00
40301099	PETRO STORAGE- UNSPECIFIED- FIXED ROOF- WORKING LOSS	0.00	1506.60	1291.00	491.05
40600198	PETRO MARKETING- UNSPECIFIED- TANK TRUCK LOSS	0.00	1562.00	1271.60	483.33
40301010	PETRO STORAGE- CRUDE RVP5- FIXED ROOF- 67K BBL-BREATHING	0.00	1550.00	1262.00	479.84
40200802	ORGANIC SOLVENT- COATING- OVEN- <175 F- UNSPECIFIED	0.00	816.00	815.90	478.03
40500399	PRINTING- INK THINNING SOLVENT- ALCOHOL BASED	0.00	1244.00	1244.00	472.93
30299999	FOOD & AG- FOOD - NOT CLASSIFIED	206.60	1095.00	772.00	467.22
40500299	PRINTING- UNSPECIFIED	0.00	896.50	896.50	450.82
30600502	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- W/O CONTROLS	9.20	1149.00	1039.00	439.00
40300102	PETRO STORAGE- CRUDE- FIXED ROOF TANK- BREATHING LOSS	0.00	1407.60	1145.60	435.39
40200518	ORGANIC SOLVENT- COATING- ENAMEL- GENERAL	0.00	681.40	681.40	419.56
40300299	PETRO STORAGE- NOT CLASSIFIED- FLOATING ROOF- STANDING LOSS	0.00	1346.00	1696.00	416.82
40200920	ORGANIC SOLVENT- THINNING SOLVENT- MINERAL SPIRITS	0.00	1096.00	1096.00	404.41
40188801	ORGANIC SOLVENT- FUGITIVE- NOT CLASSIFIED	0.00	621.50	431.70	391.00
AAA47589	JET EXHAUST- CIVIL AIRCRAFT	92.00	461.20	449.00	376.53
40300198	PETRO,STORAGE- NOT CLASSIFIED- FIXED ROOF- BREATHING LOSS	0.00	1214.60	988.60	375.00
40300207	PETRO STORAGE- DISTILLATE OIL- FLOATING ROOF- STANDING LOSS	0.00	550.90	550.90	357.00
40200699	ORGANIC SOLVENT- COATING- COMPOSITE	0.00	605.30	605.20	354.58
40300107	PETRO STORAGE- DIST OIL - FIXED ROOF TANK- BREATHING LOSS	0.00	538.60	538.70	349.05
30101899	CHEMICAL MFG- FORMICA MANUFACTURING	77.50	1140.60	802.50	342.33
40301090	PETRO STORAGE- UNSPECIFIED- FIXED ROOF- 250K BBL-BREATHING	0.00	1104.60	698.50	341.73
30300399	PRIMARY METALS- IRON & STEEL- UNCLASSIFIED	14.40	962.30	323.50	323.43
40200710	ORGANIC SOLVENT- COATING- ADHESIVE- GENERAL	0.00	421.40	421.40	300.21
30600801	PETRO INDUSTRY- FUGITIVE- PIPELINE- VALVES/FLANGES	0.00	1252.60	796.50	314.75
30688801	PETRO INDUSTRY- FUGITIVE- NOT CLASSIFIED	0.00	784.90	739.60	296.94
20200301	INTERNAL COMBUSTION-INDUSTRIAL- GASOLINE- RECIPROCATING	204.00	365.10	294.30	294.30
30600804	PETRO INDUSTRY- FUGITIVE- COMPRESSOR SEALS	0.00	470.40	368.40	294.11
40400199	BULK TERMINALS- UNSPECIFIED-	0.00	460.60	418.60	289.52
40200922	ORGANIC SOLVENT- THINNING SOLVENT- TOLUENE	0.00	285.90	285.80	275.84
40200921	ORGANIC SOLVENT- THINNING SOLVENT- NAPHTHA	0.00	720.80	720.60	260.92
40200703	ORGANIC SOLVENT- COATING- TOLUENE	0.00	274.30	274.10	264.58
40100205	ORGANIC SOLVENT- DEGREASING- TRICHLOROETHYLENE	0.00	252.10	252.10	252.10
10200707	EX COMB BOILER-INDUSTRIAL-PROCESS GAS COKE OVEN	415.20	564.30	236.70	236.70
40200912	ORGANIC SOLVENT- THINNING SOLVENT- ISOPROPYL ALCOHOL	0.00	631.90	631.90	233.16

TABLE 3-1 (continued)

30500105	PETROLEUM INDUSTRY- ASPHALT ROOFING- FELT SAT OPERATION		3.20	509.50	482.90	210.07
30109101	CHEMICAL MFG- ACETONE		0.00	232.10	232.10	205.32
30500199	PETROLEUM INDUSTRY- ASPHALT ROOFING- NOT CLASSIFIED		39.20	491.70	466.10	202.73
40500101	PRINTING- PRESS- DRYER		20.00	400.20	400.20	201.23
40600801	PETRO MARKETING- GASOLINE- FUGITIVE EMISSIONS		0.00	317.70	309.50	199.73
30501704	MINERAL PRODUCTS- MINERAL WOOL- CURING OVEN		0.00	441.00	311.00	198.20
30600601	PETRO INDUSTRY- REFINING- VACUUM JET- VACUUM DISTILLATION		0.00	492.30	463.50	196.25
39000702	INDUSTRIAL PROCESS- PROCESS GAS- COKE OVEN GAS		930.40	1249.00	173.20	173.18
30300303	PRIMARY METALS- IRON & STEEL- OVEN PUSHING		0.00	502.00	168.70	168.75
40600130	PETRO MARKETING- DIST OIL- TANK TRUCKS- SUBMERGED LOADING		0.00	250.50	250.50	167.50
40200610	ORGANIC SOLVENT- COATING- PRIMER- GENERAL		0.00	241.00	241.00	158.17
40500401	PRINTING- LITHOGRAPHIC- UNSPECIFIED		22.90	322.90	323.00	154.84
30102699	CHEMICAL MFG- SYNTHETIC RUBBER		25.50	360.20	254.00	153.75
30501205	MINERAL PRODUCTS- FIBERGLASS- CURING/ROTARY SPUN		0.00	357.90	252.40	152.76
40200399	ORGANIC SOLVENT- GENERAL		0.00	190.50	190.50	149.78
40600151	PETRO MARKETING- GASOLINE- TANK TRUCKS- UNLOADING		0.00	216.00	210.40	135.76
40301020	PETRO STORAGE- DIST #2- FIXED ROOF- 250K BBL-BREATHING		0.00	209.10	209.10	135.46
AAA47571	JET EXHAUST- MILITARY AIRCRAFT		440.00	157.90	153.00	120.94
40300399	PETRO STORAGE- UNSPECIFIED- VAR VAPOR SPACE- WORKING LOSS		0.00	369.70	300.90	114.45
30400704	PRIMARY METALS- STEEL FOUNDRY- HEAT TREAT FURNACE		0.00	332.90	111.90	111.90
40600131	PETRO MARKETING- GASOLINE- TANK TRUCKS- SUBMERGED LOADING		0.00	177.20	172.60	111.41
30101802	CHEMICAL MFG- POLYPROPYLENE		0.00	110.40	110.40	110.40
40100201	ORGANIC SOLVENT- DEGREASING- STODDARD SOLVENT		0.00	299.00	299.00	110.33
40200504	ORGANIC SOLVENT- COATING- TOLUENE		0.00	113.00	113.70	109.76
30499999	SECONDARY METALS- MISCELLANEOUS- NOT CLASSIFIED		141.00	255.60	180.30	109.11
40300302	PETRO STORAGE- GASOLINE- VAR VAPOR SPACE- WORKING LOSS		0.00	172.60	160.10	108.48
40301097	PETRO STORAGE- UNSPECIFEID- FIXED ROOF- 67K BBL-BREATHING		0.00	350.40	285.20	108.46
40301111	PETRO STORAGE- JET NAPHTHA JP4- FLOATING- 67K BBL STANDING LOSS		0.00	284.00	284.00	104.79
40600201	PETRO MARKETING- GASOLINE- MARINE VESSELS- LOADING		0.00	166.10	161.80	104.44
40500304	PRINTING- INK THINNING SOLVENT- ETHYL ALCOHOL		0.00	201.20	201.20	103.76
40301015	PETRO STORAGE- JET NAPHTHA JP4- FIXED ROOF- WORKING LOSS		0.00	275.90	275.90	101.80
20200802	INTERNAL COMBUSTION-INDUSTRIAL-NATURAL GAS- RECIPROCATING		1531.00	800.90	88.99	67.11
10200702	EX COMB BOILER-INDUSTRIAL-PROCESS GAS REFINERY 10-100 MMBTU/HR		1123.00	95.40	62.03	62.03
10200601	EX COMB BOILER-INDUSTRIAL-NATURAL GAS >100 MMBTU/HR		3424.00	270.90	90.55	58.30
10200603	EX COMB BOILER-INDUSTRIAL-NATURAL GAS <10 MMBTU/HR		1667.00	78.10	28.41	16.80
39000402	INDUSTRIAL PROCESS- RESIDUAL OIL- CEMENT KILN/DRYER		1020.00	19.20	17.32	16.67
30300819	PRIMARY METALS- IRON & STEEL- SINTERING		1056.00	85.40	15.70	15.70
39000201	INDUSTRIAL PROCESS- INPROCESS FUEL- COAL- CEMENT KILN		1350.00	36.53	25.76	15.59
39000701	INDUSTRIAL PROCESS- PROCESS GAS- CO/BLAST FURNACE		1000.00	96.69	14.49	14.49
39000299	INDUSTRIAL PROCESS- INPROCESS FUEL- MISC		2400.00	26.09	18.40	11.14
10300602	EX COMB BOILER-COMM/INSTIT-NATURAL GAS 10-100 MMBTU/HR		1010.00	33.50	12.19	7.21
40201001	ORGANIC SOLVENT- COATING- OVEN HEATER- NATURAL GAS		1484.00	20.60	10.43	6.17
39000602	INDUSTRIAL PROCESS- NATURAL GAS- CEMENT KILN		1020.00	15.91	5.79	3.42
30601401	PETRO INDUSTRY- PETROLEUM COKE- CALCINER		1074.00	0.00	0.00	0.00
30501402	MINERAL PRODUCTS- GLASS MFG- CONTAINER MELTING FURNACE		1505.00	0.00	0.00	0.00
30600802	PETRO INDUSTRY- FUGITIVE- VESSEL RELIEF VALVE		0.00	230.10	156.90	99.27
40300101	PETRO STORAGE- GASOLINE- FIXED ROOF TANK- BREATHING LOSS	VI	0.00	152.30	149.40	95.75
40301019	PETRO STORAGE- DIST #2- FIXED ROOF- 67K BBL-BREATHING		0.00	145.10	145.10	94.03
40600199	PETRO MARKETING- UNSPECIFIED- UNLOADING		0.00	295.10	240.20	91.33
20400101	INTERNAL COMBUSTION-ENGINE TESTING- TURBO JET		232.00	124.20	90.29	90.29
40300205	PETRO STORAGE- JET FUEL- FLOATING ROOF- STANDING LOSS		0.00	243.40	243.40	89.01
40600401	PETRO MARKETING- GASOLINE- STATION TANKS- VAPOR NO CONTROL		0.00	132.70	129.20	83.41
40301115	PETRO STORAGE- DIST #2- FLOATING- 67K BBL STANDING LOSS		0.00	127.90	127.90	82.87
40200503	ORGANIC SOLVENT- COATING- MLK		0.00	197.90	197.90	81.58
30601701	PETRO INDUSTRY- REFINING- FLUID COKING		0.00	298.70	196.50	78.96
40500503	PRINTING- INK THINNING SOLVENT- ETHYL ACETATE		0.00	212.70	212.70	78.48
30902699	FABRICATED METALS- CAN MAKING- NOT CLASSIFIED		0.00	180.90	127.00	77.21
40300216	PETRO STORAGE- TOLUENE- FLOATING ROOF- STANDING LOSS		0.00	78.78	78.74	76.00

TABLE 3-1 (continued)

30300302	PRIMARY METALS- IRON & STEEL- OVEN CHARGING	2.40	214.60	72.12	72.12
40301198	PETRO STORAGE- UNSPECIFIED- FLOATING- 67K BBL STANDING LOSS	0.00	221.30	180.10	60.52
40100303	ORGANIC SOLVENT- COLD CLEANING- NAPHTHA	0.00	174.80	174.60	64.50
40300150	PETRO STORAGE- JET FUEL- FIXED ROOF TANK- WORKING LOSS	0.00	173.10	173.10	63.07
30599999	MINERAL PRODUCTS- MISCELLANEOUS	230.60	137.40	96.92	58.66
30400199	SECONDARY METALS- ALUMINUM- NOT CLASSIFIED	0.00	134.80	95.00	57.54
30101903	CHEMICAL MFG- PHTHALIC ANHYDRIDE- UNCONTROLLED	14.40	133.10	93.86	56.80
40301108	PETRO STORAGE- GASOLINE RVP13/10/7- FLOATING- 250K BBL WITHDRAWA	0.00	88.61	86.31	55.70
40301197	PETRO STORAGE- UNSPECIFIED- FLOATING- WITHDRAWAL LOSS	0.00	173.90	141.50	53.82
30103399	CHEMICAL MFG- PESTICIDES- UNCLASSIFIED	0.00	103.20	86.70	52.24
40301199	PETRO STORAGE- UNSPECIFIED- FLOATING- 250K BBL STANDING LOSS	0.00	166.00	135.10	51.39
40600205	PETRO MARKETING- DIST OIL- MARINE VESSELS- LOADING	0.00	70.70	70.71	51.00
40301021	PETRO STORAGE- DIST #2- FIXED ROOF- WORKING LOSS	0.00	70.70	70.71	51.00
40300303	PETRO STORAGE- JET FUEL- VAR VAPOR SPACE- WORKING LOSS	0.00	132.50	132.50	48.09
40200913	ORGANIC SOLVENT- THINNING SOLVENT- ISOPROPYL ACETATE	0.00	122.50	122.50	45.20
30600501	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- WITH CONTROLS	9.60	105.10	95.86	40.47
40600127	PETRO MARKETING- CRUDE- TANK TRUCKS- SUBMERGED LOADING	0.00	125.60	102.20	38.06
40600105	PETRO MARKETING- DIST OIL- TANK TRUCKS- LOADING	0.00	56.57	56.57	36.65
10200502	EX COMB BOILER-INDUSTRIAL- DISTILLATE OIL 10- 100BTU/HR	995.60	40.00	36.01	35.43
30300911	PRIMARY METALS- IRON & STEEL- ROLLING/FINISH- SOAKING PITS	0.00	80.09	57.05	34.53
40400116	BULK TERMINALS- GASOLINE RVP13/10/7- FLOATING- 67K BBL WITHDRAWA	0.00	52.61	51.25	33.07
20200201	INTERNAL COMBUSTION-INDUSTRIAL-NATURAL GAS-TURBINE	516.80	175.00	32.74	32.74
40100207	ORGANIC SOLVENT- DEGREASING- TRICHLOROTRIFLUOROETHANE	0.00	31.37	31.37	31.37
40600202	PETRO MARKETING- CRUDE- MARINE VESSELS- LOADING	0.00	100.10	81.48	30.99
30101801	CHEMICAL MFG- POLYVINYL CHLORIDE	0.00	30.31	30.31	30.31
40200910	ORGANIC SOLVENT- THINNING SOLVENT- ETHYL ALCOHOL	0.00	77.24	77.24	28.58
40600197	PETRO MARKETING- UNSPECIFIED- TANK TRUCK LOSS	0.00	91.99	74.87	28.48
39999999	INDUSTRIAL PROCESS- NOT CLASSIFIED	0.00	130.40	47.45	28.06
30101805	CHEMICAL MFG- PHENOLIC RESINS	0.00	62.62	44.17	26.73
40500305	PRINTING- INK THINNING SOLVENT- ISOPROPYL ALCOHOL	0.00	71.58	71.58	26.41
30101501	CHEMICAL MFG- VARNISH- BODYING OIL	2.40	33.20	33.20	26.11
AAA57315	GASOLINE EXHAUST- COMMERCIAL AIRCRAFT	1.60	31.27	25.91	25.91
40200924	ORGANIC SOLVENT- THINNING SOLVENT- XYLENE	0.00	28.94	28.94	25.77
40400114	BULK TERMINALS- GASOLINE RVP10- FLOATING- 250K BBL STANDING LOSS	0.00	38.77	37.76	24.37
30400799	PRIMARY METALS- STEEL FOUNDRY- NOT CLASSIFIED	70.10	56.75	40.03	24.22
40600298	PETRO MARKETING- UNSPECIFIED- MARINE VESSELS	0.00	76.07	61.92	23.55
30200803	FOOD & AG- FEED MANUFACTURE- SHIPPING	0.00	54.79	38.65	23.39
33000199	TEXTILE PRODUCTS- GENERAL FABRICS- NOT CLASSIFIED	149.50	53.93	38.03	23.02
30601101	PETRO INDUSTRY- REFINING- ASPHALT BLOWING	0.00	53.05	53.04	20.56
40300105	PETRO STORAGE- JET FUEL- FIXED ROOF TANK- WORKING LOSS	0.00	54.09	54.09	19.96
30500205	PETRO INDUSTRY- ASPHALT CONCRETE- DRUM DRYER	434.80	88.55	33.79	19.54
30200802	FOOD & AG- FEED MANUFACTURE- GRAIN RECEIVING	0.00	44.36	31.29	18.93
30600301	PETRO INDUSTRY- REFINING- THERMAL CATALYTIC CRACKER	0.00	33.51	17.99	18.00
40300206	PETRO STORAGE- KEROSENE- FLOATING ROOF- STANDING LOSS	0.00	48.68	48.68	17.96
40200201	ORGANIC SOLVENT- COATING- WATER-BASED PAINT GENERAL	0.00	35.06	34.09	17.96
40600142	PETRO MARKETING- CRUDE- TANK TRUCKS- SUBMERGED LOADING	0.00	57.96	47.10	17.94
39000899	INDUSTRIAL PROCESS- COKE- NOT CLASSIFIED	2.40	127.60	17.70	17.70
40300305	PETRO STORAGE- DIST OIL- VAR VAPOR SPACE- WORKING LOSS	0.00	27.05	27.06	17.53
40200909	ORGANIC SOLVENT- THINNING SOLVENT- ETHYL ACETATE	0.00	46.49	46.49	17.15
40600128	PETRO MARKETING- JET FUEL- TANK TRUCKS- SUBMERGED LOADING	0.00	45.98	45.98	16.97
40301012	PETRO STORAGE- CRUDE RVP5- FIXED ROOF- WORKING LOSS	0.00	52.69	42.69	16.31
40301105	PETRO STORAGE- GASOLINE RVP10- FLOATING- 250K BBL STANDING LOSS	0.00	24.92	24.20	15.67
40199999	ORGANIC SOLVENT- NOT SPECIFIED	0.00	24.67	17.14	15.55
30300999	PRIMARY METALS- IRON & STEEL- NOT CLASSIFIED	607.20	35.66	25.15	15.22
30600999	PETRO INDUSTRY- REFINING- FLARES- NOT CLASSIFIED	28.80	50.27	17.12	15.02
40300212	PETRO STORAGE- HEXANE- FLOATING ROOF- STANDING LOSS	0.00	40.11	40.11	14.00
30600102	PETRO INDUSTRY- REFINING- GAS FIRED PROCESS HEATERS	278.40	22.61	14.69	14.69
39000505	INDUSTRIAL PROCESS- DISTILLATE OIL- METAL MELTING	402.40	16.80	15.16	14.59

TABLE 3-1 (continued)

10300504	EX COMB BOILER-COMM/INSTIT- #4 DIST OIL	302.40	16.80	15.16	14.59
30600401	PETRO INDUSTRY- REFINING- BLOWDOWN SYSTEM- VAPOR RECOVERY	0.00	33.92	23.92	14.48
30501299	MINERAL PRODUCTS- FIBERGLASS MANUFACTURING- NOT CLASSIFIED	0.00	28.70	20.24	12.25
30500699	MINERAL PRODUCTS- CEMENT MANUFAC- DRY PROCESS- NOT CLASSIFIED	0.00	26.09	18.40	11.14
30400103	SECONDARY METALS- ALUMINUM- SMELTING FURNACE- REVERB	511.30	26.09	16.40	11.14
40300151	PETRO STORAGE- KEROSENE- FIXED ROOF TANK- WORKING LOSS	0.00	29.75	29.75	10.98
40200310	ORGANIC SOLVENT- COATING- VARNISH/SHELLAC GENERAL	0.00	13.49	13.49	10.61
40400117	BULK TERMINALS- GASOLINE RVP13/10/7- FLOATING- 250K BBL WITHDRAW	0.00	16.61	16.10	10.44
10100502	EX COMB BOILER-ELEC GEN- DIST OIL- 10-100 MMBTU/HR	331.60	12.00	10.03	10.42
10300501	EX COMB BOILER-COMM/INSTIT-#1 & #2 DIST OIL >100 MMBTU/HR	366.40	11.20	10.11	9.72
30500104	PETROLEUM INDUSTRY- ASPHALT ROOFING- DIPPING/SPRAYING	0.00	23.04	21.03	9.50
30190099	CHEMICAL MFG- WASTW GAS FLARE	0.00	11.00	9.27	9.27
30101599	CHEMICAL MFG- VARNISH- UNCLASSIFIED	0.00	11.76	11.76	9.25
40200405	ORGANIC SOLVENT- COATING- MEK	0.00	12.07	12.07	9.12
39000599	INDUSTRIAL PROCESS- DISTILLATE OIL- NOT CLASSIFIED	600.60	10.40	9.38	9.03
20299997	INTERNAL COMBUSTION-GASEOUS MATERIAL COMBUSTION	01.40	103.00	11.33	8.55
40200105	ORGANIC SOLVENT- COATINGS- PAINT- TOLUENE	0.00	8.75	8.75	8.44
40200904	ORGANIC SOLVENT- THINNING SOLVENT- BUTYL ALCOHOL	0.00	11.05	11.05	8.35
30600602	PETRO INDUSTRY- REFINING- VACUUM DISTILLATION- COLUMN CONDENSER	0.00	21.74	20.47	8.22
30501499	MINERAL PRODUCTS- GLASS MFG- NOT CLASSIFIED	4.00	18.26	12.08	7.79
30100999	CHEMICAL MFG- CLEANING CHEMICALS NOT CLASSIFIED	0.00	18.26	12.08	7.79
10300601	EX COMB BOILER-COMM/INSTIT NATURAL GAS >100 MMBTU/HR	076.00	35.10	12.79	7.57
40600229	PETRO MARKETING- KEROSENE- MARINE VESSELS- UNLOADING	0.00	19.61	19.61	7.24
39000799	INDUSTRIAL PROCESS- PROCESS GAS- NOT CLASSIFIED	636.00	51.54	7.15	7.15
30601202	PETRO INDUSTRY- REFINING- MISCELLANEOUS	0.00	10.73	17.63	7.09
40600203	PETRO MARKETING- JET FUEL- LOADING	0.00	10.93	10.93	6.98
50300101	SOLID WASTE DISPOSAL- MULTIPLE CHAMBER INCINERATION	227.70	72.05	6.50	6.50
39099990	INDUSTRIAL PROCESS- OIL BURNER	102.40	7.20	6.50	6.25
10200402	EX COMB BOILER-INDUSTRIAL- RESIDUAL OIL- 10-100 MMBTU/HR	137.60	7.20	6.50	6.25
40300106	PETRO STORAGE- KEROSENE- FIXED ROOF TANK- BREATHING LOSS	0.00	16.23	16.23	5.99
20200902	INTERNAL COMBUSTION-INDUSTRIAL-KERO/NAPHTHA/JET RECIPRO	01.60	8.22	5.97	5.98
30799999	WOOD PRODUCTS- MISCELLANEOUS- NOT CLASSIFIED	0.00	13.70	9.66	5.85
30201301	FOOD & AG- MEAT SMOKING	11.70	13.40	9.51	5.75
40600299	PETRO MARKETING- UNSPECIFIED- MARINE VESSELS	0.00	18.44	15.01	5.71
40600152	PETRO MARKETING- CRUDE- TANK TRUCKS- UNLOADING	0.00	18.44	15.01	5.71
30501411	MINERAL PRODUCTS- GLASS MFG- BATCHING/MIXING	369.60	13.05	9.20	5.57
20200901	INTERNAL COMBUSTION-INDUSTRIAL-KERO/NAPHTHA/JET TURBINE	01.60	7.31	5.31	5.31
40600499	PETRO MARKETING- GASOLINE- STATION TANKS- NOT CLASSIFIED	0.00	8.31	8.09	5.22
30600504	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- WASTE WATER SEPTR	0.00	13.36	12.19	5.15
40301299	PETRO STORAGE- UNSPECIFIED- VAR VAPOR SPACE- FILLING LOSS	0.00	15.01	12.07	4.89
40200702	ORGANIC SOLVENT- COATING- MEK	0.00	6.39	6.39	4.03
40600135	PETRO MARKETING- DIST OIL- TANK TRUCKS- SUBMERGED LOADING	0.00	7.30	7.30	4.78
10200503	EX COMB BOILER-INDUSTRIAL-#1 & #2 DISTILLATE OIL <10 MMBTU/HR	140.80	5.50	4.96	4.78
30100901	CHEMICAL MFG- CLEANING CHEMICALS SOAP/DET SPRAY DRY	0.00	11.09	7.82	4.73
10201201	EX COMB BOILER-INDUSTRIAL-SOLID WASTE	60.80	4.79	4.71	4.71
40200402	ORGANIC SOLVENT- COATING- ACETONE	0.00	5.29	5.29	4.68
40200919	ORGANIC SOLVENT- THINNING SOLVENT- METHYL ISOBUTYL KETONE	0.00	6.90	6.90	4.33
40200914	ORGANIC SOLVENT- THINNING SOLVENT- KEROSENE	0.00	11.72	11.72	4.32
39000499	INDUSTRIAL PROCESS- RESIDUAL OIL- NOT CLASSIFIED	420.00	4.80	4.33	4.17
10300401	EX COMB BOILER-COMM/INSTIT-#6 OIL	144.00	4.80	4.33	4.17
10201302	EX COMB BOILER-INDUSTRIAL-WSTE OIL	14.40	4.80	4.33	4.17
40600133	PETRO MARKETING- JET FUEL- TANK TRUCKS- SUBMERGED LOADING	0.00	10.82	10.82	3.99
20200101	INTERNAL COMBUSTION-INDUSTRIAL- OIL- TURBINE	102.40	5.40	3.98	3.98
39000605	INDUSTRIAL PROCESS- NATURAL GAS- METAL MELTING	573.60	10.43	6.70	3.96
40300112	PETRO STORAGE- HEXANE- FIXED ROOF TANK- BREATHING LOSS	0.00	10.70	10.70	3.95
49200899	ORGANIC SOLVENT- COATING- OVEN- UNSPECIFIED	2.40	6.56	6.56	3.86
10200401	EX COMB BOILER-INDUSTRIAL- RESIDUAL OIL- #6	133.40	4.40	3.97	3.82
10100602	EX COMB BOILER-ELEC GEN-NATURAL GAS <100 MMBTU/HR	532.40	16.33	5.94	3.51

TABLE 3-1 (continued)

30203299	FOOD & AG- BAKERIES	0.00	9.45	9.45	3.49
40200907	ORGANIC SOLVENT- THINNING SOLVENT- CELLOSOLVE ACETATE	0.00	3.49	3.49	3.09
30405001	SECONDARY METALS- MISCELLANEOUS- CASTING/FABRICATING	0.00	6.96	4.91	2.97
10300603	EX CONB BOILER-COMM/INSTIT-NATURAL GAS <10 MMBTU/HR	427.00	12.56	4.57	2.70
30400899	SECONDARY METALS- ZINC- NOT CLASSIFIED	82.20	6.09	4.29	2.60
40200906	ORGANIC SOLVENT- THINNING SOLVENT- CELLOSOLVE	0.00	3.41	3.41	2.58
30501406	MINERAL PRODUCTS- GLASS MFG- CONTAINER FORMING/FINISHING	417.60	5.22	3.68	2.23
40201002	ORGANIC SOLVENT- COATING- OVEN HEATER- DISTILLATE OIL	66.50	2.40	2.16	2.08
10500_05	EX CONB BOILER-COMM/INSTIT-SPACE HEATING-DISTILLATE OIL	72.00	2.40	2.16	2.08
10301301	EX CONB BOILER-COMM/INSTIT-LIQUID WASTE	16.00	2.40	2.16	2.08
10300502	EX CONB BOILER-COMM/INSTIT-DIST OIL- 10-100 MMBTU/HR	90.40	2.40	2.16	2.08
40301112	PETRO STORAGE- JET NAPHTHA JP4- FLOATING- 250K BBL STANDING LOSS	0.00	5.41	5.41	2.00
20200401	INTERNAL COMBUSTION-INDUSTRIAL-DEISEL OIL- RECIPROCATION	31.20	2.74	1.99	1.99
20100102	INTERNAL COMBUSTION-ELEC GEN- DIST OIL- RECIPROCATING	16.80	2.74	1.99	1.99
40300215	PETRO STORAGE- PENTANE- FLOATING ROOF- STANDING LOSS	0.00	5.32	5.32	1.96
40500201	PRINTING- LETTER PRESS	62.80	3.11	3.11	1.56
30102099	CHEMICAL MFG- PRINTING INK- UNCLASSIFIED	0.00	2.93	2.93	1.54
30501599	MINERAL PRODUCTS- GYPSUM MFG- NOT CLASSIFIED	0.00	3.40	2.45	1.48
30501101	MINERAL PRODUCTS- CONCRETE BATCHING GENERAL	9.60	3.40	2.45	1.48
30102499	CHEMICAL MFG- SYNTHETIC ORG FIBER- NOT CLASSIFIED	0.00	3.40	2.45	1.48
30101299	CHEMICAL MFG- HYDROFLUORIC ACID	0.00	3.40	2.45	1.48
30400217	SECONDARY METALS- COPPER- ROTARY FURNACE- BRASS/BRONZE	120.70	3.26	2.30	1.39
30400200	SECONDARY METALS- COPPER- WIRE BURNING- INCINERATOR	9.50	2.61	1.84	1.11
30103204	CHEMICAL MFG- SULFUR(ELEMENTAL)- S RNVL PRCS 99.9	60.00	2.61	1.84	1.11
39001099	INDUSTRIAL PROCESS- LPG FUEL- NOT CLASSIFIED	100.00	5.02	1.83	1.08
40300154	PETRO STORAGE- CYCLOHEXANE- FIXED ROOF TANK- WORKING LOSS	0.00	2.74	2.74	1.01
40300109	PETRO STORAGE- CYCLOHEXANE- FIXED ROOF TANK- BREATHING LOSS	0.00	2.74	2.74	1.01
40600154	PETRO MARKETING- KEROSENE- TANK TRUCKS- UNLOADING	0.00	2.70	2.70	1.00
40600134	PETRO MARKETING- KEROSENE- TANK TRUCKS- SUBMERGED LOADING	0.00	2.70	2.70	1.00
40600103	PETRO MARKETING- JET FUEL- TANK TRUCKS- SPLASH LOADING	0.00	2.70	2.70	1.00
40300304	PETRO STORAGE- KEROSENE- VAR VAPOR SPACE- WORKING LOSS	0.00	2.70	2.70	1.00
40300312	PETRO STORAGE- ISOPENTANE- VAR VAPOR SPACE- WORKING LOSS	0.00	2.66	2.66	0.98
30400101	SECONDARY METALS- ALUMINUM- SWEATING FURNACE	40.20	2.17	1.53	0.93
39601299	INDUSTRIAL PROCESS- MISCELLANEOUS- NOT CLASSIFIED	0.00	3.35	1.22	0.72
30300901	PRIMARY METALS- IRON & STEEL- STEEL FURNACES- OPEN HEARTH	367.20	4.51	1.09	0.64
39000608	INDUSTRIAL PROCESS- NATURAL GAS- GLASS FURNACE	93.60	2.51	0.91	0.54
10500206	EX CONB BOILER-COMM/INSTIT-SPACE HEATING-NATURAL GAS	131.40	2.51	0.91	0.54
50300108	SOLID WASTE DISPOSAL- AUTO BODY COMPONENT INCINERATION	4.00	4.60	0.42	0.42
50200505	SOLID WASTE DISPOSAL- PATHOLOGICAL INCINERATION	66.50	2.40	0.22	0.22
50300102	SOLID WASTE DISPOSAL- SINGLE CHAMBER INCINERATION	49.60	1.10	0.10	0.10
31000202	OIL & GAS PRODUCTION- NATURAL GAS- GAS STRIPPING	64.00	24.05	0.23	0.08
40360208	PETRO STORAGE- BENZENE- FLOATING ROOF- STANDING LOSS	0.00	5.90	0.00	0.00
40300153	PETRO STORAGE- BENZENE- FIXED ROOF TANK- WORKING LOSS	0.00	41.29	0.00	0.00
40300108	PETRO STORAGE- BENZENE- FIXED ROOF TANK- BREATHING LOSS	0.00	17.70	0.00	0.00
40200603	ORGANIC SOLVENT- COATING- XYLENE	24.00	0.00	0.00	0.00
40100305	ORGANIC SOLVENT- COLD CLEANING- 1,1,1-TRICHLOROETHANE	0.00	74.83	0.00	0.00
40100302	ORGANIC SOLVENT- COLD CLEANING- METHYLENE CHLORIDE	0.00	209.60	0.00	0.00
40100204	ORGANIC SOLVENT- DEGREASING- PERCHLOROETHYLENE	0.00	316.60	0.00	0.00
40100199	ORGANIC SOLVENT- DRY CLEANING- NOT CLASSIFIED	0.00	142.20	0.00	0.00
40100101	ORGANIC SOLVENT- DRY CLEANING- PERCHLOROETHYLENE	0.00	190.20	0.00	0.00
39000797	INDUSTRIAL PROCESS- PROCESS GAS- NOT CLASSIFIED	24.00	0.00	0.00	0.00
39000631	INDUSTRIAL PROCESS- NATURAL GAS- FOOD-DRYING/COOKING/ETC	28.80	0.00	0.00	0.00
39000531	INDUSTRIAL PROCESS- DISTILLATE OIL- FOOD COOKING	2.40	0.00	0.00	0.00
39000506	INDUSTRIAL PROCESS- DISTILLATE OIL- BRICK KILN	48.00	0.00	0.00	0.00
30588002	MINERAL PRODUCTS- FUGITIVE EMISSION- NOT CLASSIFIED	33.60	0.00	0.00	0.00
30501410	MINERAL PRODUCTS- GLASS MFG- RAW MATERIAL HANDLING	328.80	0.00	0.00	0.00
30501401	MINERAL PRODUCTS- GLASS MFG- SODA LIME- FURNACE/GENERAL	621.60	0.00	0.00	0.00
30501204	MINERAL PRODUCTS- FIBERGLASS- FORMING/ROTARY SPUN	0.00	0.00	0.00	0.00

TABLE 3-1 (concluded)

30501201	MINERAL PRODUCTS- FIBERGLASS- REGENERATIVE FURNACE	74.40	0.00	0.00	0.00
30500312	MINERAL PRODUCTS- BRICK MFG- TUNNEL KILNS- OIL FIRED	2.40	0.00	0.00	0.00
30500311	MINERAL PRODUCTS- BRICK MFG- TUNNEL KILNS- GAS FIRED	105.60	2.40	0.00	0.00
30500206	PETRO INDUSTRY- ASPHALT HEATER- NATURAL GAS	0.00	0.00	0.00	0.00
30500201	PETRO INDUSTRY- ASPHALT CONCRETE ROTARY DRYER	460.80	0.00	0.00	0.00
30480801	SECONDARY METALS- FUGITIVE EMISSION- NOT CLASSIFIED	4.80	0.00	0.00	0.00
30400028	SECONDARY METALS- ZINC- REVERB-SWEAT FURNACE- SCRAP METAL	52.80	0.00	0.00	0.00
30400803	SECONDARY METALS- ZINC- POT FURNACE	15.90	0.00	0.00	0.00
30400801	SECONDARY METALS- ZINC- RETORT FURNACE	2.40	0.00	0.00	0.00
30400705	PRIMARY METALS- STEEL FOUNDRY- ELEC INDUCTION FN	0.00	0.00	0.00	0.00
30400702	PRIMARY METALS- OPEN HEARTH STEEL FOUNDRY	12.20	0.00	0.00	0.00
30400701	PRIMARY METALS- STEEL FOUNDRY- ELEC ARC FURNACE	101.90	0.00	0.00	0.00
30400499	SECONDARY METALS- LEAD- NOT CLASSIFIED	1.00	0.00	0.00	0.00
30400407	SECONDARY METALS- LEAD- POT FURNACE HEATER- NATURAL GAS	22.40	0.00	0.00	0.00
30400402	SECONDARY METALS- LEAD- SMELTING FURNACE- REVERB	0.00	0.00	0.00	0.00
30400301	PRIMARY METALS- STEEL FOUNDRY- CUPOLA	0.00	0.00	0.00	0.00
30400219	SECONDARY METALS- COPPER- CRUCIBLE/POT FURNACE- BRASS/BRONZE	29.00	0.00	0.00	0.00
30400212	SECONDARY METALS- COPPER- CUPOLA- SCRAP CU/BRS	12.00	0.00	0.00	0.00
30400205	SECONDARY METALS- COPPER- REVERB FURNACE	14.40	0.00	0.00	0.00
30400109	SECONDARY METALS- ALUMINUM- BURNING/DRYING	64.00	0.00	0.00	0.00
30400102	SECONDARY METALS- ALUMINUM- SMELTING FURNACE- CRUCIBLE	7.20	0.00	0.00	0.00
30300801	PRIMARY METALS- FUGITIVE EMISSION- NOT CLASSIFIED	652.00	0.00	0.00	0.00
30301003	PRIMARY METALS- LEAD SMELTING- DROSS REVERB FURN	0.00	0.00	0.00	0.00
30300914	PRIMARY METALS- IRON & STEEL- STEEL FURNACES- BASIC OX- CLD	232.00	0.00	0.00	0.00
30300913	PRIMARY METALS- IRON & STEEL- STEEL FURNACES- BASIC OX- OPN	108.00	0.00	0.00	0.00
30300001	PRIMARY METALS- IRON & STEEL- ORE CHARGE	640.00	0.00	0.00	0.00
30300304	PRIMARY METALS- IRON & STEEL- QUENCHING	0.00	0.00	0.00	0.00
30112502	CHEMICAL MFG- ETHYLENE DICHLORIDE	0.00	0.70	0.00	0.00
30103299	CHEMICAL MFG- SULFUR(ELEMENTAL)- UNCLASSIFIED	0.00	0.00	0.00	0.00
30103202	CHEMICAL MFG- SULFUR(ELEMENTAL)- MOD CLS 3STG 95-6	0.00	0.00	0.00	0.00
30102308	CHEMICAL MFG- INORGANIC CHEM- H2SO4 CONTACT- 98% CONVERSION	21.60	0.00	0.00	0.00
30101701	CHEMICAL MFG- PHOS ACID/THERMAL- GENERAL	7.20	0.00	0.00	0.00
30101699	CHEMICAL MFG- PHOS ACID/WET PROC- UNCLASSIFIED	0.00	0.00	0.00	0.00
20100501	INTERNAL COMBUSTION-ELEC GEN- JET FUEL- TURBINE	00.00	0.00	0.00	0.00
10500110	EX COMB BOILER-INDUSTRIAL- SPACE HEATING-LPG	2.40	0.00	0.00	0.00
10500106	EX COMB BOILER-INDUSTRIAL- SPACE HEATING-NATURAL GAS	109.60	0.00	0.00	0.00
10500105	EX COMB BOILER-INDUSTRIAL- SPACE HEATING- DISTILLATE OIL	45.60	0.00	0.00	0.00
10399998	EX COMB BOILER-COMM/OTHERT-UNSPECIFIEDE	2.40	0.00	0.00	0.00
10399997	EX COMB BOILER-COMM/OTHER- UNSPECIFIED	16.00	0.00	0.00	0.00
10300503	EX COMB BOILER-COMM/INSTIT-DIST OIL- <10 MMBTU/HR	2.40	0.00	0.00	0.00
10300402	EX COMB BOILER-COMM/INSTIT-RESIDUAL OIL- 10-100 MMBTU/HR	2.40	0.00	0.00	0.00
10201002	EX COMB BOILER-INDUSTRIAL-LPG- LARGE	0.40	0.00	0.00	0.00
10200799	EX COMB BOILER-INDUSTRIAL-PROCESS GAS UNCLASSIFIED	2.00	0.00	0.00	0.00
10200703	EX COMB BOILER-INDUSTRIAL-PROCESS GAS REFINERY <10 MMBTU/HR	4.00	0.00	0.00	0.00
10200504	EX COMB BOILER-INDUSTRIAL- #4 OIL	40.00	0.00	0.00	0.00
10100603	EX COMB BOILER-ELEC GEN-NATURAL GAS <10 MMBTU/HR	12.00	0.00	0.00	0.00
10100503	EX COMB BOILER-ELEC GEN- DIST OIL- <10 MMBTU/HR	2.40	0.00	0.00	0.00

TABLE 3-2. Ranking of area source categories on the basis of WROG.

CODE	DESCRIPTION		NOX	TOG	ROG	WROG
AAA47316	WILD FIRES- TIMBER & BRUSH	I	9706.00	50140.00	32100.00	32098.00
AAA46540	GASOLINE EVAPORATION AT SERVICE STATIONS- VEHICLE REFUELING		0.00	46550.00	45340.00	29260.16
AAA46763	SURFACE COATING- EVAPORATION- OIL BASED		0.00	51960.00	51700.00	26611.38
AAA66746	UTILITY EQUIPMENT- GASOLINE COMBUSTION		4516.00	31000.00	26350.00	26352.00
AAA50610	GASOLINE EXHAUST- PLEASURE CRAFT		2031.00	22420.00	18550.00	18578.00
AAA46870	ASPHALT PAVING- CUTBACK ASPHALT EVAPORATION		0.00	19799.00	13650.00	11907.95
AAA46771	SURFACE COATING- EVAPORATION- SOLVENT		0.00	19600.00	19600.00	11649.49
AAA66787	INTERNAL COMBUSTION- NATURAL GAS		37560.00	13890.00	1528.60	1152.43
AAA47449	GASOLINE EXHAUST- RESIDENTIAL UTILITY EQUIPMENT	II	693.60	11610.00	9764.00	9764.60
AAA47308	WILD FIRES- GRASS & WOODLAND		0.00	20150.00	19840.00	9417.67
AAA46912	DOMESTIC SOLVENT USE- UNSPECIFIED		0.00	20850.00	29850.00	9181.07
AAA46755	SURFACE COATING- EVAPORATION- WATER BASED		0.00	13750.00	13650.00	7042.69
AAA50701	RESIDENTIAL NON SYNTHETIC SOLVENT EVAPORATION- AEROSOL PROPELL		0.00	19620.00	16530.00	6117.84
AAA54387	GASOLINE EXHAUST- FORKLIFTS & ETC		621.90	7382.00	6117.00	6117.40
AAA46847	DEGREASING- NON SYNTHETIC SOLVENT EVAPORATION- SERVICES		0.00	14520.00	14520.00	5357.73
AAA66605	AGRICULTURAL- LIVESTOCK- UNSPECIFIED PROCESSES- FEEDLOT WASTE		0.00	124600.00	9295.00	5115.90
AAA47597	DIESEL EXHAUST- RAIL TRANSPORT		14070.00	3773.00	3440.00	3416.76
AAA54437	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- RESIDENTIAL		15260.00	2336.00	2130.00	2115.46
AAA50605	NATURAL GAS LOSS FROM PIPELINES		0.00	262500.00	2470.00	914.36
AAA54536	DIESEL EXHAUST- PUBLIC WORKS		11030.00	932.70	850.40	844.49
AAA54429	LPG EXHAUST- FORKLIFTS & ETC		17020.00	7136.00	785.60	592.03
AAA54577	NATURAL GAS COMBUSTION- RESIDENTIAL WATER HEATING		10210.00	602.90	0.00	0.00
AAA19315	SURFACE COATING- WOOD FURNITURE & FIXTURES	III	0.00	7171.00	7017.00	3733.92
AAA46565	GASOLINE EVAPORATION AT SERVICE STATIONS- SPILLAGE		0.00	5815.00	5664.00	3654.04
AAA46808	ASPHALT PAVING- ROAD OIL EVAPORATION		0.00	4829.00	3332.00	2925.29
AAA47464	GASOLINE EXHAUST- OFF-ROAD TRAIL BIKES		73.20	3306.00	2740.00	2739.80
AAA31963	SURFACE COATING- FABRICATED STRUCTURAL METAL		0.00	5056.00	4947.00	2632.45
AAA27920	SURFACE COATING- TRANSPORTATION EQUIPMENT #3		0.00	4956.00	4850.00	2580.78
AAA25213	SURFACE COATING- FABRICATED STEEL		0.00	4655.00	4555.00	2423.84
AAA47134	DOMESTIC PESTICIDE APPLICATION- NON SYNTHETIC		0.00	4428.00	3723.00	2241.03
AAA10108	???????? UNSPECIFIED EMISSIONS ????????????		118.00	4144.00	2923.00	1760.39
AAA46904	ASPHALT PAVING- EMULSIFIED ASPHALT EVAPORATION		0.00	2809.00	1993.00	1750.17
AAA42358	SURFACE COATING- RUBBER & PLASTICS FABRICATION		0.00	3089.00	3023.00	1638.75
AAA46532	GASOLINE EVAPORATION AT SERVICE STATIONS- TANK WORKING LOSS		0.00	2423.00	2360.00	1522.74
AAA47126	AGRICULTURAL PESTICIDE APPLICATION- NON SYNTHETIC		0.00	3007.00	2529.00	1522.17
AAA47092	EVAPORATION- PESTICIDE APPLICATION- SYNTHETIC PESTICIDES		0.00	2902.00	2440.00	1468.08
AAA25056	SURFACE COATING- WHOLESALE & RETAIL AUTO		0.00	2820.00	2759.00	1460.41
AAA19034	SURFACE COATING- MISCELLANEOUS MANUFACTURING		0.00	2633.00	2577.00	1370.99
AAA57349	BAKING ETHANOL LOSS		0.00	3540.00	3540.00	1306.22
AAA47100	EVAPORATION- SYNTHETIC PESTICIDE APPLICATIONS- DOMESTIC		0.00	2531.00	2128.00	1260.94
AAA54411	GASOLINE EXHAUST- RECREATIONAL 4 WHEEL DRIVES		616.00	1215.00	1097.00	1097.09
AAA54379	DIESEL EXHAUST- FORKLIFTS & ETC		9174.00	919.20	837.20	831.53
AAA50677	DIESEL EXHAUST- FOREIGN SHIPS INTRANSIT		7361.00	770.60	702.60	697.84
AAA54593	DIESEL EXHAUST- FORK LIFTS		5061.00	485.20	442.40	439.36
AAA46896	ASPHALT PAVING- PAVING ASPHALT EVAPORATION	IV	0.00	1632.00	1176.00	968.70
AAA60418	FOOD & AGRICULTURAL- CHARCOAL BROILING		0.00	2255.00	1591.00	962.70
AAA54353	DIESEL EXHAUST- FRUIT & VEGETABLE REFRIGERATION		3890.00	971.30	885.60	879.52
AAA42416	SURFACE COATING- MACHINERY- ELECTRICAL COMPONENTS		0.00	1624.00	1559.00	845.51
AAA24077	SURFACE COATING- FURNITURE & FIXTURES- COTTON GIN		0.00	1550.00	1525.00	811.47
AAA46581	GASOLINE EVAPORATION- TANKER LOADING		0.00	1274.00	1241.00	670.63
AAA19109	SURFACE COATING- TRANSPORTATION EQUIPMENT #1		0.00	1311.00	1263.00	662.63
AAA27995	SURFACE COATING- LUMBER & WOOD PRODUCTS		0.00	1306.00	1278.00	660.13
AAA50628	DIESEL EXHAUST- COMMERCIAL CRAFT		3017.00	632.60	576.90	572.96
AAA47696	DIESEL EXHAUST- FOREIGN SHIP BERTHING		825.60	577.30	576.40	522.79
AAA20107	SURFACE COATING- MISCELLANEOUS SERVICES- WHOLESALE & RETAIL		0.00	941.30	921.10	490.17
AAA46714	CRUDE EVAPORATION- MARINE VESSEL LIGHTERING		0.00	1470.00	1203.00	457.43

TABLE 3-2 (continued)

AAA50602	DIESEL EXHAUST- PLEASURE CRAFT	876.00	490.70	454.70	454.60
AAA47498	GASOLINE EXHAUST- AGRICULTURAL CROP PRODUCTION	225.60	544.40	451.10	451.15
AAA37861	SURFACE COATING- TRANSPORTATION EQUIPMENT- MISSLES	0.00	865.30	846.70	450.57
AAA46722	CRUDE EVAPORATION- TANKER/BARGE BALLASTING	0.00	1200.00	1042.00	396.33
AAA11676	AIRPORT- VEHICLE REFUELING- GASOLINE	0.00	589.00	574.50	378.76
AAA54361	GASOLINE EXHAUST- FRUIT & VEGETABLE REFRIGERATION	75.60	420.50	355.10	355.12
AAA54452	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- COMMERCIAL	2565.00	356.60	325.20	322.95
AAA47118	CREOSOTE EVAPORATION	0.00	746.30	526.30	310.52
AAA66738	ROOFING TAR POTS & UNSPECIFIED EMISSIONS	169.20	602.00	401.00	291.12
AAA20464	SURFACE COATING- MACHINERY CONSTRUCTION	0.00	550.00	546.00	290.55
AAA54470	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INDUSTRIAL	2100.00	310.00	289.90	287.95
AAA47324	STRUCTURAL FIRES	57.60	475.60	262.60	262.59
AAA54445	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION-RESIDENTIAL	156.60	286.00	237.60	237.62
AAA46730	GASOLINE EVAPORATION- TANKER/BARGE BALLASTING	0.00	360.00	350.60	226.32
AAA47480	DIESEL EXHAUST- AGRICULTURAL CROP PRODUCTION	1231.00	243.60	222.10	220.55
AAA54494	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INSTITUTIONA	1655.00	241.60	220.30	218.01
AAA10697	SURFACE COATING- EDUCATIONAL SERVICES	0.00	418.90	409.90	210.12
AAA27854	SURFACE COATING- TRANSPORTATION EQUIPMENT #2	0.00	309.00	301.40	202.95
AAA24935	SURFACE COATING- TEXTILES & APPAREL	0.00	322.70	315.70	160.03
AAA47647	DIESEL EXHAUST- FOREIGN SHIP MANEUVERING	1306.00	123.70	112.00	112.02
AAA54544	GASOLINE EXHAUST- PUBLIC WORKS	45.90	123.70	102.50	102.47
AAA50743	NATURAL GAS COMBUSTION- BOILERS & HETERS- SERVICES & COMMERCE	2200.00	59.17	0.00	0.00
AAA50735	NATURAL GAS COMBUSTION- SPACE HEATERS- SERVICES & COMMERCE	2494.00	86.36	0.00	0.00
AAA54505	NATURAL GAS COMBUSTION- RESIDENTIAL COOKING	6381.00	412.30	0.00	0.00
AAA54569	NATURAL GAS COMBUSTION- RESIDENTIAL SPACE HEATING	7393.00	404.60	0.00	0.00
AAA47167	NATURAL GAS COMBUSTION- SERVICES & COMMERCE	4614.00	191.90	0.00	0.00
AAA47142	NATURAL GAS COMBUSTION- MANUFACTURING & INDUSTRIAL	2896.00	20.39	0.00	0.00
AAA24794	SURFACE COATING- RUBBER & PLASTICS MANUFACTURING	0.00	102.00	178.10	94.75
AAA19018	SURFACE COATING- AIR TRANSPORTATION	0.00	102.00	178.10	94.75
AAA47654	EXHAUST FROM TUG BOATS- UNSPECIFIED FUEL	633.60	92.79	84.60	84.83
AAA31503	SURFACE COATING- MW PRODUCTS	0.00	152.00	149.60	79.58
AAA50636	GASOLINE EXHAUST- COMMERCIAL CRAFT	15.60	80.13	73.03	73.02
AAA24729	SURFACE COATING- PRINT & PUBLISHING	0.00	114.00	112.40	59.79
AAA46573	CRUDE EVAPORATION- TANKER LOADING	0.00	189.70	154.40	58.73
AAA17947	SURFACE COATING- CANS & CONTAINERS	0.00	79.25	77.55	41.27
AAA35212	SURFACE COATING- NON FERROUS METALS	0.00	76.02	74.39	39.59
AAA47662	RESIDUAL OIL COMBUSTION- STEAM SHIP BERTHING	208.00	30.40	34.65	33.34
AAA47258	AGRICULTURAL BURNING- FIELD CROP DEBRIS	0.00	31.91	31.42	31.41
AAA57397	AUTO TIRE BURNING- UNPLANNED	0.00	69.25	48.05	29.56
AAA60467	WINE AND BRANDY AGING	0.00	80.01	80.01	29.52
AAA46490	GASOLINE EVAPORATION- MARKETING- STORAGE & TRANSFER- BULK	0.00	31.15	30.34	19.58
AAA47241	AGRICULTURAL BURNING- PRUNINGS	0.00	19.14	18.85	18.85
AAA39024	SURFACE COATING- CHEMICAL & ALLIED	0.00	25.87	24.53	13.85
AAA46599	JET FUEL EVAPORATION- TANKER LOADING	0.00	32.45	32.45	11.97
AAA54460	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- COMMERCIAL	1.80	12.79	10.60	10.60
AAA47613	RESIDUAL OIL COMBUSTION- STEAM SHIP MANEUVERING	105.60	9.60	8.66	8.34
AAA47266	WLED BURNING- OPEN FIELD	0.00	7.90	7.85	7.85
AAA52472	SURFACE COATING- AG CROP PREPARATION FOR MARKET	0.00	6.50	6.50	5.73
AAA54486	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INDUSTRIAL	0.00	3.20	2.65	2.65
AAA20506	SURFACE COATING- ADHESIVES & MOTION PICTURES	0.00	3.23	3.16	1.68
AAA32342	SURFACE COATING- LUMBER & WOOD	0.00	1.62	1.50	0.84
AAA19190	SURFACE COATING- TIRE MANUFACTURING- RUBBER & PLASTICS	0.00	1.62	1.50	0.84
AAA19026	SURFACE COATING- MISCELLANEOUS SERVICES	0.00	1.62	1.50	0.84
AAA25916	SURFACE COATING- GLASS PRODUCTS	0.00	0.81	0.79	0.42
AAA25262	SURFACE COATING- IRON & STEEL FOUNDRY	0.00	0.81	0.79	0.42
AAA50727	LPG COMBUSTION- SERVICES & COMMERCE	6.49	0.00	0.00	0.00
AAA50693	RESIDENTIAL SYNTHETIC SOLVENT EVAPORATION- AEROSOL PROPELLENT	0.00	1377.60	0.00	0.00
AAA50669	DIESEL EXHAUST- U.S. SHIPS INTRANSIT	249.60	0.00	0.00	0.00

TABLE 3-2 (concluded)

AAA50651	RESIDUAL OIL COMBUSTION- FOREIGN SHIPS INTRANSIT	158.40	0.00	0.00	0.00
AAA50644	RESIDUAL OIL COMBUSTION- U.S. STEAM SHIPS INTRANSIT	523.20	0.00	0.00	0.00
AAA54502	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INSTITUTIO	0.00	0.00	0.00	0.00
AAA47670	RESIDUAL OIL COMBUSTION- FOREIGN SHIP BERTHING	19.20	0.00	0.00	0.00
AAA47639	DIESEL EXHAUST- SHIP MANEUVERING	28.00	0.00	0.00	0.00
AAA47621	RESIDUAL OIL COMBUSTION- FOREIGN SHIP MANEUVERING	9.60	0.00	0.00	0.00
AAA47563	GASOLINE EXHAUST- COMMERCIAL AIRCRAFT- AG SERVICES	0.00	0.00	0.00	0.00

its high NO_x emissions--the highest among all source categories in Table 3-1--suggested that it should be placed higher on the list.

Sources were grouped to assist the review of the WROG ranked lists. Grouping was also useful for selecting the sources that would be studied in the ensuing steps of the three-step approach and for deciding the degree of detail in which these sources would be examined. Sources in Table 3-1 were divided into six groups and those in Table 3-2 into five groups. The top five groups in Table 3-1 and the top four groups in Table 3-2 were studied in the remaining steps of Task 1.

Step 2--Review of Uncertainty in Other Components of the Emission Inventory

Whereas Step 1 focused on emissions, in Step 2 we analyzed the uncertainties and variabilities in different components of an emission estimate. Because sources with high uncertainty/variability in their emissions were expected to ascend to the top of the final Task 1 list, the uncertainty/variability in each component of the emission estimate was evaluated in Step 2. The results of the Step 2 process were assimilated into the Step 1 lists to form the Step 2 lists presented in the next section. The following characteristics were selected for the uncertainty/variability assessment:

- Speciation profiles
- Emission factors
- Activity (throughput) data
- Control effectiveness
- Temporal distributions
- Stack heights

All source categories in the first five groups of the Step 1 SCC list and in the first four groups of the Step 1 CES list were ranked for uncertainty in their speciation profiles and emission factors. These two characteristics were felt to be the most important. Ranking based on the remaining four characteristics was then performed for the first four groups of the Step 1 SCC list and the first three groups of the Step 1 CES list. A five-point (1 to 5) scale, with 5 being the most uncertain, was used to individually rank the source categories for each of the six characteristics.

Speciation Profiles

Improving the TOG profiles in the emission inventory was an important objective of this study. Most of the species profiles employed in the 1979 inventory were taken from the volatile organic compound (VOC) species data manual (EPA, 1980). Information on the uncertainty associated with each profile is presented in this publication as a numerical confidence level. This confidence level generally reflects the quality of the test data used to develop these profiles.

For each source category, we first analyzed the applicability of the species profile selected for that particular source category. The confidence levels attributed to the profiles were then used in conjunction with these applicability considerations to numerically estimate from 1 to 5 the uncertainty in the speciation data for each source category. In addition, some speciation profiles came from sources other than the VOC data manual (Allen, 1982) and were generally judged to have a high degree of confidence. Nevertheless, source categories assigned the speciation profile of "unknown organic gas" were rated the most uncertain.

Emission Factors

Several documents were used to rate uncertainty in emission factors. A report from the Air Quality Management Plan (AQMP) (SCAQMD, 1981a) was examined to establish the emission factors employed for each area source category. Emission factors used for point source categories were primarily identified using the document describing SCCs (ARB, 1982c). Because a majority of the emission factors are contained in the EPA publication AP-42 (EPA, 1983), this document was also consulted and the alphabetical emission factor uncertainty rating was recorded. On the basis of (1) the emission factor used, (2) the AP-42 uncertainty rating (where applicable), and (3) other considerations, an overall emission factor rating from 1 to 5 was assigned.

Other considerations varied greatly; however, examples of these considerations include

The applicability of the emission factor to the specific source category.

The level of detail of the emission factors. For example, if emission factors for each type of asphalt were used instead of an average emission factor for all types of asphalt, the emission factors were considered more certain.

If the emission factor did not have an AP-42 rating, the basis for development of the emission factor was evaluated and considered in the emission factor rating process.

Activity Data

Uncertainty in activity data is an important element in the overall uncertainty of an emission estimate. Activity data for point sources tend to be more certain than those for area sources. This is because activity data for point sources tend to be more quantifiable, e.g., as throughput or processing rates. Activity data for area sources, however, are more often estimates and tend to account for emissions not included in the point source file.

Employing the documents used to identify emission factors, the activity data used for each category were established. These activity data were then rated for uncertainty. For point sources, the rating was based on a knowledge of how the activity data are measured and how accurately records of activity data are normally maintained. For example, if the activity data applied to a product that would be accurately measured for sales purposes, these data were rated as certain. On the other hand, if the activity data were unspecified, they were rated as uncertain. For area sources, the rating of uncertainty was based on a review of the methods employed for developing these data. Considerations included whether the data were measured or estimated, the possibility of double counting with a point source category, and other judgments.

Control Effectiveness

The effect of emission controls was one of the more difficult characteristics to rate for uncertainty. This was because there is little documentation describing whether the emissions from a specific source category are controlled, and if so, what the control technique and estimated effectiveness are. Therefore, a general knowledge of the control techniques used in the SOCAB was relied on to judge the applicable control technology for each source category.

Source categories that were considered uncontrolled were given the highest confidence rating because the effect of their controls was certain (zero percent). The uncertainty of control effectiveness for other source categories was estimated using such considerations as

The extent of the range of emission control estimates commonly used or reported in the literature; e.g., we estimated if the effect of

controls ranged from, say, 30 to 70 percent versus those cases for which there was wide agreement that the control effectiveness approximated 50 percent.

The probability of breakdowns or upset conditions that would cause a control system to operate at a reduced level of effectiveness.

Temporal Distributions

Emissions from different sources change as a function of time. These changes are often considered on three different scales: diurnal, weekly, and seasonal. A high-resolution inventory will characterize these changes by temporally distributing the emissions. Inaccurate representations of the operating characteristics of sources can lead to over- or underpredictions of emissions for particular time periods. In some cases, variability in the temporal distribution of emissions is inherent because the sources constituting a particular source category may individually exhibit widely different operating schedules.

A recent study identified source types in the 1979 SOCAB emission inventory with questionable temporal distributions (Oliver, Hogo, and Saxena, 1983). The findings of this study were translated into numerical uncertainty levels for specific SCCs and CESs. Results of other studies were also used to identify source categories with potentially uncertain temporal distributions (Tesche et al., 1981; Oliver and Mark, 1980). Source categories comprising such activities as vehicle refueling at gasoline service stations and surface coating were considered to be uncertain because of the wide variability in the temporal data for individual sources in these categories.

Stack Heights

Emission release height is useful for segregating source categories that should be carefully examined. The importance of effective release height stems from the following considerations.

Elevated ROG emissions disperse and may have a smaller ozone impact, gram for gram, than ROG emissions emitted near ground level.

Better emission-related data are generally available for elevated sources (e.g., elevated industrial combustion processes versus domestic solvent use).

The tallest elevated emitters typically have low ROG mass emission rates from their stacks.

Elevated sources are usually important emitters of NO_x emissions.

To rank the effect of stack height on ozone predictions, source categories were divided into three groups--power plants (the tallest elevated emitters), other elevated sources, and low-level sources. Power plant stacks were ranked as the most certain in this case and low-level sources as the least certain.

Integration of Step 1 and Step 2 Results

The results of Step 1 and Step 2 were combined to obtain an overall ranking of the source categories on the basis of WROG values and the six characteristics discussed in the previous section. The WROG value was considered to be the most important ranking criterion; speciation profile and emission factor ratings were next; the remaining four characteristics were deemed less important. These priorities were transformed into numerical rankings by developing the set of weighting factors shown in Table 3-3 for both point and area sources.

TABLE 3-3. Weighting factors used in the Task 1 ranking process.

Inventory Characteristic	Weighting Factors	
	Point Sources	Area Sources
WROG	15	15
Emission factor	5	5
TOG speciation	5	5
Activity data	3	4
Control effectiveness	3	2
Temporal distribution	2	2
Stack height	1	1

The WROG scores given in Tables 3-1 and 3-2 were first normalized to a linear scale of 1 to 5, as indicated in Figure 3-1, to make the numerical value of WROG equivalent to the value of the other rankings before the application of the weighting factors. Furthermore, source categories that were promoted on the WROG ranked lists because of high NO_x or TOG

emissions (e.g., SCC 1-01-005-01 in Table 3-1) were assigned a "dummy" WROG score that reflected their revised position in the ranked lists. The following equation was then used to compute a total score:

$$S_x = \sum_{y=1}^{N} WF_{xy} R_{xy} ,$$

where

S_x = total score for source category x

WF_{xy} = weighting factor for source category x and characteristic y (WROG, emission factor, etc.)

R_{xy} = uncertainty ranking for source category x and characteristic y

N = number of elements used to compute the total score

For example, SCC 4-02-999-99 has the following WROG value and rankings:

WROG	Emission Factor	Speciation Profile	Activity Data	Control Effectiveness	Temporal Distribution	Stack Height
7978.32	3	3	4	4	1	5

Using the equation, the final score for this SCC is 135.9 (7-element score given in Table 3-4).

Tables 3-4 through 3-9 are the products of these manipulations. Values given in the first three (Tables 3-4, 3-5, and 3-6) are for the point source file and values in the remaining three (Tables 3-7, 3-8, and 3-9) are for the area source file. Source categories for which the WROG scores and all six inventory characteristics were used in computing a total score (called the "7-element score") are presented in Tables 3-4 and 3-7 for SCCs and CESs, respectively. Source categories in each table are arranged by their 7-element score in descending order. The rankings of these SCCs and CESs in the Step 1 lists (Tables 3-1 and 3-2) are also given.

Tables 3-5 and 3-8 present SCCs and CESs that were ranked using WROG scores and two of the six other characteristics (speciation profile and emission factor uncertainties). Source categories are thus ranked by their "3-element score." Categories that were not ranked using any of the six inventory characteristics are presented in Tables 3-6 and 3-9 for SCCs

TABLE 3-4. Seven element scores and WROG ranking for selected point source categories.

SCC	DESCRIPTION	7-ELEMENT SCORE	STEP I(WROG) RANKING
40299999	ORGANIC SOLVENT- COATING- UNSPECIFIED	135.90	4
AAA57201	SOLID WASTE LANDFILL EVAPORATION*	135.50	1
31000199	OIL & GAS PRODUCTION- CRUDE- NOT CLASSIFIED	135.00	2
40200901	ORGANIC SOLVENT- THINNING SOLVENT- GENERAL	123.60	5
30199999	CHEMICAL MFG- FUGITIVE EMISSIONS	118.20	16
40200501	ORGANIC SOLVENT- COATING- ENAMEL- GENERAL	115.00	7
40200701	ORGANIC SOLVENT- COATING- ADHESIVE- GENERAL	114.40	8
40200101	ORGANIC SOLVENT- COATINGS- PAINT- POLYMERIC HOT AIR DRIED	112.10	6
40200401	ORGANIC SOLVENT- COATING- GENERAL LACQUER	111.70	9
AAA47555	JET EXHAUST- COMMERCIAL AIRCRAFT- TRANSPORTATION	110.50	3
40200499	ORGANIC SOLVENT- COATING- NOT CLASSIFIED(LAQUER)	108.20	10
49099999	ORGANIC SOLVENT- MISCELLANEOUS- UNSPECIFIED	108.10	19
30699999	PETRO INDUSTRY- MISCELLANEOUS- NOT CLASSIFIED	105.80	34
30299998	FOOD & AG- FOOD - NOT CLASSIFIED	99.40	52
40399999	PETRO STORAGE- UNSPECIFIED EMISSION	98.80	50
30699998	PETRO INDUSTRY- MISCELLANEOUS- NOT CLASSIFIED	98.20	60
30999999	FABRICATED METALS- MISCELLANEOUS- NOT CLASSIFIED	97.30	68
30600005	PETRO INDUSTRY- FUGITIVE- MISCELLANEOUS- SAMPLING/PURGING	93.50	33
40388801	PETRO STORAGE- UNPECIFIED FUGITIVE EMISSION	92.40	62
40300202	PETRO STORAGE- GASOLINE- FLOATING ROOF- WORKING LOSS	92.10	14
40200199	ORGANIC SOLVENT- COATING- NOT CLASSIFIED(PAINT)	91.40	17
30600104	PETRO INDUSTRY- REFINING- GAS FIRED PROCESS HEATERS	91.00	13
30800799	RUBBER & PLASTICS- PLASTIC FABRICATION- NOT CLASSIFIED	90.10	18
40200801	ORGANIC SOLVENT- COATING- OVEN- UNSPECIFIED	86.00	27
40200601	ORGANIC SOLVENT- COATING- PRIMER- GENERAL	85.90	28
40200599	ORGANIC SOLVENT- COATING- COMPOSITE	85.20	21
40100299	ORGANIC SOLVENT- DEGREASING- COMPOSITE SOLVENT	83.60	15
40200210	ORGANIC SOLVENT- COATING- WATER-BASED PAINT GENERAL	83.10	55
40200001	ORGANIC SOLVENT- COATING- FUGITIVE- UNSPECIFIED	81.30	67
40200301	ORGANIC SOLVENT- COATING- VARNISH/SHELLAC GENERAL	80.20	35
40300201	PETRO STORAGE- GASOLINE- FLOATING ROOF- STANDING LOSS	80.10	20
40200810	ORGANIC SOLVENT- COATING- OVEN- GENERAL	79.50	61
40500599	PRINTING- INK THINNING SOLVENT- UNSPECIFIED	78.00	29
30601301	PETRO INDUSTRY- CATALYTIC REFORMER- GENERAL	77.90	54
40500501	PRINTING- ROTOGRAVURE- UNSPECIFIED	77.90	38
40300199	PETRO STORAGE- NOT CLASSIFIED- FIXED ROOF- WORKING LOSS	77.80	51
40200110	ORGANIC SOLVENT- COATINGS- PAINT- SOLVENT-BASED	77.70	36
40200799	ORGANIC SOLVENT- COATING- COMPOSITE	75.00	40
40200410	ORGANIC SOLVENT- COATING- GENERAL LACQUER	74.60	65
30101401	CHEMICAL MFG- GENERAL PAINTS- MIXING/HANDLING	74.20	59
39000699	INDUSTRIAL PROCESS- NATURAL GAS- NOT CLASSIFIED	73.80	26
40300103	PETRO STORAGE- GASOLINE- FIXED ROOF TANK- WORKING LOSS	73.50	41
10100401	EX COMB BOILER-ELEC GEN-#6 OIL NORM FRG	73.50	12
10100501	EX COMB BOILER-ELEC GEN-#1 & #2 DISTILLATE OIL	73.50	11
40200902	ORGANIC SOLVENT- THINNING SOLVENT- ACETONE	72.60	32
40500301	PRINTING- FLEXOGRAPHIC	72.30	39
20200202	INTERNAL COMBUSTION-INDUSTRIAL-NATURAL GAS-RECIPROCATING	72.30	23
20200402	INTERNAL COMBUSTION-INDUSTRIAL-DIESEL OIL -TURBINE	72.10	43
40100399	ORGANIC SOLVENT- COLD CLEANING- NOT SPECIFIED	71.00	44
40200803	ORGANIC SOLVENT- COATING- OVEN- >175 F	70.40	57
AAA47605	DIESEL EXHAUST- RAIL SWITCHING	69.80	22
40300204	PETRO STORAGE- CRUDE- FLOATING ROOF- WORKING LOSS	69.70	46
40100104	ORGANIC SOLVENT- DRY CLEANING- STODDARD SOLVENT	69.70	30

* The Request for Proposal excluded this category from the study.

TABLE 3-4 (concluded)

40200918	ORGANIC SOLVENT- THINNING SOLVENT- METHYL ETHYL KETONE	68.70	37
40600126	PETRO MARKETING- GASOLINE- TANK TRUCKS- SUBMERGED LOADING	68.00	31
30600803	PETRO INDUSTRY- FUGITIVE- PUMP SEALS W/O CONTROLS	67.40	53
40300104	PETRO STORAGE- CRUDE- FIXED ROOF TANK- WORKING LOSS	64.70	42
40200102	ORGANIC SOLVENT- COATINGS- PAINT- ACETONE	64.60	64
20100101	INTERNAL COMBUSTION-ELEC GEN- OIL TURBINE	64.30	69
31000299	OIL & GAS PRODUCTION- NATURAL GAS- NOT CLASSIFIED	63.80	78
40400111	BULK TERMINALS- GASOLINE RVP10- FLOATING- 67K BBL STANDING LOSS	63.40	49
AAA57331	GASOLINE EXHAUST- CIVILLIAN AIRCRAFT	63.20	45
20200102	INTERNAL COMBUSTION-INDUSTRIAL- OIL- RECIPROCATING	62.30	77
40200915	ORGANIC SOLVENT- THINNING SOLVENT- LACTOL SPIRITS	62.10	63
10200704	EX COMB BOILER-INDUSTRIAL-PROCESS GAS BLAST FURNACE	60.30	71
40300203	PETRO STORAGE- CRUDE- FLOATING ROOF- STANDING LOSS	59.90	66
40100102	ORGANIC SOLVENT- DRY CLEANING- STODDARD SOLVENT	59.90	56
30600201	PETRO INDUSTRY- REFINING- FLUID CATALYTIC CRACKER	58.30	70
40600101	PETRO MARKETING- GASOLINE LOADING- TANK CARS/TRUCKS	58.30	58
20100201	INTERNAL COMBUSTION-ELEC GEN- NATURAL GAS-TURBINE	58.00	47
10200602	EX COMB BOILER-INDUSTRIAL-NATURAL GAS 10-100 MMBTU/HR	57.80	25
40300152	PETRO STORAGE- DIST OIL- FIXED ROOF TANK- WORKING LOSS	55.90	48
40100202	ORGANIC SOLVENT- DEGREASING- TRICHLOROETHANE	55.30	80
40100203	ORGANIC SOLVENT- DEGREASING- PERCHLOROETHYLENE	55.30	79
10100601	EX COMB BOILER-ELEC GEN-NATURAL GAS >100 MMBTU/HR	54.80	24
40100103	ORGANIC SOLVENT- DRY CLEANING- PERCHLOROETHYLENE	53.30	81
10200701	EX COMB BOILER-INDUSTRIAL-PROCESS GAS REFINERY	52.30	73
20100202	INTERNAL COMBUSTION-ELEC GEN- NATURAL GAS-RECIPROCATING	51.80	76
10200403	EX COMB BOILER-INDUSTRIAL- RESIDUAL OIL- <10 MMBTU/HR	47.80	72
10200501	EX COMB BOILER-INDUSTRIAL-#1 & #2 DISTILLATE OIL>100 MMBTU/HR	44.80	75
30600103	PETRO INDUSTRY- REFINING- OIL FIRED PROCESS HEATERS	44.80	74

TABLE 3-5. Three element scores and WROG ranking for selected point source categories.

SCC	DESCRIPTION	3-ELEMENT SCORE	STEP I(WROG) RANKING
30299999	FOOD & AG- FOOD - NOT CLASSIFIED	66.00	87
30102699	CHEMICAL MFG- SYNTHETIC RUBBER	63.70	127
30499999	SECONDARY METALS- MISCELLANEOUS- NOT CLASSIFIED	63.30	139
40400199	BULK TERMINALS- UNSPECIFIED-	62.10	108
40688801	PETRO MARKETING- GASOLINE- FUGITIVE EMISSIONS	61.50	119
30300399	PRIMARY METALS- IRON & STEEL- UNCLASSIFIED	59.90	102
30688801	PETRO INDUSTRY- FUGITIVE- NOT CLASSIFIED	59.80	105
30109101	CHEMICAL MFG- ACETONE	56.50	116
40301099	PETRO STORAGE- UNSPECIFIED- FIXED ROOF- WORKING LOSS	56.30	82
40500401	PRINTING- LITHOGRAPHIC- UNSPECIFIED	56.20	126
39000299	INDUSTRIAL PROCESS- INPROCESS FUEL- MISC	55.80	154
40300299	PETRO STORAGE- NOT CLASSIFIED- FLOATING ROOF- STANDING LOSS	55.70	92
40301098	PETRO STORAGE- UNSPECIFIED- FIXED ROOF- 250K BBL-BREATHING	55.10	101
30500199	PETROLEUM INDUSTRY- ASPHALT ROOFING- NOT CLASSIFIED	54.00	117
30501704	MINERAL PRODUCTS- MINERAL WOOL- CURING OVEN	53.90	120
40200802	ORGANIC SOLVENT- COATING- OVEN- <175 F- UNSPECIFIED	53.60	85
40600198	PETRO MARKETING- UNSPECIFIED- TANK TRUCK LOSS	53.60	83
30601401	PETRO INDUSTRY- PETROLEUM COKE- CALCINER	53.30	158
40301097	PETRO STORAGE- UNSPECIFEID- FIXED ROOF- 67K BBL-BREATHING	53.30	141
30500105	PETROLEUM INDUSTRY- ASPHALT ROOFING- FELT SAT OPERATION	51.70	115
40500299	PRINTING- UNSPECIFIED	51.00	88
30400704	PRIMARY METALS- STEEL FOUNDRY- HEAT TREAT FURNACE	50.90	134
30600502	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- W/O CONTROLS	50.80	89
30501205	MINERAL PRODUCTS- FIBERGLASS- CURING/ROTARY SPUN	50.00	128
30600804	PETRO INDUSTRY- FUGITIVE- COMPRESSOR SEALS	49.80	107
30600601	PETRO INDUSTRY- REFINING- VACUUM JET- VACUUM DISTILLATION	48.90	121
30501402	MINERAL PRODUCTS- GLASS MFG- CONTAINER MELTING FURNACE	48.30	159
39000201	INDUSTRIAL PROCESS- INPROCESS FUEL- COAL- CEMENT KILN	48.30	152
30300819	PRIMARY METALS- IRON & STEEL- SINTERING	48.30	151
40301010	PETRO STORAGE- CRUDE RVP5- FIXED ROOF- 67K BBL-BREATHING	46.30	84
30300303	PRIMARY METALS- IRON & STEEL- OVEN PUSHING	46.20	123
40200510	ORGANIC SOLVENT- COATING- ENAMEL- GENERAL	45.70	91
40300198	PETRO STORAGE- NOT CLASSIFIED- FIXED ROOF- BREATHING LOSS	45.40	96
30600801	PETRO INDUSTRY- FUGITIVE- PIPELINE- VALVES/FLANGES	44.80	104
40200710	ORGANIC SOLVENT- COATING- ADHESIVE- GENERAL	44.80	103
40200610	ORGANIC SOLVENT- COATING- PRIMER- GENERAL	43.70	125
40200399	ORGANIC SOLVENT- GENERAL	43.60	129
40300399	PETRO STORAGE- UNSPECIFIED- VAR VAPOR SPACE- WORKING LOSS	43.40	133
20200802	INTERNAL COMBUSTION-INDUSTRIAL-NATURAL GAS- RECIPROCATING	43.30	146
40301015	PETRO STORAGE- JET NAPHTHA JP4- FIXED ROOF- WORKING LOSS	43.30	145
40300302	PETRO STORAGE- GASOLINE- VAR VAPOR SPACE- WORKING LOSS	43.30	140
40300102	PETRO STORAGE- CRUDE- FIXED ROOF TANK- BREATHING LOSS	43.30	90
40200699	ORGANIC SOLVENT- COATING- COMPOSITE	42.70	98
30101899	CHEMICAL MFG- FORMICA MANUFACTURING	42.60	100
40500101	PRINTING- PRESS- DRYER	41.50	118
40600151	PETRO MARKETING- GASOLINE- TANK TRUCKS- UNLOADING	41.10	130
40500399	PRINTING- INK THINNING SOLVENT- ALCOHOL BASED	41.10	86
30101802	CHEMICAL MFG- POLYPROPYLENE	40.90	136
40600131	PETRO MARKETING- GASOLINE- TANK TRUCKS- SUBMERGED LOADING	40.90	135
40201001	ORGANIC SOLVENT- COATING- OVEN HEATER- NATURAL GAS	40.80	156
40600201	PETRO MARKETING- GASOLINE- MARINE VESSELS- LOADING	40.80	143
40301111	PETRO STORAGE- JET NAPHTHA JP4- FLOATING- 67K BBL STANDING LOSS	40.80	142
40188801	ORGANIC SOLVENT- FUGITIVE- NOT CLASSIFIED	40.50	94

TABLE 3-5 (concluded)

10200707	EX COMB BOILER-INDUSTRIAL-PROCESS GAS COKE OVEN	39.30	113
40100201	ORGANIC SOLVENT- DEGREASING- STODDARD SOLVENT	38.40	137
AAA47589	JET EXHAUST- CIVIL AIRCRAFT	35.40	95
40300207	PETRO STORAGE- DISTILLATE OIL- FLOATING ROOF- STANDING LOSS	35.20	97
40300107	PETRO STORAGE- DIST OIL - FIXED ROOF TANK- BREATHING LOSS	35.10	99
20200301	INTERNAL COMBUSTION-INDUSTRIAL- GASOLINE- RECIPROCATING	34.80	106
40100205	ORGANIC SOLVENT- DEGREASING- TRICHLOROETHYLENE	34.50	112
AAA47571	JET EXHAUST- MILITARY AIRCRAFT	33.40	132
39000701	INDUSTRIAL PROCESS- PROCESS GAS- CO/BLAST FURNACE	33.30	153
10200702	EX COMB BOILER-INDUSTRIAL-PROCESS GAS REFINERY 10-100 MMBTU/HR	33.30	147
40200504	ORGANIC SOLVENT- COATING- TOLUENE	33.30	138
40200920	ORGANIC SOLVENT- THINNING SOLVENT- MINERAL SPIRITS	33.00	93
40200922	ORGANIC SOLVENT- THINNING SOLVENT- TOLUENE	32.10	109
40200703	ORGANIC SOLVENT- COATING- TOLUENE	32.00	111
40200921	ORGANIC SOLVENT- THINNING SOLVENT- NAPHTHA	32.00	110
40200912	ORGANIC SOLVENT- THINNING SOLVENT- ISOPROPYL ALCOHOL	31.80	114
39000702	INDUSTRIAL PROCESS- PROCESS GAS- COKE OVEN GAS	31.40	122
40600130	PETRO MARKETING- DIST OIL- TANK TRUCKS- SUBMERGED LOADING	31.20	124
40301020	PETRO STORAGE- DIST #2- FIXED ROOF- 250K BBL-BREATHING	31.10	131
39000602	INDUSTRIAL PROCESS- NATURAL GAS- CEMENT KILN	28.30	157
39000402	INDUSTRIAL PROCESS- RESIDUAL OIL- CEMENT KILN/DRYER	28.30	150
40500304	PRINTING- INK THINNING SOLVENT- ETHYL ALCOHOL	28.30	144
10300602	EX COMB BOILER-COMM/INSTIT-NATURAL GAS 10-100 MMBTU/HR	25.80	155
10200603	EX COMB BOILER-INDUSTRIAL-NATURAL GAS <10 MMBTU/HR	25.80	149
10200601	EX COMB BOILER-INDUSTRIAL-NATURAL GAS >100 MMBTU/HR	25.80	148

TABLE 3-6. WROG ranking for selected point source categories.

SCC	DESCRIPTION	STEP I(WROG) RANKING
30600002	PETRO INDUSTRY- FUGITIVE- VESSEL RELIEF VALVE	160
40300101	PETRO STORAGE- GASOLINE- FIXED ROOF TANK- BREATHING LOSS	161
40301019	PETRO STORAGE- DIST #2- FIXED ROOF- 67K BBL-BREATHING	162
40600199	PETRO MARKETING- UNSPECIFIED- UNLOADING	163
20400101	INTERNAL COMBUSTION-ENGINE TESTING- TURBO JET	164
40300205	PETRO STORAGE- JET FUEL- FLOATING ROOF- STANDING LOSS	165
40600401	PETRO MARKETING- GASOLINE- STATION TANKS- VAPOR NO CONTROL	166
40301115	PETRO STORAGE- DIST #2- FLOATING- 67K BBL STANDING LOSS	167
40200503	ORGANIC SOLVENT- COATING- MEK	168
30601201	PETRO INDUSTRY- REFINING- FLUID COKING	169
40500503	PRINTING- INK THINNING SOLVENT- ETHYL ACETATE	170
30902099	FABRICATED METALS- CAN MAKING- NOT CLASSIFIED	171
40300216	PETRO STORAGE- TOLUENE- FLOATING ROOF- STANDING LOSS	172
30300302	PRIMARY METALS- IRON & STEEL- OVEN CHARGING	173
40301198	PETRO STORAGE- UNSPECIFIED- FLOATING- 67K BBL STANDING LOSS	174
40100303	ORGANIC SOLVENT- COLD CLEANING- NAPHTHA	175
40300150	PETRO STORAGE- JET FUEL- FIXED ROOF TANK- WORKING LOSS	176
30599999	MINERAL PRODUCTS- MISCELLANEOUS	177
30400199	SECONDARY METALS- ALUMINUM- NOT CLASSIFIED	178
30101903	CHEMICAL MFG- PHTHALIC ANHYDRIDE- UNCONTROLLED	179
40301108	PETRO STORAGE- GASOLINE RVP13/10/7- FLOATING- 250K BBL WITHDRAWA	180
40301197	PETRO STORAGE- UNSPECIFIED- FLOATING- WITHDRAWAL LOSS	181
30103399	CHEMICAL MFG- PESTICIDES- UNCLASSIFIED	182
40301199	PETRO STORAGE- UNSPECIFIED- FLOATING- 250K BBL STANDING LOSS	183
40600205	PETRO MARKETING- DIST OIL- MARINE VESSELS- LOADING	184
40301021	PETRO STORAGE- DIST #2- FIXED ROOF- WORKING LOSS	185
40300303	PETRO STORAGE- JET FUEL- VAR VAPOR SPACE- WORKING LOSS	186
40200913	ORGANIC SOLVENT- THINNING SOLVENT- ISOPROPYL ACETATE	187
30600501	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- WITH CONTROLS	188
40600127	PETRO MARKETING- CRUDE- TANK TRUCKS- SUBMERGED LOADING	189
40600105	PETRO MARKETING- DIST OIL- TANK TRUCKS- LOADING	190
10200502	EX COMB BOILER-INDUSTRIAL- DISTILLATE OIL 10- 100BTU/HR	191
30300911	PRIMARY METALS- IRON & STEEL- ROLLING/FINISH- SOAKING PITS	192
40400116	BULK TERMINALS- GASOLINE RVP13/10/7- FLOATING- 67K BBL WITHDRAWA	193
20200201	INTERNAL COMBUSTION-INDUSTRIAL-NATURAL GAS-TURBINE	194
40100207	ORGANIC SOLVENT- DEGREASING- TRICHLOROTRIFLUOROETHANE	195
40600202	PETRO MARKETING- CRUDE- MARINE VESSELS- LOADING	196
30101801	CHEMICAL MFG- POLYVINYL CHLORIDE	197
40200910	ORGANIC SOLVENT- THINNING SOLVENT- ETHYL ALCOHOL	198
40600197	PETRO MARKETING- UNSPECIFIED- TANK TRUCK LOSS	199
39999999	INDUSTRIAL PROCESS- NOT CLASSIFIED	200
30101805	CHEMICAL MFG- PHENOLIC RESINS	201
40500305	PRINTING- INK THINNING SOLVENT- ISOPROPYL ALCOHOL	202
30101501	CHEMICAL MFG- VARNISH- BODYING OIL	203
AAA57315	GASOLINE EXHAUST- COMMERCIAL AIRCRAFT	204
40200924	ORGANIC SOLVENT- THINNING SOLVENT- XYLENE	205
40400114	BULK TERMINALS- GASOLINE RVP10- FLOATING- 250K BBL STANDING LOSS	206
30400799	PRIMARY METALS- STEEL FOUNDRY- NOT CLASSIFIED	207
40600298	PETRO MARKETING- UNSPECIFIED- MARINE VESSELS	208
30200803	FOOD & AG- FEED MANUFACTURE- SHIPPING	209
33000199	TEXTILE PRODUCTS- GENERAL FABRICS- NOT CLASSIFIED	210
30601101	PETRO INDUSTRY- REFINING- ASPHALT BLOWING	211
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40300206	PETRO STORAGE- KEROSENE- FLOATING ROOF- STANDING LOSS	216
40200201	ORGANIC SOLVENT- COATING- WATER-BASED PAINT GENERAL	217
40600142	PETRO MARKETING- CRUDE- TANK TRUCKS- SUBMERGED LOADING	218
39000899	INDUSTRIAL PROCESS- COKE- NOT CLASSIFIED	219
40300305	PETRO STORAGE- DIST OIL- VAR VAPOR SPACE- WORKING LOSS	220
40200909	ORGANIC SOLVENT- THINNING SOLVENT- ETHYL ACETATE	221
40600128	PETRO MARKETING- JET FUEL- TANK TRUCKS- SUBMERGED LOADING	222
40301012	PETRO STORAGE- CRUDE RVP5- FIXED ROOF- WORKING LOSS	223
40301105	PETRO STORAGE- GASOLINE RVP10- FLOATING- 250K BBL STANDING LOSS	224
40199999	ORGANIC SOLVENT- NOT SPECIFIED	225
30300999	PRIMARY METALS- IRON & STEEL- NOT CLASSIFIED	226
30600999	PETRO INDUSTRY- REFINING- FLARES- NOT CLASSIFIED	227
40300212	PETRO STORAGE- HEXANE- FLOATING ROOF- STANDING LOSS	228
30600102	PETRO INDUSTRY- REFINING- GAS FIRED PROCESS HEATERS	229
39000505	INDUSTRIAL PROCESS- DISTILLATE OIL- METAL MELTING	230
10300504	EX COMB BOILER-COMM/INSTIT- #4 DIST OLI	231
30600401	PETRO INDUSTRY- REFINING- BLOWDOWN SYSTEM- VAPOR RECOVERY	232
30501299	MINERAL PRODUCTS- FIBERGLASS MANUFACTURING- NOT CLASSIFIED	233
30500699	MINERAL PRODUCTS- CEMENT MANUFAC- DRY PROCESS- NOT CLASSIFIED	234
30400103	SECONDARY METALS- ALUMINUM- SMELTING FURNACE- REVERB	235
40300151	PETRO STORAGE- KEROSENE- FIXED ROOF TANK- WORKING LOSS	236
40200310	ORGANIC SOLVENT- COATING- VARNISH/SHELLAC GENERAL	237
40400117	BULK TERMINALS- GASOLINE RVP13/10/7- FLOATING- 250K BBL WITHDRAW	238
10100502	EX COMB BOILER-ELEC GEN- DIST OIL- 10-100 MMBTU/HR	239
10300501	EX COMB BOILER-COMM/INSTIT-#1 & #2 DIST OIL >100 MMBTU/HR	240
30500104	PETROLEUM INDUSTRY- ASPHALT ROOFING- DIPPING/SPRAYING	241
30190099	CHEMICAL MFG- WASTW GAS FLARE	242
30101599	CHEMICAL MFG- VARNISH- UNCLASSIFIED	243
40200405	ORGANIC SOLVENT- COATING- MEK	244
39000599	INDUSTRIAL PROCESS- DISTILLATE OIL- NOT CLASSIFIED	245
20299997	INTERNAL COMBUSTION-GASEOUS MATERIAL COMBUSTION	246
40200105	ORGANIC SOLVENT- COATINGS- PAINT- TOLUENE	247
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30600602	PETRO INDUSTRY- REFINING- VACUUM DISTILLATION- COLUMN CONDENSER	249
30501499	MINERAL PRODUCTS- GLASS MFG- NOT CLASSIFIED	250
30100999	CHEMICAL MFG- CLEANING CHEMICALS NOT CLASSIFIED	251
10300601	EX COMB BOILER-COMM/INSTIT NATURAL GAS >100 MMBTU/HR	252
40600229	PETRO MARKETING- KEROSENE- MARINE VESSELS- UNLOADING	253
39000799	INDUSTRIAL PROCESS- PROCESS GAS- NOT CLASSIFIED	254
30601202	PETRO INDUSTRY- REFINING- MISCELLANEOUS	255
40600203	PETRO MARKETING- JET FUEL- LOADING	256
50300101	SOLID WASTE DISPOSAL- MULTIPLE CHAMBER INCINERATION	257
39099998	INDUSTRIAL PROCESS- OIL BURNER	258
10200402	EX COMB BOILER-INDUSTRIAL- RESIDUAL OIL- 10-100 MMBTU/HR	259
40300106	PETRO STORAGE- KEROSENE- FIXED ROOF TANK- BREATHING LOSS	260
20200902	INTERNAL COMBUSTION-INDUSTRIAL-KERO/NAPHTHA/JET RECIPRO	261
30799999	WOOD PRODUCTS- MISCELLANEOUS- NOT CLASSIFIED	262
30201301	FOOD & AG- MEAT SMOKING	263
40600299	PETRO MARKETING- UNSPECIFIED- MARINE VESSELS	264
40600152	PETRO MARKETING- CRUDE- TANK TRUCKS- UNLOADING	265
30501411	MINERAL PRODUCTS- GLASS MFG- BATCHING/MIXING	266
20200901	INTERNAL COMBUSTION-INDUSTRIAL-KERO/NAPHTHA/JET TURBINE	267
40600499	PETRO MARKETING- GASOLINE- STATION TANKS- NOT CLASSIFIED	268
30600504	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- WASTE WATER SEPTR	269
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30100901	CHEMICAL MFG- CLEANING CHEMICALS SOAP/DET SPRAY DRY	274
10201201	EX COMB BOILER-INDUSTRIAL-SOLID WASTE	275
40200402	ORGANIC SOLVENT- COATING- ACETONE	276
40200919	ORGANIC SOLVENT- THINNING SOLVENT- METHYL ISOBUTYL KETONE	277
40200914	ORGANIC SOLVENT- THINNING SOLVENT- KEROSENE	278
39000499	INDUSTRIAL PROCESS- RESIDUAL OIL- NOT CLASSIFIED	279
10300401	EX COMB BOILER-COMM/INSTIT-#6 OIL	280
10201302	EX COMB BOILER-INDUSTRIAL-WSTE OIL	281
40600132	PETRO MARKETING- JET FUEL- TANK TRUCKS- SUBMERGED LOADING	282
20200101	INTERNAL COMBUSTION-INDUSTRIAL- OIL- TURBINE	283
39000605	INDUSTRIAL PROCESS- NATURAL GAS- METAL MELTING	284
40300112	PETRO STORAGE- HEXANE- FIXED ROOF TANK- BREATHING LOSS	285
40200899	ORGANIC SOLVENT- COATING- OVEN- UNSPECIFIED	286
10200401	EX COMB BOILER-INDUSTRIAL- RESIDUAL OIL- #6	287
10100602	EX COMB BOILER-ELEC GEN-NATURAL GAS <100 MMBTU/HR	288
30203299	FOOD & AG- BAKERIES	289
40200907	ORGANIC SOLVENT- THINNING SOLVENT- CELLOSOLVE ACETATE	290
30405001	SECONDARY METALS- MISCELLANEOUS- CASTING/FABRICATING	291
10300603	EX COMB BOILER-COMM/INSTIT-NATURAL GAS <10 MMBTU/HR	292
30400899	SECONDARY METALS- ZINC- NOT CLASSIFIED	293
40200906	ORGANIC SOLVENT- THINNING SOLVENT- CELLOSOLVE	294
30501406	MINERAL PRODUCTS- GLASS MFG- CONTAINER FORMING/FINISHING	295
40201002	ORGANIC SOLVENT- COATING- OVEN HEATER- DISTILLATE OIL	296
10500205	EX COMB BOILER-COMM/INSTIT-SPACE HEATING-DISTILLATE OIL	297
10301301	EX COMB BOILER-COMM/INSTIT-LIQUID WASTE	298
10300502	EX COMB BOILER-COMM/INSTIT-DIST OIL- 10-100 MMBTU/HR	299
40301112	PETRO STORAGE- JET NAPHTHA JP4- FLOATING- 250K BBL STANDING LOSS	300
20200401	INTERNAL COMBUSTION-INDUSTRIAL-DEISEL OIL- RECIPROCATION	301
20100102	INTERNAL COMBUSTION-ELEC GEN- DIST OIL- RECIPROCATING	302
40300215	PETRO STORAGE- PENTANE- FLOATING ROOF- STANDING LOSS	303
40500201	PRINTING- LETTER PRESS	304
30102099	CHEMICAL MFG- PRINTING INK- UNCLASSIFIED	305
30501599	MINERAL PRODUCTS- GYPSUM MFG- NOT CLASSIFIED	306
30501101	MINERAL PRODUCTS- CONCRETE BATCHING GENERAL	307
30102499	CHEMICAL MFG- SYNTHETIC ORG FIBER- NOT CLASSIFIED	308
30101299	CHEMICAL MFG- HYDROFLUORIC ACID	309
30400217	SECONDARY METALS- COPPER- ROTARY FURNACE- BRASS/BRONZE	310
30400208	SECONDARY METALS- COPPER- WIRE BURNING- INCINERATOR	311
30103204	CHEMICAL MFG- SULFUR(ELEMENTAL)- S RMVL PRCS 99.9	312
39001099	INDUSTRIAL PROCESS- LPG FUEL- NOT CLASSIFIED	313
40300154	PETRO STORAGE- CYCLOHEXANE- FIXED ROOF TANK- WORKING LOSS	314
40300109	PETRO STORAGE- CYCLOHEXANE- FIXED ROOF TANK- BREATHING LOSS	315
40600154	PETRO MARKETING- KEROSENE- TANK TRUCKS- UNLOADING	316
40600134	PETRO MARKETING- KEROSENE- TANK TRUCKS- SUBMERGED LOADING	317
40600103	PETRO MARKETING- JET FUEL- TANK TRUCKS- SPLASH LOADING	318
40300304	PETRO STORAGE- KEROSENE- VAR VAPOR SPACE- WORKING LOSS	319
40300312	PETRO STORAGE- ISOPENTANE- VAR VAPOR SPACE- WORKING LOSS	320
30400101	SECONDARY METALS- ALUMINUM- SWEATING FURNACE	321
39001299	INDUSTRIAL PROCESS- MISCELLANEOUS- NOT CLASSIFIED	322
30300901	PRIMARY METALS- IRON & STEEL- STEEL FURNACES- OPEN HEARTH	323
39000608	INDUSTRIAL PROCESS- NATURAL GAS- GLASS FURNACE	324
10500206	EX COMB BOILER-COMM/INSTIT-SPACE HEATING-NATURAL GAS	325
50300108	SOLID WASTE DISPOSAL- AUTO BODY COMPONENT INCINERATION	326
50200505	SOLID WASTE DISPOSAL- PATHOLOGICAL INCINERATION	327
50300102	SOLID WASTE DISPOSAL- SINGLE CHAMBER INCINERATION	328

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40300200	PETRO STORAGE- BENZENE- FLOATING ROOF- STANDING LOSS	330
40300153	PETRO STORAGE- BENZENE- FIXED ROOF TANK- WORKING LOSS	331
40300100	PETRO STORAGE- BENZENE- FIXED ROOF TANK- BREATHING LOSS	332
40200603	ORGANIC SOLVENT- COATING- XYLENE	333
40100305	ORGANIC SOLVENT- COLD CLEANING- 1,1,1-TRICHLOROETHANE	334
40100302	ORGANIC SOLVENT- COLD CLEANING- METHYLENE CHLORIDE	335
40100204	ORGANIC SOLVENT- DEGREASING- PERCHLOROETHYLENE	336
40100199	ORGANIC SOLVENT- DRY CLEANING- NOT CLASSIFIED	337
40100101	ORGANIC SOLVENT- DRY CLEANING- PERCHLOROETHYLENE	338
39000797	INDUSTRIAL PROCESS- PROCESS GAS- NOT CLASSIFIED	339
39000631	INDUSTRIAL PROCESS- NATURAL GAS- FOOD-DRYING/COOKING/ETC	340
39000531	INDUSTRIAL PROCESS- DISTILLATE OIL- FOOD COOKING	341
39000506	INDUSTRIAL PROCESS- DISTILLATE OIL- BRICK KILN	342
30588802	MINERAL PRODUCTS- FUGITIVE EMISSION- NOT CLASSIFIED	343
30501410	MINERAL PRODUCTS- GLASS MFG- RAW MATERIAL HANDLING	344
30501401	MINERAL PRODUCTS- GLASS MFG- SODA LIME- FURNACE/GENERAL	345
30501204	MINERAL PRODUCTS- FIBERGLASS- FORMING/ROTARY SPUN	346
30501201	MINERAL PRODUCTS- FIBERGLASS- REGENERATIVE FURNACE	347
30500312	MINERAL PRODUCTS- BRICK MFG- TUNNEL KILNS- OIL FIRED	348
30500311	MINERAL PRODUCTS- BRICK MFG- TUNNEL KILNS- GAS FIRED	349
30500206	PETRO INDUSTRY- ASPHALT HEATER- NATURAL GAS	350
30500201	PETRO INDUSTRY- ASPHALT CONCRETE ROTARY DRYER	351
30488801	SECONDARY METALS- FUGITIVE EMISSION- NOT CLASSIFIED	352
30400828	SECONDARY METALS- ZINC- REVERB-SWEAT FURNACE- SCRAP METAL	353
30400803	SECONDARY METALS- ZINC- POT FURNACE	354
30400801	SECONDARY METALS- ZINC- RETORT FURNACE	355
30400705	PRIMARY METALS- STEEL FOUNDRY- ELEC INDUCTION FN	356
30400702	PRIMARY METALS- OPEN HEARTH STEEL FOUNDRY	357
30400701	PRIMARY METALS- STEEL FOUNDRY- ELEC ARC FURNACE	358
30400499	SECONDARY METALS- LEAD- NOT CLASSIFIED	359
30400407	SECONDARY METALS- LEAD- POT FURNACE HEATER- NATURAL GAS	360
30400402	SECONDARY METALS- LEAD- SMELTING FURNACE- REVERB	361
30400301	PRIMARY METALS- STEEL FOUNDRY- CUPOLA	362
30400219	SECONDARY METALS- COPPER- CRUCIBLE/POT FURNACE- BRASS/BRONZE	363
30400212	SECONDARY METALS- COPPER- CUPOLA- SCRAP CU/BRS	364
30400205	SECONDARY METALS- COPPER- REVERB FURNACE	365
30400109	SECONDARY METALS- ALUMINUM- BURNING/DRYING	366
30400102	SECONDARY METALS- ALUMINUM- SMELTING FURNACE- CRUCIBLE	367
30388801	PRIMARY METALS- FUGITIVE EMISSION- NOT CLASSIFIED	368
30301003	PRIMARY METALS- LEAD SMELTING- DROSS REVERB FURN	369
30300914	PRIMARY METALS- IRON & STEEL- STEEL FURNACES- BASIC OX- CLD	370
30300913	PRIMARY METALS- IRON & STEEL- STEEL FURNACES- BASIC OX- OPN	371
30300801	PRIMARY METALS- IRON & STEEL- ORE CHARGE	372
30300304	PRIMARY METALS- IRON & STEEL- QUENCHING	373
30112502	CHEMICAL MFG- ETHYLENE DICHLORIDE	374
30103299	CHEMICAL MFG- SULFUR(ELEMENTAL)- UNCLASSIFIED	375
30103202	CHEMICAL MFG- SULFUR(ELEMENTAL)- MOD CLS 3STG 95-6	376
30102308	CHEMICAL MFG- INORGANIC CHEM- H2SO4 CONTACT- 98% CONVERSION	377
30101701	CHEMICAL MFG- PHOS ACID/THERMAL- GENERAL	378
30101699	CHEMICAL MFG- PHOS ACID/WET PROC- UNCLASSIFIED	379
20100501	INTERNAL COMBUSTION-ELEC GEN- JET FUEL- TURBINE	380
10500110	EX COMB BOILER-INDUSTRIAL- SPACE HEATING-LPG	381
10500106	EX COMB BOILER-INDUSTRIAL- SPACE HEATING-NATURAL GAS	382
10500105	EX COMB BOILER-INDUSTRIAL- SPACE HEATING- DISTILLATE OIL	383
10399998	EX COMB BOILER-COMM/OTHERT-UNSPECIFIEDE	384
10399997	EX COMB BOILER-COMM/OTHER- UNSPECIFIED	385
10300503	EX COMB BOILER-COMM/INSTIT-DIST OIL- <10 MMBTU/HR	386

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10300402	EX COMB BOILER-COMM/INSTIT-RESIDUAL OIL- 10-100 MMBTU/HR	387
10201002	EX COMB BOILER-INDUSTRIAL-LPG- LARGE	388
10200799	EX COMB BOILER-INDUSTRIAL-PROCESS GAS UNCLASSIFIED	389
10200703	EX COMB BOILER-INDUSTRIAL-PROCESS GAS REFINERY <10 MMBTU/HR	390
10200504	EX COMB BOILER-INDUSTRIAL- #4 OIL	391
10100603	EX COMB BOILER-ELEC GEN-NATURAL GAS <10 MMBTU/HR	392
10100503	EX COMB BOILER-ELEC GEN- DIST OIL- <10 MMBTU/HR	393

TABLE 3-7. Seven element scores and WROG ranking for selected area source categories.

CES	DESCRIPTION	7-ELEMENT SCORE	STEP I(WROG) RANKING
AAA46763	SURFACE COATING- EVAPORATION- OIL BASED	126.00	3
AAA58610	GASOLINE EXHAUST- PLEASURE CRAFT	125.00	5
AAA66746	UTILITY EQUIPMENT- GASOLINE COMBUSTION	125.00	4
AAA47316	WILD FIRES- TIMBER & BRUSH	122.00	1
AAA46540	GASOLINE EVAPORATION AT SERVICE STATIONS- VEHICLE REFUELING	121.00	2
AAA10100	?????????? UNSPECIFIED EMISSIONS ????????????????	115.00	31
AAA46771	SURFACE COATING- EVAPORATION- SOLVENT	109.00	7
AAA46870	ASPHALT PAVING- CUTBACK ASPHALT EVAPORATION	106.00	6
AAA46912	DOMESTIC SOLVENT USE- UNSPECIFIED	105.00	11
AAA47300	WILD FIRES- GRASS & WOODLAND	103.00	10
AAA47449	GASOLINE EXHAUST- RESIDENTIAL UTILITY EQUIPMENT	102.00	9
AAA19315	SURFACE COATING- WOOD FURNITURE & FIXTURES	90.30	23
AAA46847	DEGREASING- NON SYNTHETIC SOLVENT EVAPORATION- SERVICES	90.10	15
AAA66787	INTERNAL COMBUSTION- NATURAL GAS	89.00	8
AAA31963	SURFACE COATING- FABRICATED STRUCTURAL METAL	87.00	27
AAA27920	SURFACE COATING- TRANSPORTATION EQUIPMENT #3	86.80	28
AAA66605	AGRICULTURAL- LIVESTOCK- UNSPECIFIED PROCESSES- FEEDLOT WASTE	86.80	16
AAA46755	SURFACE COATING- EVAPORATION- WATER BASED	86.70	12
AAA25213	SURFACE COATING- FABRICATED STEEL	86.20	29
AAA42358	SURFACE COATING- RUBBER & PLASTICS FABRICATION	83.80	33
AAA25056	SURFACE COATING- WHOLESALE & RETAIL AUTO	83.40	37
AAA46888	ASPHALT PAVING- ROAD OIL EVAPORATION	83.40	25
AAA19034	SURFACE COATING- MISCELLANEOUS MANUFACTURING	83.10	38
AAA47464	GASOLINE EXHAUST- OFF-ROAD TRAIL BIKES	80.80	26
AAA46565	GASOLINE EVAPORATION AT SERVICE STATIONS- SPILLAGE	80.00	24
AAA46904	ASPHALT PAVING- EMULSIFIED ASPHALT EVAPORATION	79.80	32
AAA54429	LPG EXHAUST- FORKLIFTS & ETC	78.50	21
AAA54387	GASOLINE EXHAUST- FORKLIFTS & ETC	76.80	14
AAA58701	RESIDENTIAL NON SYNTHETIC SOLVENT EVAPORATION- AEROSOL PROPELL	76.30	13
AAA54536	DIESEL EXHAUST- PUBLIC WORKS	75.00	20
AAA54411	GASOLINE EXHAUST- RECREATIONAL 4 WHEEL DRIVES	74.00	41
AAA47134	DOMESTIC PESTICIDE APPLICATION- NON SYNTHETIC	72.80	30
AAA54437	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- RESIDENTIAL	72.50	18
AAA47100	EVAPORATION- SYNTHETIC PESTICIDE APPLICATIONS- DOMESTIC	69.90	40
AAA54577	NATURAL GAS COMBUSTION- RESIDENTIAL WATER HEATING	68.00	22
AAA57349	BAKING ETHANOL LOSS	67.40	39
AAA58685	NATURAL GAS LOSS FROM PIPELINES	62.50	19
AAA47597	DIESEL EXHAUST- RAIL TRANSPORT	62.00	17
AAA47126	AGRICULTURAL PESTICIDE APPLICATION- NON SYNTHETIC	59.00	35
AAA46532	GASOLINE EVAPORATION AT SERVICE STATIONS- TANK WORKING LOSS	59.00	34
AAA47092	EVAPORATION- PESTICIDE APPLICATION- SYNTHETIC PESTICIDES	58.90	36
AAA54593	DIESEL EXHAUST- FORK LIFTS	56.50	44
AAA58677	DEISEL EXHAUST- FOREIGN SHIPS INTRANSIT	56.50	43
AAA54379	DIESEL EXHAUST- FORKLIFTS & ETC	56.50	42

TABLE 3-8. Three element scores and WROG ranking for selected area source categories.

CES	DESCRIPTION	3-ELEMENT SCORE	STEP I(WROG) RANKING
AAA66738	ROOFING TAR POTS & UNSPECIFIED EMISSIONS	63.40	65
AAA60418	FOOD & AGRICULTURAL- CHARCOAL BROILING	60.90	46
AAA47118	CREOSOTE EVAPORATION	53.40	64
AAA42416	SURFACE COATING- MACHINERY- ELECTRICAL COMPONENTS	52.60	48
AAA24877	SURFACE COATING- FURNITURE & FIXTURES- COTTON GIN	52.40	49
AAA27995	SURFACE COATING- LUMBER & WOOD PRODUCTS	52.10	52
AAA19109	SURFACE COATING- TRANSPORTATION EQUIPMENT #1	52.10	61
AAA20107	SURFACE COATING- MISCELLANEOUS SERVICES- WHOLESALE & RETAIL	51.50	55
AAA37861	SURFACE COATING- TRANSPORTATION EQUIPMENT- MISSLES	51.40	59
AAA28464	SURFACE COATING- MACHINERY CONSTRUCTION	50.90	66
AAA47324	STRUCTURAL FIRES	50.80	68
AAA27854	SURFACE COATING- TRANSPORTATION EQUIPMENT #2	50.60	74
AAA18697	SURFACE COATING- EDUCATIONAL SERVICES	50.60	73
AAA24935	SURFACE COATING- TEXTILES & APPAREL	50.50	75
AAA46896	ASPHALT PAVING- PAVING ASPHALT EVAPORATION	50.50	45
AAA54361	GASOLINE EXHAUST- FRUIT & VEGETABLE REFRIGERATION	43.60	62
AAA11676	AIRPORT- VEHICLE REFUELING- GASOLINE	43.60	61
AAA47498	GASOLINE EXHAUST- AGRICULTURAL CROP PRODUCTION	41.40	58
AAA54445	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION-RESIDENTIAL	40.80	69
AAA54544	GASOLINE EXHAUST- PUBLIC WORKS	40.30	77
AAA58602	DIESEL EXHAUST- PLEASURE CRAFT	38.90	57
AAA46730	GASOLINE EVAPORATION- TANKER/BARGE BALLASTING	38.30	70
AAA47142	NATURAL GAS COMBUSTION- MANUFACTURING & INDUSTRIAL	37.80	83
AAA54353	DIESEL EXHAUST- FRUIT & VEGETABLE REFRIGERATION	37.70	47
AAA46581	GASOLINE EVAPORATION- TANKER LOADING	37.40	50
AAA58628	DIESEL EXHAUST- COMMERCIAL CRAFT	36.70	53
AAA47696	DIESEL EXHAUST- FOREIGN SHIP BERTHING	36.50	54
AAA54478	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INDUSTRIAL	35.90	67
AAA54452	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- COMMERCIAL	35.90	63
AAA54494	DIESEL EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INSTITUTIONA	35.60	72
AAA47480	DIESEL EXHAUST- AGRICULTURAL CROP PRODUCTION	35.60	71
AAA47167	NATURAL GAS COMBUSTION- SERVICES & COMMERCE	35.30	82
AAA58735	NATURAL GAS COMBUSTION- SPACE HEATERS- SERVICES & COMMERCE	35.30	79
AAA58743	NATURAL GAS COMBUSTION- BOILERS & HETERS- SERVICES & COMMERCE	35.30	78
AAA47647	DIESEL EXHAUST- FOREIGN SHIP MANEUVERING	35.30	76
AAA46714	CRUDE EVAPORATION- MARINE VESSEL LIGHTERING	31.40	56
AAA46722	CRUDE EVAPORATION- TANKER/BARGE BALLASTING	31.20	60
AAA54569	NATURAL GAS COMBUSTION- RESIDENTIAL SPACE HEATING	30.30	81
AAA54585	NATURAL GAS COMBUSTION- RESIDENTIAL COOKING	30.30	80

TABLE 3-9. WROG ranking for selected area source categories.

CES	DESCRIPTION	STEP I(WROG) RANKING
AAA24794	SURFACE COATING- RUBBER & PLASTICS MANUFACTURING	84
AAA19Ø18	SURFACE COATING- AIR TRANSPORTATION	85
AAA47654	EXHAUST FROM TUG BOATS- UNSPECIFIED FUEL	86
AAA31583	SURFACE COATING- MW PRODUCTS	87
AAA58636	GASOLINE EXHAUST- COMMERCIAL CRAFT	88
AAA24729	SURFACE COATING- PRINT & PUBLISHING	89
AAA46573	CRUDE EVAPORATION- TANKER LOADING	9Ø
AAA17947	SURFACE COATING- CANS & CONTAINERS	91
AAA35212	SURFACE COATING- NON FERROUS METALS	92
AAA47662	RESIDUAL OIL COMBUSTION- STEAM SHIP BERTHING	93
AAA47258	AGRICULTURAL BURNING- FIELD CROP DEBRIS	94
AAA573Ø7	AUTO TIRE BURNING- UNPLANNED	95
AAA6Ø467	WINE AND BRANDY AGING	96
AAA4649Ø	GASOLINE EVAPORATION- MARKETING- STORAGE & TRANSFER- BULK	97
AAA47241	AGRICULTURAL BURNING- PRUNINGS	98
AAA39Ø24	SURFACE COATING- CHEMICAL & ALLIED	99
AAA46599	JET FUEL EVAPORATION- TANKER LOADING	1ØØ
AAA5446Ø	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- COMMERCIAL	1Ø1
AAA47613	RESIDUAL OIL COMBUSTION- STEAM SHIP MANEUVERING	1Ø2
AAA47266	WEED BURNING- OPEN FIELD	1Ø3
AAA52472	SURFACE COATING- AG CROP PREPARATION FOR MARKET	1Ø4
AAA54486	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INDUSTRIAL	1Ø5
AAA2Ø586	SURFACE COATING- AMUSEMENTS & MOTION PICTURES	1Ø6
AAA32342	SURFACE COATING- LUMBER & WOOD	1Ø7
AAA1919Ø	SURFACE COATING- TIRE MANUFACTURING- RUBBER & PLASTICS	1Ø8
AAA19Ø26	SURFACE COATING- MISCELLANEOUS SERVICES	1Ø9
AAA25916	SURFACE COATING- GLASS PRODUCTS	11Ø
AAA25262	SURFACE COATING- IRON & STEEL FOUNDRY	111
AAA58727	LPG COMBUSTION- SERVICES & COMMERCE	112
AAA58693	RESIDENTIAL SYNTHETIC SOLVENT EVAPORATION- AEROSOL PROPELLENT	113
AAA58669	DEISEL EXHAUST- U.S. SHIPS INTRANSIT	114
AAA58651	RESIDUAL OIL COMBUSTION- FOREIGN SHIPS INTRANSIT	115
AAA58644	RESIDUAL OIL COMBUSTION- U.S. STEAM SHIPS INTRANSIT	116
AAA5452Ø	GASOLINE EXHAUST- BUILDING CONSTRUCTION/DEMOLITION- INSTITUTIO	117
AAA4767Ø	RESIDUAL OIL COMBUSTION- FOREIGN SHIP BERTHING	118
AAA47639	DIESEL EXHAUST- SHIP MANEUVERING	119
AAA47621	RESIDUAL OIL COMBUSTION- FOREIGN SHIP MANEUVERING	12Ø
AAA47563	GASOLINE EXHAUST- COMMERCIAL AIRCRAFT- AG SERVICES	121

and CESs, respectively. These categories are arranged simply by their WROG scores.

Although from the standpoint of the study objectives Table 3-4 is the most important among the three point source file tables and Table 3-6 is the least important (a similar conclusion can be drawn for the area source file), caution should be exercised in reviewing and comparing these tables because of the variable basis of the scores computed for categories contained therein. The incomparability of the 7- and 3-element scores should be particularly emphasized.

Step 3--Final Selection of Categories

Using the results in Tables 3-4 through 3-9, a list of source types was completed and recommended for further study investigation. Source categories were selected from both the point and area source files and incorporated into a single list. In addition to ranking sources on the basis of 3- or 7-element scores, a primary consideration in the derivation of this final list was the contractual requirement to include at least one each of the following source categories in the remainder of the study:

Petroleum-product storage and transfer facilities

Fossil-fuel-fired power plants

Petroleum refineries

Processing plants using spray-type or hand-applied organic coatings

Manufacturing plants using organic coatings

Information contained in Tables 3-4, 3-5, 3-7, and 3-8 reveals that most of these source categories already rank fairly high.

Survey and testing considerations were also important in making a final selection. Since these activities would be conducted at various facilities, it was desirable to carefully consider individual SCCs and CESs during the source selection process. For example, if two petroleum refinery SCCs were selected because of their high ranking, it might be advantageous and cost-effective to include similar SCCs even though they ranked lower.

Table 3-10 identifies the general source categories (e.g., power plants, refineries, and chemical manufacturing) and the specific SCCs and CESs that the study team recommended for detailed investigation during the remainder of the study. Source categories were selected from both the point and area source files. Group 1 in Table 3-10 includes the SCCs recommended for study in Tasks 2 through 4. Group 2 covers other SCCs

TABLE 3-10. Categories of sources recommended for further investigation.

POINT SOURCE FILE

POWER PLANTS (SCAQMD--TEMPORAL DATA)

10100401	EX COMB BOILER-ELEC GEN-#6 OIL NORM FRG
10100501	EX COMB BOILER-ELEC GEN-#1 & #2 DISTILLATE OIL
10100601	EX COMB BOILER-ELEC GEN-NATURAL GAS >100 MMBTU/HR

REFINERIES

GROUP 1

30699999	PETRO INDUSTRY- MISCELLANEOUS- NOT CLASSIFIED
30699998	PETRO INDUSTRY- MISCELLANEOUS- NOT CLASSIFIED
30600805	PETRO INDUSTRY- FUGITIVE- MISCELLANEOUS- SAMPLING/PURGING
30601301	PETRO INDUSTRY- CATALYTIC REFORMER- GENERAL
30600803	PETRO INDUSTRY- FUGITIVE- PUMP SEALS W/O CONTROLS
30600301	PETRO INDUSTRY- FUGITIVE- NOT CLASSIFIED
30600502	PETRO INDUSTRY- FUGITIVE- PROCESS DRAINS- W/O CONTROLS
30600304	PETRO INDUSTRY- FUGITIVE- COMPRESSOR SEALS
30600001	PETRO INDUSTRY- FUGITIVE- PIPELINE- VALVES/FLANGES

GROUP 2

30600601	PETRO INDUSTRY- REFINING- VACUUM JET- VACUUM DISTILLATION

BULK PLANTS AND TERMINALS

GROUP 1

40400111	BULK TERMINALS- GASOLINE RVP10- FLOATING- 67K BBL STANDING LOSS
40400199	BULK TERMINALS- UNSPECIFIED-

GROUP 2

40600126	PETRO MARKETING- GASOLINE- TANK TRUCKS- SUBMERGED LOADING
40600101	PETRO MARKETING- GASOLINE LOADING- TANK CARS/TRUCKS
40600001	PETRO MARKETING- GASOLINE- FUGITIVE EMISSIONS
40600131	PETRO MARKETING- GASOLINE- TANK TRUCKS- SUBMERGED LOADING
40699198	PETRO MARKETING- UNSPECIFIED- TANK TRUCK LOSS
40600151	PETRO MARKETING- GASOLINE- TANK TRUCKS- UNLOADING

TABLE 3-10 (continued)

SURFACE COATING FACILITIES

GROUP 1

40299999	ORGANIC SOLVENT- COATING- UNSPECIFIED
40288801	ORGANIC SOLVENT- COATING- FUGITIVE- UNSPECIFIED
40200901	ORGANIC SOLVENT- THINNING SOLVENT- GENERAL
40200801	ORGANIC SOLVENT- COATING- OVEN- UNSPECIFIED
40200810	ORGANIC SOLVENT- COATING- OVEN- GENERAL
40200803	ORGANIC SOLVENT- COATING- OVEN- >175 F
40200802	ORGANIC SOLVENT- COATING- OVEN- <175 F- UNSPECIFIED
40200101	ORGANIC SOLVENT- COATINGS- PAINT- POLYMERIC HOT AIR DRIED
40200199	ORGANIC SOLVENT- COATING- NOT CLASSIFIED(PAINT)
40200110	ORGANIC SOLVENT- COATINGS- PAINT- SOLVENT-BASED
40200102	ORGANIC SOLVENT- COATINGS- PAINT- ACETONE

GROUP 2

40200701	ORGANIC SOLVENT- COATING- ADHESIVE- GENERAL
40200799	ORGANIC SOLVENT- COATING- COMPOSITE
40200710	ORGANIC SOLVENT- COATING- ADHESIVE- GENERAL
40200703	ORGANIC SOLVENT- COATING- TOLUENE
40200501	ORGANIC SOLVENT- COATING- ENAMEL- GENERAL
40200599	ORGANIC SOLVENT- COATING- COMPOSITE
40200510	ORGANIC SOLVENT- COATING- ENAMEL- GENERAL
40200504	ORGANIC SOLVENT- COATING- TOLUENE
40200401	ORGANIC SOLVENT- COATING- GENERAL LACQUER
40200499	ORGANIC SOLVENT- COATING- NOT CLASSIFIED(LAQUER)
40200410	ORGANIC SOLVENT- COATING- GENERAL LACQUER
40200601	ORGANIC SOLVENT- COATING- PRIMER- GENERAL
40200610	ORGANIC SOLVENT- COATING- PRIMER- GENERAL
40200699	ORGANIC SOLVENT- COATING- COMPOSITE
40200210	ORGANIC SOLVENT- COATING- WATER-BASED PAINT GENERAL
40200301	ORGANIC SOLVENT- COATING- VARNISH/SHELLAC GENERAL
40200399	ORGANIC SOLVENT- GENERAL

STORAGE TANKS

GROUP 1

40399999	PETRO STORAGE- UNSPECIFIED EMISSION
40388801	PETRO STORAGE- UNPECIFIED FUGITIVE EMISSION
40300199	PETRO STORAGE- NOT CLASSIFIED- FIXED ROOF- WORKING LOSS
40301099	PETRO STORAGE- UNSPECIFIED- FIXED ROOF- WORKING LOSS
40301098	PETRO STORAGE- UNSPECIFIED- FIXED ROOF- 250K BBL-BREATHING
40301097	PETRO STORAGE- UNSPECIFEID- FIXED ROOF- 67K BBL-BREATHING
40300198	PETRO STORAGE- NOT CLASSIFIED- FIXED ROOF- BREATHING LOSS

GROUP 2

40300299	PETRO STORAGE- NOT CLASSIFIED- FLOATING ROOF- STANDING LOSS
40300104	PETRO STORAGE- CRUDE- FIXED ROOF TANK- WORKING LOSS
40301010	PETRO STORAGE- CRUDE RVP5- FIXED ROOF- 67K BBL-BREATHING
40300102	PETRO STORAGE- CRUDE- FIXED ROOF TANK- BREATHING LOSS
40300204	PETRO STORAGE- CRUDE- FLOATING ROOF- WORKING LOSS
40300203	PETRO STORAGE- CRUDE- FLOATING ROOF- STANDING LOSS

TABLE 3-10 (continued)

OIL AND GAS PRODUCTION

31000199	OIL & GAS PRODUCTION- CRUDE- NOT CLASSIFIED
31000299	OIL & GAS PRODUCTION- NATURAL GAS- NOT CLASSIFIED

CHEMICAL MANUFACTURING

GROUP 1

30199999	CHEMICAL MFG- FUGITIVE EMISSIONS

GROUP 2

30101401	CHEMICAL MFG- GENERAL PAINTS- MIXING/HANDLING
30102699	CHEMICAL MFG- SYNTHETIC RUBBER

AREA SOURCE FILE

ASPHALT PAVING

AAA46870	ASPHALT PAVING- CUTBACK ASPHALT EVAPORATION
AAA46888	ASPHALT PAVING- ROAD OIL EVAPORATION
AAA46904	ASPHALT PAVING- EMULSIFIED ASPHALT EVAPORATION

STATIONARY INTERNAL COMBUSTION SOURCES

AAA66787	INTERNAL COMBUSTION- NATURAL GAS

GASOLINE EVAPORATION AT SERVICE STATIONS

AAA46540	GASOLINE EVAPORATION AT SERVICE STATIONS- VEHICLE REFUELING
AAA46565	GASOLINE EVAPORATION AT SERVICE STATIONS- SPILLAGE

UNSPECIFIED EMISSIONS

AAA10100	????????? UNSPECIFIED EMISSIONS ?????????????

TABLE 3-10 (concluded)

OTHER POSSIBLE SOURCE TYPES

POINT SOURCE FILE

POWER PLANTS (ROG SPECIATION DATA)

10100401	EX COMB BOILER-ELEC GEN-#6 OIL NORM FRG
10100501	EX COMB BOILER-ELEC GEN-#1 & #2 DISTILLATE OIL
10100601	EX COMB BOILER-ELEC GEN-NATURAL GAS >100 MMBTU/HR

MISCELLANEOUS SOLVENT

49099999	ORGANIC SOLVENT - MISCELLANEOUS - UNSPECIFIED

PRINTING

40500599	PRINTING- INK THINNING SOLVENT- UNSPECIFIED
40500501	PRINTING- ROTOGRAVURE- UNSPECIFIED
40500301	PRINTING- FLEXOGRAPHIC
40500401	PRINTING- LITHOGRAPHIC- UNSPECIFIED
40500299	PRINTING- UNSPECIFIED

DEGREASING

40100299	ORGANIC SOLVENT- DEGREASING- COMPOSITE SOLVENT
40100399	ORGANIC SOLVENT- COLD CLEANING- NOT SPECIFIED

that might also merit examination. Furthermore, "Other Possible Source Types" includes certain sources of lower priority that were frequently ranked lower in Tables 3-4 through 3-9 and were therefore not expected to be studied.

USE OF TASK 1 RESULTS IN OTHER STUDIES

Tables 3-4 through 3-10 represent the product of the Task 1 effort; that is, they represent the results from all three steps performed under Task 1. The categories listed in Table 3-10 as recommended source types for study were analyzed in the remainder of the project; however, they represent a fraction of the total number of categories shown in Tables 3-4 through 3-9. The methodology we created to rank all source categories in the inventory, as illustrated in Tables 3-4 through 3-9, provides valuable guidance for further studies. Most important, hundreds of categories have now been examined and ranked for emission inventory uncertainties. These tables can thus be used to establish priorities during the conception and performance of future studies aimed at improving the quality of ROG and NO_x emission inventories.

4 TASK 2: SURVEY AND INVESTIGATION OF SELECTED SOURCE CATEGORIES

SELECTION OF GRID CELLS AND FACILITIES

After identifying the source types recommended for further study, the next task involved a survey of facilities in the SOCAB representative of these source types. For point sources, this process involved a random selection of grid cells, followed by a random selection of facilities for the SCCs listed in Table 3-10. For area sources, "individual facilities" were not listed in the inventory; by definition, each CES is a group of sources distributed throughout the SOCAB. Therefore, we examined the methods used to generate the emission estimates for area sources in Table 3-10 including, for example, a review of emission factors, activity (throughput) data, speciation profiles, etc.

There are several ways in which grid cells and facilities could have been selected for the survey. In particular, we considered selecting a grid cell in the basin, surveying it in detail, and then extrapolating the results to other grid cells in the SOCAB. This type of survey might be performed specifically to identify missing point sources. However, it was felt that surveying a grid cell would not provide a significant insight into the types of uncertainties in the inventory, nor would it allow us to locate unreported or new sources. A major problem with this type of survey stems from an inability to determine why a specific source identified during the survey was not in the 1979 point source inventory. In most cases, we felt that it would be difficult to identify the reason for its omission from among the following possibilities.

The source was covered by the area source file (and thus was unpermitted or exempt, but was reported in the 1979 inventory, nevertheless).

The source had no emissions.

The source began operations after 1979 (or shut down before 1979).

The source changed its company name since 1979.

The source, as named on the building, was a subsidiary of the company named in the EDS data base.

The source was in the inventory, but was located in a nearby grid cell.

The source was inadvertently omitted from the inventory and thus was unreported.

Moreover, because the survey represented only one grid cell from a set of over 600 cells, there would be no method of extrapolating any "conclusions" to the entire basin. For example, if all sources identified in the grid cell matched the inventory, there might still be an important number of unreported sources in the basin. Conversely, if several sources did not match, this finding would tell us little about the remainder of the basin. Therefore, performing such a survey would not likely shed much light on the types and quantities of systematic errors in the 1979 inventory.

Other difficulties might be encountered in carrying out this type of survey. The existing coordinate systems are not considered accurate enough to locate the precise grid cell of all sources from a map. In addition, over the years we have found that even major point sources have slightly inaccurate Universal Transverse Mercator (UTM) coordinates that sometimes place them in a cell of the inventory adjoining their correct cell position. With regard to the objective of the overall project, it was also felt that the results of a survey of a single grid cell would not lead to improved, modeling-quality emission inventories of ROG or NO_x emissions, both because of our inability to determine the cause of any "missing" source from the results of the survey and because the survey would not provide a means of quantifying the effects on emission levels of sources possibly omitted from the inventory. In addition, we would not be able to extrapolate other results from this survey to facilities in the remaining grid cells.

Initial Selection Process

The selection process for identifying facilities to be surveyed had to meet several requirements that included the use of data collected in later tasks of the project, representativeness of the survey sample, mimimization of bias, and consideration of available resources. We chose a procedure that involved the random selection of grid cells and facilities so that the SCCs in Table 3-10 would be examined in depth. The number of unique facilities in the SOCAB possessing the SCCs in Table 3-10 was first determined by reviewing the information in the 1979 computerized

inventory. We searched the SOCAB inventory for each SCC in the table and kept track of the individual facilities possessing these SCCs.

We then determined a minimum number of facilities to be selected using the grid cell and facility selection procedure. Although it would have been desirable to survey all facilities with SCCs in Table 3-10, to do so would have limited us to one or two source types (such as refineries) instead of the 15 source types represented in the table. Therefore, we chose a number for each SCC that represented the number of facilities for which we would review EDS data and potentially survey in Task 2. This number had to be large enough, relative to the total number of similar facilities in the basin, to give us a representative set of facilities, and small enough so that the total number of all selected facilities could be examined within the available resources.

The following procedure was used to randomly select grid cells and facilities for the point source SCCs in Table 3-10.

Step 1

1.1 Randomly select a grid cell from the population of nonzero ROG grid cells in the SOCAB.

1.2 Record the number of unique facilities for each SCC of interest (i.e., all the SCCs in Table 3-10) that occur in the grid cell.

1.3 Repeat this process until the minimum number of facilities is obtained for eacn SCC.

Step 2

Perform the following process for each source type of interest (e.g., power plants, refineries, surface coating facilities, etc.).

2.1 Begin with the first SCC listed for the source type.

2.2 From the selected grid cells, define the population of facilities that contains the SCC.

2.3 Randomly select a facility from the population identified above.

2.4 Identify those SCCs in Groups 1 and 2 (for the source type of interest) that occur at the chosen facility; consider that facility selected for those SCCs.

2.5 Move to the next SCC listed for the source type.

2.6 If the number of selected facilities for this SCC is greater than or equal to the minimum number, move to the next SCC (and repeat Step 2.6). If it is not, repeat Steps 2.2 through 2.5 for this SCC.

2.7 Repeat this process for the SCCs in Group 1 until the number of selected facilities for each SCC is greater than or equal to the minimum number. These are the facilities that will be used to investigate Group 1 SCCs.

2.8 Continue this process for all Group 2 SCCs for the source type of interest. Repeat this process until the number of selected facilities for each SCC in Group 2 is greater than or equal to the minimum number.

A total of 248 unique facilities in the SOCAB, each possessing at least one SCC in Table 3-10, were randomly chosen in a manner consistent with the selection procedure. Data from EDS were then obtained from the ARB in the form of turnaround documents (TADs) for each of the selected facility identification numbers.

Review of Inventory Data for Initially Selected Facilities

After the TADs were acquired for the selected facilities, we performed a data review to assist in the survey formulation. This review was a major undertaking since the TADs consisted of over 5000 pages of computer output listing for each facility SIC/SCC codes, emission factors, operating schedules, annual emission rates, and so forth. At this stage we found that the TADs provided an extensive framework for data entry, but that often the data were missing from the framework. For example, the source description field could be valuable for examining and understanding nonspecific SCCs, but the field was seldom used. Nonspecific SCCs (e.g., 3-06-999-99, petroleum industry-miscellaneous-not classified) are frequently assigned to sources for which the details of the materials used or the processes performed are unknown. Sources with nonspecific SCCs had therefore been selected for investigation because of the suspected high degree of uncertainty in their emission rates and speciation profiles, but the TADs did not contain insightful information for these sources. We further found little similarity between sources with the same nonspecific SCCs. Therefore, an extrapolation of information to all sources with nonspecific SCCs could not be carried out. However, a few sources with nonspecific SCCs were found to represent the majority of emissions for these SCCs.

Final Selection of Facilities for Survey

After reviewing the TADs for nonspecific SCCs, we concluded that (1) sources with nonspecific SCCs were a diverse group, (2) the number of facilities for each of the nonspecific SCCs was too large to permit a survey of the entire population, and (3) a large percentage of the total emissions from these SCCs came from a small number of facilities. Therefore, the survey for the nonspecific SCCs was designed to focus on the largest emitters for such SCCs rather than on randomly selected facilities. For each nonspecific SCC, the emissions from each facility were reviewed to select the largest emitters for the survey. A significant result of surveying these particular sources was a more than threefold increase--to 488--in the number of facility devices that were examined during the survey.

The final set of facilities selected for the survey is presented in Table 4-1. This table, which is derived from Table 3-10, lists the SCCs, source types, and number of facilities that were initially planned to be surveyed or otherwise investigated in Task 2.

SURVEY OF SELECTED FACILITIES

As shown in Table 4-1, the source types to be surveyed were grouped into higher (Group 1) and lower (Group 2) priorities. In consideration of available resources for the task, it was decided that generally only Group 1 facilities would be surveyed. Thus, a total of 161 facilities were selected for survey. The types of facilities selected are categorized in Table 4-2. Investigations of more than one type of process were planned for many of the selected facilities. However, after comparing emission fee data with inventory information for a number of facilities, it was decided that each process at almost every facility needed to be investigated. Although emission totals for facilities in the EIS file agreed with the emission fee data, the breakdown of these emissions among types of processes did not agree. As a result, changes in the inventory for one process at a facility might result in less accurate information for that facility. Therefore, it became necessary to survey the entire facility in almost every case; this resulted in a greatly increased effort for the project.

Questionnaire Design

Two sets of questionnaires, a cover letter, and an introduction were developed for use in the survey. Each facility to be surveyed was sent the cover letter, introduction, and a subset of the questionnaires

TABLE 4-1. Summary of initial approach to Task 2.

SCC	Descriptor	Population of Facilities in SCAQMD	Number of Facilities for which TADs were Obtained	Sample Size of Facilities to be Surveyed	Method of Selecting Facilities to be Surveyed	Summary of Approach
Table 3-10 Recommended Source Types for Study						
Point Source File						
(1) Power Plants						
10100401	Ex Comb Boiler-Elec Gen-#6 Oil Norm Frg	10	3	NA	NA	Obtain temporal data from SCE.
10100501	Ex Comb Boiler-Elec Gen-#1 & #2 Distillate Oil	14	4	NA		
10100601	Ex Comb Boiler-Elec Gen-Natural Gas >100 MMBtu/hr	16	4	NA		
(2) Refineries						
Group 1						
30699999	Petro Industry-Miscellaneous-Not Classified	132	12	17	High Emission Rates	Survey facilities to attempt to characterize sources and estimate emissions.
30699998	Petro Industry-Miscellaneous-Not Classified	13	5	6		
30688801	Petro Industry-Not Classified	5	2	2		
(3) Refineries						
Group 1						
30600805	Petro Industry-Fugitive-Miscellaneous-Sampling/Purging	16	4	4	Random	Survey facilities. Obtain estimates of the numbers of each type of component (e.g., valves, flanges, pump seals, etc.). Collect information on catalytic reformers and vacuum distillation units.
30601301	Petro Industry-Catalytic Reformer-General	10	3	3		
30600803	Petro Industry-Fugutive-Pump Seals w/o Controls	13	4	4		
30600502	Petro Industry-Fugitive-Process Drains-w/o Controls	12	3	3		
30600804	Petro Industry-Fugitive-Compressor Seals	3	1	1		
30600801	Petro Industry-Fugitive-Pipeline-Valves/Flanges	7	2	2		
Group 2						
30600601	Petro Industry-Refining-Vacuum Jet-Vacuum Distillation	7	2	2		
(4) Bulk Plants and Terminals						
Group 1						
40400111	Bulk Terminals-Gasoline RVP10-Floating-67K bbl Standing Loss	2	1	1	Random	Survey facility. Obtain throughput data and data on other parameters on a tank by tank basis from emission fee data and survey results.

NA - Not Applicable. No facilities will be surveyed for these SCCs.

(Continued)

TABLE 4-1 (continued)

SCC	Descriptor	Population of Facilities in SCAQMD	Number of Facilities for which TADs were Obtained	Sample Size of Facilities to be Surveyed	Method of Selecting Facilities to be Surveyed	Summary of Approach
(5) Bulk Plants and Terminals						
Group 1						
40400199	Bulk Terminals-Unspecified	12	4	4	High Emission Rates	Survey facilities to attempt to identify sources and estimate emissions.
(6) Bulk Plants and Terminals						
Group 2						
40600126	Petro Marketing-Gasoline-Tank Trucks-Submerged Loading	21	4	NA	NA	The TADs were reviewed for these source types and a decision was made to exclude them from further examination.
40600101	Petro Marketing-Gasoline Loading-Tank Cars/Trucks	12	3	NA		
40688801	Petro Marketing-Gasoline-Fugitive Emissions	6	3	NA		
40600131	Petro Marketing-Gasoline-Tank Trucks-Submerged Loading	1	1	NA		
40600198	Petro Marketing-Unspecified-Tank Truck Loss	36	6	NA		
40600151	Petro Marketing-Gasoline-Tank Trucks Unloading	5	2	NA		
(7) Surface Coating Facilities						
Group 1						
40299999	Organic Solvent-Coating-Unspecified	1003	50	50	Random	Survey facilities. Evaluate similarities in coatings used, and therefore in emission factors and species profiles, within groups of SCCs and and SICs.
40288801	Organic Solvent-Coating-Fugitive-Unspecified	4	2	2		
40200901	Organic Solvent-Thinning Solvent-General	141	12	12		
40200801	Organic Solvent-Coating-Oven-Unspecified	111	12	12		
40200810	Organic Solvent-Coating-Oven-General	4	1	1		
40200803	Organic Solvent-Coating-Oven-<175 F	50	5	5		
40200802	Organic Solvent-Coating-Oven-<175 F-Unspecified	31	4	4		
40200101	Organic Solvent-Coatings-Paint-Polymeric Hot Air Dried	84	6	6		
40200199	Organic Solvent-Coatings-Not Classified (Paint)	19	2	2		
40200110	Organic Solvent-Coatings-Paint-Solvent Based	4	1	1		
40200102	Organic Solvent-Coatings-Paint-Acetone	3	1	1		

NA - Not Applicable. No facilities will be surveyed for these SCCs.

(Continued)

TABLE 4-1 (continued)

SCC	Descriptor	Population of Facilities in SCAQMD	Number of Facilities for which TADs were Obtained	Sample Size of Facilities to be Surveyed	Method of Selecting Facilities to be Surveyed	Summary of Approach
(7) Surface Coating Facilities (Continued)						
Group 2						
40200701	Organic Solvent-Coating-Adhesive-General	42	4	4	Random	Same approach as described above for Group 1 Surface Coating Facilities.
40200799	Organic Solvent-Coating-Composite	11	2	2		
40200710	Organic Solvent-Coating-Adhesive-General	2	1	1		
40200703	Organic Solvent-Coating-Toluene	1	1	1		
40200501	Organic Solvent-Coating-Enamel-General	151	10	10		
40200599	Organic Solvent-Coating-Composite	31	3	3		
40200510	Organic Solvent-Coating-Enamel-General	6	1	1		
40200504	Organic Solvent-Coating-Toluene	1	1	1		
40200401	Organic Solvent-Coating-General Lacquer	118	8	8		
40200499	Organic Solvent-Coating-Not Classified (Lacquer)	38	3	3		
40200410	Organic Solvent-Coating-General Lacquer	7	1	1		
40200601	Organic Solvent-Coating-Primer-General	55	5	5		
40200610	Organic Colvent-Coating-Primer-General	5	1	1		
40200699	Organic Solvent-Coating-Composite	3	1	1		
40200210	Organic Solvent-Coating-Water-Based Paint-General	2	1	1		
40200301	Organic Solvent-Coating-Varnish/Shellac-General	25	3	3		
40200399	Organic Solvent-General	3	1	1		
(8) Storage Tanks						
Group 1						
40399999	Petro Storage-Unspecified Emission	73	10	14	High Emission Rates	Survey facilities. Obtain throughput data and identify tank contents on a tank by tank basis.
40388801	Petro Storage-Unspecified Fugitive Emission	1	1	1		

NA - Not Applicable. No facilities will be surveyed for these SCCs.

(Continued)

TABLE 4-1 (continued)

SCC	Descriptor	Population of Facilities in SCAQMD	Number of Facilities for which TADs were Obtained	Sample Size of Facilities to be Surveyed	Method of Selecting Facilities to be Surveyed	Summary of Approach
(9) Storage Tanks						
Group 1						
40300199	Petro Storage-Not Classified-Fixed Roof-Working Loss	60	8			The TADs were reviewed for these source types and a dicision was made to exclude them from further examination. This decision was based on the expectation that large sample sizes would need to be surveyed in order to investigate these source types because of the diversity of the tank contents. After further discussion, two of these SCCs were added to the survey: 40300199 and 40301099.
40301099	Petro Storage-Unspecified-Fixed Roof-Working Loss	13	2			
40301098	Petro Storage-Unspecified-Fixed Roof-250K bbl-Breathing Loss	6	1	NA		
40301097	Petro storage-Unspecified-Fixed Roof-67K bbl-Breathing Loss	10	2	NA		
40300198	Petro storage-Not Classified-Fixed Roof-Breathing Loss	42	5	NA		
Group 2						
40300299	Petro Storage-Not Classified-Floating Roof-Standing Loss	24	4	NA		
(10) Storage Tanks						
Group 2						
40300104	Petro Storage-Crude-Fixed Roof Tank-Working Loss	25	3			Survey facilities. Obtain throughput data and other parameters on a tank by tank basis from emission fee data and survey results. After further discussion, these three SCCs were excluded from the survey.
40301010	Petro Storage-Crude RVP5-Fixed Roof-67K bbl-Breathing Loss	35	4			
40300102	Petro Storage-Crude-Fixed Roof Tank-Breathing Loss	18	3			
(11) Storage Tanks						
Group 2						
40300204	Petro Storage-Crude-Floating Roof-Working Loss	22	3	NA	NA	The TADs were reviewed for these source types and a decision made to exclude them from further examination.
40300203	Petro Storage-Crude-Floating Roof-Standing Loss	23	3	NA		
(12) Oil and Gas Production						
31000199	Oil & Gas Production-Crude-Not Classified	68	20	NA	NA	Emission estimates by source type and by production field will be derived using results from the study KVB recently performed for the ARB and other information.
31000299	Oil & Gas Production-Natural Gas-Not Classified	60	20	NA		

NA - Not Applicable. No facilities will be surveyed for these SCCs.

(Continued)

TABLE 4-1 (continued)

SCC	Descriptor	Population of Facilities in SCAQMD	Number of Facilities for which TADs were Obtained	Sample Size of Facilities to be Surveyed	Method of Selecting Facilities to be Surveyed	Summary of Approach
(13) Chemical Manufacturing						
Group 1						
30199999	Chemical Mfg-Fugitive Emissions	353	30	32	High Emission Rates	Survey facilities to attempt to characterize sources and estimate emissions.
(14) Chemical Manufacturing						
Group 2						
30101401	Chemical Mfg-General Paints-Mixing/Handling	4	2	NA	NA	The TADs were reviewed for these source types and a decision made to exclude them from further examination.
30102699	Chemical Mfg-Synthetic Rubber	9	3	NA		
Area Source File						
(15) Asphalt Paving						
AAA46870	Asphalt Paving-Cutback Asphalt Evaporation	Not Applicable to Area Sources				The composition of asphalt products used in the South Coast Air Basin will be investigated.
AAA46888	Asphalt Paving-Road Oil Evaporation					
AAA46904	Asphalt Paving-Emulsified Asphalt Evaporation					
(16) Stationary Internal Combustion Sources						
AAA66787	Internal Combustion-Natural Gas	Not Applicable to Area Sources				The emission factors that are being used for engines that are currently in the inventory will be revised. Engines that are missing from the inventory will be identified and included using various sources of information.
(17) Gasoline Evaporation at Service Stations						
AAA46540	Gasoline Evaporation at Service Stations-Vehicle Refueling	Not Applicable to Area Sources				The activity data, emission factors, and ROG species profiles for these sources will be reviewed and improvements will be investigated.
AAA46565	Gasoline Evaporation at Service Stations-Spillage					

NA - Not Applicable. No facilities will be surveyed for these SCCs.

(Continued)

TABLE 4-1 (concluded)

SCC	Descriptor	Population of Facilities in SCAQMD	Number of Facilities for which TADs were Obtained	Sample Size of Facilities to be Surveyed	Method of Selecting Facilities to be Surveyed	Summary of Approach
(18) Unspecified Emissions						
AAA10108	???????? Unspecified Emissions ????????	Not Applicable to Area Sources				The speciation of emissions from this source may be changed on the basis of our investigation of surface coating point sources. Other than that, this source type will be excluded from further examination.
Other Possible Source Types						
(19) Point Source File						
Power Plants (ROG Speciation Data)						
10100401	Ex Comb Boiler-Elec Gen-#6 Oil Norm Frg	10	3	NA	NA	Existing source test data that includes speciation of ROG emissions will be researched using available literature and through discussions with various individuals.
10100501	Ex Comb Boiler-Elec Gen-#1 & #2 Distillate Oil	14	4	NA		
10100601	Ex Comb Boiler-Elec Gen-Natural Gas->100 mmBtu/hr	16	4	NA		
(20) Miscellaneous Solvent						
49099999	Organic Solvent-Miscellaneous-Unspecified	92	11	NA	NA	The TADs were reviewed for these source types and a decision made to exclude them from futher investigation.
(21) Printing						
40500599	Printing-Ink Thinning Solvent-Unspecified	22	5	NA	NA	The TADs were reviewed for these source types and a decision made to exclude them from futher investigation.
40500501	Printing-Rotogravure-Unspecified	6	2	NA		
40500301	Printing-Flexographic	27	5	NA		
40500401	Printing-Lithographic-Unspecified	14	4	NA		
40500299	Printing-Unspecified	1	1	NA		
(22) Degreasing						
40100299	Organic Solvent-Degreasing-Composite Solvent	832	50	NA	NA	The TADs were reviewed for these source types and a decision made to exclude them from further investigation.
40100399	Organic Solvent-Cold Cleaning-Not Specified	26	5	NA		

NA - Not Applicable. No facilities will be surveyed for these SCCs.

TABLE 4-2. Types of facilities selected for the survey.

Type of Facility	No. of Facilities
Facilities from EIS File	
Surface coating	36
Refinery	14
Chemical plant	6
Petroleum bulk plant/terminal	5
Tire manufacturing	2
Fuel oil pumping	2
Oil production	1
Power plant	1
Lube oil blending	1
Facilities from EDP File	
Surface coating	57
Petroleum bulk plant/terminal	11
Oil production	6
Chemical plant	6
Chemical bulk plant/terminal	5
Surface coating manufacturing	4
Gas processing or compression plant	3
Oil industry research laboratory	1

selected specifically for the individual facility. The cover letter was presented on ARB letterhead and signed by the chief of the ARB Research Division, which was thought to be one of the major reasons that the survey response rate was high. The introduction described the purpose of the survey, the procedures to be used in completing the questionnaires, and provided assistance regarding difficulties that might be encountered.

The first set of questionnaires (forms I-A through I-E) was designed to investigate emission sources currently included in the inventory as well as all emission sources that should have been included. The second set of questionnaires (forms II-A through II-E) was designed to investigate source categories possibly missing from the inventory. The questionnaires were generally based on information contained in the inventory and the SCAQMD emission fee forms, and in many cases were individually tailored to each facility. Appendix A contains the two sets of questionnaires.

Questionnaire Form I-A: Miscellaneous Emissions--This questionnaire was used for the majority of emission sources with nonspecific SCCs (e.g., chemical manufacturing-unspecified, petroleum industry-unspecified, etc.) that orginiated from the EDP file. For these emission sources, the only information contained in the inventory consisted of a permit identification number, a nonspecific SCC, and an emission rate. On the basis of such limited information, it was difficult to formulate well-directed questions.

Questionnaire Form I-B: Surface Coating--This questionnaire was primarily used for facilities involved in surface coating that originated from the EDP file. A two-part approach was taken for these facilities. First, an attempt was made to obtain a complete inventory of all organic materials used at the facility in 1979. Second, each source included in the inventory was investigated. As with Form I-A, the questions were general in nature since a permit identification number and an SCC were the only means of identifying the source of interest.

Questionnaire Form I-C: Facility-Specific Questions--This form was used to ask a variety of specific questions developed with the intent of identifying a complete emission inventory for the surveyed facility. If the facility consisted of well-defined sources, the questions were quite specific.

Questionnaire Form I-D: Emissions from Storage Tanks--This form was specifically directed at entries in the inventory with SCCs for storage tanks with unspecified contents. In general, this form was used for facilities from the EDP file. Therefore, the information in the survey response included both the specification of the contents of the tank and an emission estimate representative of 1979.

Questionnaire Form I-E: Surface-Coating-Facility-Specific Questions--This questionnaire was similar to Form I-B except that it was used for facilities from the EIS file rather than from the EDP file and consisted of two parts. The first part was used to obtain a complete inventory of all organic materials that were used by the facility in 1979; the second contained specific questions that usually involved more detailed identification of an organic material or concerned a control system at the facility.

Questionnaire Form II-A: Fugitive Emissions--This form was directed toward estimating fugitive emissions from various components (e.g., valves, pumps, compressors, etc.) that contain organic materials.

Questionnaire Form II-B: Emissions from Vacuum Trucks--This form was used to identify facilities that used vacuum trucks to transfer organic materials in 1979. Information that would assist in estimating emissions from this activity was requested.

Questionnaire Form II-C: Emissions from Storage Tank Cleaning--This form was used to identify facilities that cleaned storage tanks during 1979 and to request information that would assist in estimating these emissions.

Questionnaire Form II-D: Emissions from Industrial Solvent and Surface Coating Use--This form was directed toward estimating emissions from solvent and surface coating use at facilities whose primary business was unrelated to these activities (e.g., refineries, bulk plants, and chemical plants).

Questionnaire Form II-E: Stationary Internal Combustion Engines--This questionnaire was used to identify stationary internal combustion engines at all of the facilities in the survey and requested information that would allow the estimation of these emissions for 1979.

Survey Procedures

Initial Contact

Five of the 161 facilities had recently been surveyed by Science Applications, Inc. as part of an ARB study of solvent use and were therefore dropped from the survey. For facilities from the EIS file, the company name, facility address, and a contact name generally existed in the inventory. For facilities from the EDP file, the company name and facility identification number were the only identifying information in the inventory. The facility identification number for EDP facilities is

not used for external correspondence with companies, and company personnel were therefore not familiar with these numbers. As a result, companies with multiple facilities were unable to use these identification numbers to determine which of their facilities were being surveyed.

With this information as a starting point, an attempt was made to determine an address, telephone number, and contact name for each of the facilities using the following sources of information.

The 1982 California Manufacturers' Register published by Times Mirror Press

The 1983 U.S.A. Oil Industry Directory published by Penn Well Publishing Company

Telephone directories

The SCAQMD permit files.

Once a facility phone number was identified, an initial call was made to identify the individual who would receive the survey. This call was also used to confirm or obtain an address to which the survey would be sent. These initial phone calls were believed to be another reason for the high response rate obtained in the survey; by identifying an individual accountable for completing and returning the survey, the probability of obtaining responses was greatly improved.

However, two problems occurred during these initial contacts. The first problem related to the identification of certain facilities for firms such as oil companies with numerous facilities. One method of identifying such facilities was through the equipment permit identification numbers. However, in some cases, we found that the permit identification numbers contained in the inventory were not valid; as a result, it became more difficult to identify some facilities. A second difficulty concerned a number of facilities that were temporarily or permanently out of business and therefore could not be surveyed. In some cases, changes for these facilities were still made on the basis of emission fee data or other information.

Follow-up Methods

Within one month of sending the questionnaires, each facility that had not yet responded was called. During these calls, questions posed by the facility contact were answered and a schedule was set for completion of the questionnaire. Approximately once a month for the following two

months a series of calls were placed to facilities that still had not responded to the survey. The intent of these calls was to obtain a survey response as soon as possible. Approximately four months after the questionnaires were sent a final set of calls was made. During these calls attempts were made to obtain answers from the facility contact to key questions over the phone, if possible. As a result of this extensive survey follow-up, facilities that did not respond to the survey were contacted over 10 times before efforts to obtain a response were discontinued.

Most Frequently Asked Questions

The survey resulted in numerous questions from individuals at the selected facilities. A review of some frequently asked questions provides two types of information. First, the problems encountered in responding to the questionnaire provide some insight into possible shortcomings in the data that were provided. Second, these same problems provide insight into ways in which questionnaire and survey design can be improved. The following questions were asked most frequently.

> Why is the survey being performed for 1979 and what do we do if 1979 data are no longer available?
>
> What is the purpose of this survey?
>
> The cover letter indicates that the questionnaire must be returned in 10 days. When do we actually have to return it?
>
> How can we identify the facilities to which the questionnaires apply?
>
> How can we identify the equipment to which the questionnaires apply?

In general, the last two questions caused the greatest confusion because, in many cases, the only information in the questionnaire that could be used to positively identify the equipment or facility being surveyed was the permit identification number. Therefore, the use of permit identification numbers to identify equipment and facilities needs to be clearly stated in designing these types of questionnaires.

Summary of Survey Responses

A description of survey responses and the reasons why responses were not obtained for some of the original 161 facilities is presented in Table 4-3. We were unable to obtain responses for 25 facilities. For 20 of

TABLE 4-3. Summary of survey responses.

Response Characterization	No. of Facilities
Returned completed survey	112
Completed by telephone	10
Not deliverable or facility closed	17
Facility changed ownership--1979 records not available	3
Surveyed by Science Applications	5
No response	14

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these facilities, the questionnaire was not deliverable, the facility was closed, or the facility had changed ownership and 1979 records were not available. The other 5 facilities were not sent surveys, as noted, because they had recently been surveyed as part of another study.

Of the 136 facilities that could have responded to the survey, 122 facilities responded. This represents a 90 percent survey response which is considered to be quite high. This high survey response appears to be the result of

The initial facility contact to identify a responsible individual prior to sending the survey.

The use of a cover letter on ARB letterhead.

The comprehensive survey follow-up.

INVESTIGATION OF SYSTEMATIC ERRORS AND WEAKNESSES IN THE INVENTORY

In addition to the survey of facilities, the approach we designed to improve the emission inventory included other investigations described in the following paragraphs.

Review of Existing Information on Systematic Errors and Areas of Weakness in the Inventory

Both source-specific and systematic problems with the inventory were explored in the project. Source-specific problems are related to specific types of sources; investigation of such problems was intended to improve the 1979 MED inventory. Systematic errors, on the other hand, are biases in the inventory that represent broad types of errors that might affect several source categories. The major emphasis in Task 2 was on investigating source-specific errors. Systematic errors were primarily identified for informational purposes rather than to effect specific changes to the data in the inventory or in EDS.

Three sources of information on systematic errors and areas of weakness in the inventory were reviewed:

(1) The ARB's comments on areas in the emission inventory that were considered weak or in need of improvement as described by R. Tate of ARB in a 3 December 1982 letter.

(2) Chapter IV of the SCAQMD Technical Paper No. 1, "Overview of Methods Used to Develop 1979 Emission Data for the 1982 AQMP Revision," 1 December 1980.

(3) Chapters II and IV of "Appendix No. IV-A: Final 1979 Emission Inventory for the South Coast Air Basin, Air Quality Management Plan, 1979 Revision", July 1982.

From our review of these three sources of information, we developed the following summary list of areas to be examined in greater depth, many of which were subsequently addressed during the study:

Stationary internal combustion engines that were exempt from permitting were not included in the point source file of the inventory. An estimate of these emissions was made by the ARB and entered into the area source file under CES 66787. The emission estimate and spatial allocation of these emissions appeared questionable.

Fugitive organic gas emission estimates for oil and gas production were made using uncertain emission factors in conjunction with oil and gas production rates for each field; thus these emission estimates were also uncertain.

In many cases, the breakdown of emissions by SCC for facilities from the EIS file was not current or accurate. The specification of most SCCs was developed for EIS facilities in 1976 and 1977 (often by students) using data from engineering files. The total facility emissions were subsequently revised to represent 1979 conditions, but the breakdown of these emissions by SCC appeared to be inaccurate.

Emissions from storage tanks were calculated using equations that were now out of date. Revised equations from AP-42 were expected to result in more accurate emission estimates.

The temporal distribution of emissions from some large sources such as power plants had not received special treatment.

The information for facilities from the EDP file was not considered to be accurate or representative of 1979 conditions. In general, this information was updated only when a permit was modified or when special survey data were incorporated into the system.

Emissions from sources operating under known rule violations and equipment operating under variances were not included in the inventory.

There were inconsistencies in the derivation of emission factors for organic gases. Emission factors had been developed for HC, volatile

organic compounds (VOC), TOG, or ROG; however, it was not clear which of these classes of compounds were represented by a given emission factor. As a result, the speciation profile used for a source might not be consistent with the emission factor in terms of organic compounds (e.g., aldehydes, methane, ethane, etc.).

There were few test data on which to base the assignment of species profiles to source categories. In many cases, assignment was based on a similarity in processes rather than on actual data covering the species emitted.

The approach that was used to address systematic errors consisted of three types of activities: (1) survey and investigation of selected facilities, (2) investigation of selected source categories, and (3) review of species profile development and assignment.

Survey and Investigation of Selected Facilities

This activity was designed to address weak areas in the inventory that included

Revision of the breakdown of emissions by SCC for each of the selected facilities.

Revision of emissions from storage tanks to represent the most recent storage tank emission equations for each of the selected facilities.

Revision of information on facilities from the EDP file to represent 1979 conditions.

Review of data contained in the SCAQMD emission fee forms on emissions from upset/breakdown conditions and emissions from operations under variance.

The investigation of selected facilities also examined missing source categories and double counting of sources.

Missing Source Categories

Facilities were surveyed to determine if the following source categories existed, but were not included in the inventory.

Fugitive emissions from valves, pumps, compressors, etc.

Vacuum trucks

Storage tank cleaning

Industrial solvents and surface coating

Stationary internal combustion engines

Double Counting of Sources

In general, all types of double counting were investigated. As the project proceeded, these investigations centered on facilities that had been entered into the inventory from both the EIS and EDP files.

Investigation of Selected Source Categories

These investigations were performed to address specific areas in the inventory. They included

A detailed evaluation of emissions from stationary internal combustion engines.

Revisions to emission estimates for oil and gas production.

Development of a diurnally varying temporal profile for power plant emissions.

Species Profile Development and Assignment

This work addressed the speciation of TOG emissions and is described in Section 5; it consisted of the development of new profiles through testing and the use of existing data. An effort was also made to assign the most appropriate profile to each source category.

INVESTIGATION OF SELECTED SOURCE CATEGORIES

Three source categories were selected for in-depth investigation in addition to the survey of selected facilities:

(1) Power plants--Information on the temporal distribution of power plant emissions in the SOCAB was obtained and evaluated to develop a diurnal operating profile.

(2) Stationary reciprocating internal combustion engines--Emissions were reallocated from the area source file to the point source

file to improve the accuracy and spatial distribution of the emission estimates.

(3) Oil and gas production--The existing fugitive TOG emission estimates, which were based on an emission factor and the production rate for each field, were replaced by emission estimates from a recent ARB study. For oil and gas fields with large emission rates, detailed estimates were entered into the inventory by source category. For other fields, a single emission estimate for each field was entered.

Power Plant Temporal Data

Because the original power plant NO_x emission estimates were practically equal from hour to hour, a new diurnal profile was developed for emissions from external combustion sources at power plants in the SOCAB. This temporal profile was developed from continuous-emission monitoring data for NO_x emissions from Southern California Edison (SCE) plants in the Basin. Because emissions from SCE's facilities make up the majority of emissions from power plants in the SOCAB, the profile was applied to the emissions of all pollutants for each facility with the SIC/SCC combination 4911/1-01-XXX-XX in the inventory.

Hourly NO_x emission data were obtained for June, July, and August of 1979 for each of SCE's SOCAB power plants. To develop a profile for an average summer weekday, over 5000 hourly data points for weekday operations were averaged. Every third weekday was included in the analysis, which insured that each weekday was weighted equally. Therefore, the temporal profile consisted of average hourly NO_x emissions from weekday operations by SCE plants in the Basin. Daily emissions for individual power plant stacks were unchanged; the revision resulted in only a new diurnal profile. The resulting temporal profile is shown in Figure 4-1.

Stationary Reciprocating Natural-Gas-Fired Internal Combustion Engines

Need for Revisions to the Inventory

An ARB survey of stationary internal combustion (IC) engines indicated that NO_x emissions from gas-fired IC engines in the SCAQMD point source data base were underestimated due to the following four types of occurrences.

(1) Several facilities with stationary IC engines were not contained in the SCAQMD point source data base.

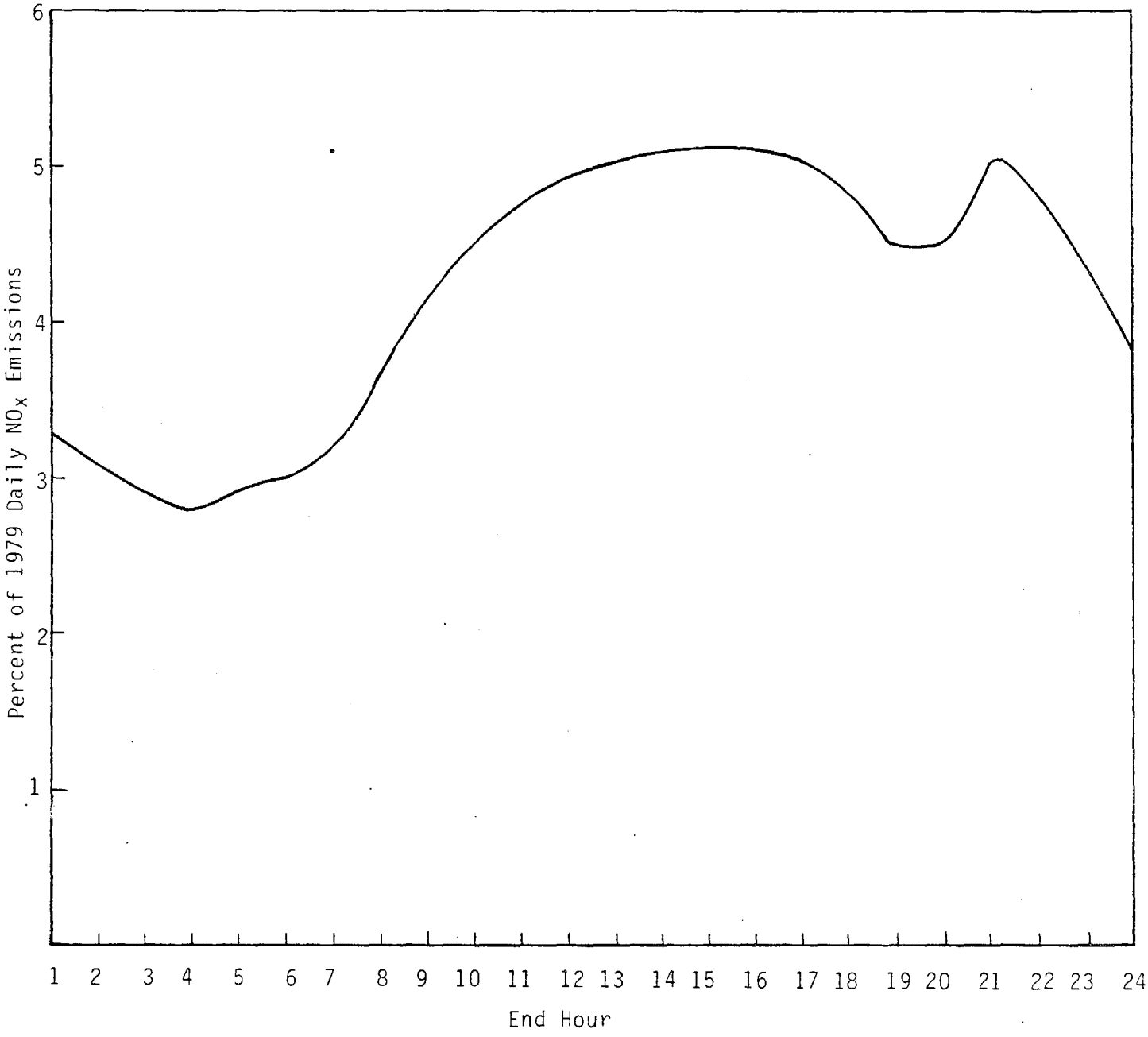

FIGURE 4-1. Diurnal profile developed for power plants in the inventory.

(2) Some facilities with stationary IC engines were in the point source data base, but no IC engines were listed for the facility.

(3) Total fuel use for gas-fired IC engines in the point source data base was lower than in the ARB survey.

(4) The average NO_x emission factor used in the SCAQMD data base was lower than the factor used by the ARB.

As a temporary solution to the underestimation of emissions, an area source category was previously developed for the remaining NO_x emissions and assigned CES number 66787, as documented in an ARB technical note dated 2 February 1983. We developed a more comprehensive solution by entering emissions from as many IC engines as possible into the point source file of the inventory. This resulted in a more accurate spatial emission distribution as well as a more accurate estimate of total emissions from this source category.

Development of Emission Factors

The first step in improving the estimates for this source category was to review the ARB survey to determine the engine manufacturers and models involved. Various literature sources were then reviewed to determine the most appropriate NO_x emission factors for these engines. These literature sources included

EPA Publication No. AP-42--"Compilation of Air Pollutant Emission Factors."

A document prepared by Engineering-Science for Southern California Edison--"Evaluation of CARB Proposed NO_x Emission Standards for Stationary Internal Combustion Engines."

A recent report prepared for an ARB research contract--"Emission Characteristics of Crude Oil Production in California."

On the basis of a review of the data contained in these documents, different emission factors for several types of engines were identified. However, the use of several different emission factors in the inventory posed certain problems. First, some categories of emission factors were based on limited data, and thus might not be representative. Second, the improved accuracy of using several emission factors for IC engines in

the inventory might not justify the increased complexity of this approach. As a result, only two categories of emission factors were developed:

(1) An emission factor of 640 pounds of NO_x per million standard cubic feet of gas (lb $NO_x/10^6$ SCF) was applied to small engines (less than 300 horsepower) used to drive oil well pumping units. Small engines tend to be less efficient and therefore have lower NO_x emission factors. Moreover, these engines are normally operated at less than 50 percent of load, which results in substantially lower NO_x emission factors. This emission factor was developed on the basis of source test data from an ARB study of emissions from crude oil production operations in California (KVB, 1983).

(2) An emission factor of 3400 lb $NO_x/10^6$ SCF was used for all other engines. This is the most widely accepted NO_x emission factor for IC engines and is contained in AP-42.

Procedure for Modifying the Inventory

The main source of information used to change the inventory was a 1979 ARB survey of emissions from stationary IC engines. The responses to this survey were obtained from the ARB and organized by facility. These data were then reviewed and compared to the contents of the 1979 inventory. On the basis of this review, three conditions were identified, each of which required a special approach to changing the inventory.

(1) Facilities in the inventory that include emissions from stationary gas-fired IC engines.

(2) Facilities in the inventory that do not include emissions from IC engines.

(3) Facilities not identifiable as being in the 1979 inventory.

Prior to modifying the inventory for IC engines, all revisions for facilities that were surveyed were made to the inventory. Using the modified inventory as a baseline, the emissions from stationary gas-fired IC engines were reviewed on a facility-by-facility basis. The contents of the inventory were compared with the results of the ARB survey and with available 1979 emission fee data to select the most appropriate emission estimate for these engines. This estimate was then entered into the point source file either by modifying emissions for an existing device or by adding emissions for a new device. This process resulted in the modification or addition of 24 devices to the inventory. These changes are presented in Appendix B together with documentation for the revisions.

None of the remaining facilities in the ARB survey of IC engines could be identified in the point source file. Total emissions from these 34 facilities or combinations of facilities were therefore estimated and included as an area source under CES 66787. The identification of these facilities and documentation of the emission estimates are also presented in Appendix B.

Oil and Gas Production

Reasons for Changes to the Inventory

The original emission estimates for oil and gas production in the 1979 inventory were estimated by production field. The emission estimates were developed through use of the total oil and gas production rates for each field together with EPA emission factors for fugitive HC emissions. There were several reasons why this approach to estimating emissions from oil and gas production could be improved.

Large variations exist in the types and numbers of emission sources that comprise oil production fields. Therefore, emissions from oil and gas production should be based on data for specific types of sources.

The types and numbers of sources that make up oil production fields in the SOCAB are significantly different from those in other United States oil fields. Therefore, relevant information applicable to sources in the United States, such as the EPA fugitive emission factors, may not be applicable to oil and gas production in the SOCAB.

Information Used to Modify the Inventory

The primary basis for modifying the inventory was information obtained from an ARB research study (KVB, 1983). The emission estimates from this study were used with some modification; however, two limitations to these estimates should be noted.

Storage tanks--The KVB study used data from Ventura County to develop a number of storage tank emission models based on well populations and gas-to-oil ratios. Because this method may be inaccurate for storage tank emissions, a new ARB survey of emissions from oil production storage tanks now underway should represent a significant improvement in the emission estimates for this source category.

Sumps--The KVB study developed models that estimated sump surface area on the basis of well population. The correlation between sump surface area and well population for the oil field models was inadequate, resulting in inaccurate sump emission estimates.

The total emission estimates for all source categories by field are presented in Table 7.2-2 of the final report (KVB, 1983). These emission estimates were also broken down by source category. However, the estimates for each source category in a field were only available from the draft report of the study. Between the draft and final stages of the study, changes were made to the emission estimates for sumps and pits. Therefore, to use the emission estimates by source category, the sump and pit emission estimates had to be adjusted. Separate adjustment factors were developed for Los Angeles and Orange counties, as shown in Table 4-4. By applying these adjustment factors to the draft sump and pit emission estimates, estimates that were consistent with those of the final report were obtained.

Procedure for Modifying the Inventory

Prior to modifying the emission inventory for oil and gas production, all revisions to the inventory for surveyed facilities were made. This modified inventory then served as a baseline for changes specifically related to oil and gas production. The first step was to eliminate potential double counting of emissions from oil and gas production in the point and area source files of the inventory. Double counting might occur because the point source file contained some fugitive emissions from oil and gas production. Therefore, if the emission estimates from the ARB study of oil and gas production--which were intended to represent all fugitive emissions from this source category--were simply entered into the file, then double counting of emissions would occur. It was therefore necessary to subtract the emissions that existed in the point source file from the results of the ARB study prior to entering the new emissions into the file.

To identify all fugitive TOG emissions from oil and gas production in the point source file, a listing of all emissions with SIC 1311 (crude oil and natural gas extraction) was generated. After these estimates were reviewed and the fugitive TOG emissions identified, two types of sources--combustion activities and gas processing plants--were excluded. This step was taken because these two source types were contained in other portions of the inventory--in the point source file for gas processing plants and in the point and area source files for combustion activities. The remaining fugitive emissions were then subtracted from the ARB study results. This adjustment took place in two steps.

TABLE 4-4. Development of adjustment factors for sump and pit emission estimates.

Information	Sump and Pit Emissions (Metric Tons/Year)	
	Los Angeles County	Orange County
Total emissions from detailed sheets (draft stage of study)	5211.7	5028.8
Total emissions from final report	2232.0	1932.9
Adjustment factor to be applied to detailed sheets	0.4283	0.3844

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(1) For point source file entries that could be identified with a specific field, fugitive emissions were subtracted from the appropriate oil and gas production field. Because the majority of emissions that existed in the point source file were breathing losses from storage tanks, emissions were subtracted from this source category in the ARB study results. The amount of emissions that were subtracted is presented in Table 4-5.

(2) For point source file entries that could not be identified with a specific field, adjustment factors were developed to subtract these emissions from the ARB study results. The first step in developing these adjustment factors was to total the point source TOG emissions for entries that could not be identified with a specific field. These totals were

Los Angeles County: 249.0 tons/year;

Orange County: 4.5 tons/year.

Because the emission total for Orange County was insignificant, no adjustment factor was developed for that county. The next step was to determine the amount of fugitive TOG emissions from oil and gas production in Los Angeles County to be adjusted. This amount was determined from Table 7.3-3 of the report and was 12,575.5 metric tons/year (or 13,864.5 tons/year). Therefore, the adjustment factor for Los Angeles County was:

$$\frac{13,864.5 - 249.0}{13,864.5} = 0.9820$$

This factor was applied to all fugitive TOG emissions from oil and gas production in Los Angeles County that were entered into the point source file of the inventory.

Once these adjustments were made, the emission estimates from the ARB study were ready to be entered into the point source file. Emission estimates were entered by source category for some fields and as total emissions for other fields. All fields that had TOG emissions greater than 500 metric tons/year (as listed in Table 7.2-2 of the report) were entered into the inventory by detailed source type. Total fugitive TOG emissions from the other fields were entered as single numbers in the same manner as in the original inventory. To enter emissions by source type, SCCs were assigned to each of the processes in the ARB study. A list of the SCC assigned to these processes is presented in Table 4-6.

TABLE 4-5. Fugitive TOG emissions subtracted from ARB study results by field.

Field	TOG Emissions (tons/year)
Brea Olinda (Los Angeles County)	31.0
Castaic Hills	2.1
Honor Rancho	31.5
Inglewood	8.0
Long Beach	22.0
Montebello	3.6
Rosecrans	15.8
Sansinena	4.3
Venice Beach	0.8
Wilmington	21.2

TABLE 4-6. Assignment of source classification codes to process names.

SCC	Process Name
4-04-003-01	Tank breathing losses
4-04-003-02	Tank working losses
3-10-001-21	Well cellars
3-10-001-22	Sumps and pits
3-10-001-01	Valves
3-10-001-04	Fittings
3-10-001-11	Well heads
3-10-001-07	Pumps
3-10-001-08	Compressors
4-04-003-01	Tank breathing loss with vapor recovery
4-04-003-02	Tank working loss with vapor recovery
3-10-001-31	Mechanical oil water separator

The final step for oil and gas production emissions involved special treatment of several oil fields. These fields were either present in the original inventory, but not in the ARB study or vice versa. The specific ways in which these oil fields were handled are as follows:

The Canton Creek oil field emission estimate from the ARB study was entered as facility 100155 in Los Angeles County.

The Kraemer oil field emission estimate from the ARB study was entered as facility 100213 in Orange County.

The Los Angeles City oil field, which was in the original inventory but not in the ARB study, was deleted from the inventory. It was assumed that the emissions from this field were accounted for by other fields in the ARB study.

Grid cell locations were identified by reviewing various maps. They were entered into the inventory for two fields new to the inventory and for nine other fields listed in EDS, but not contained in the MED files because the original kilogram/hour emission estimates were zero. These fields are shown in Table 4-7.

In summary, new TOG emission data were entered into the MED inventory for 68 oil and gas production fields. For 13 fields with TOG emissions greater than 500 metric tons/year, detailed entries were made to the inventory using the SCCs in Table 4-6. In the case of nondetailed entries, SCC 3-10-888-01 was used; TOG emissions for up to three CES codes for each field were replaced with a new estimate using this SCC. Changes were made to the TOG estimates only in the point source file. Any emissions other than TOG were retained in the MED file for fields undergoing TOG revisions. In addition, begin and end hours used in the inventory were always 0 and 23 for the new TOG estimates. Finally, no changes were made to the original inventory for fields in Riverside and San Bernardino counties.

One revision to the inventory had a major effect on TOG emissions from a single oil field. Approximately 27.1 tons/day of TOG--representing about 20 tons/day of ROG--had been incorrectly assigned to a grid cell in Orange County in the original inventory. This value was an overestimate of emissions from operations in the Yorba Linda oil field (identification code 100211), and resulted from the use of an incorrect emission factor. This emission estimate, representing about 50 percent of the 1979 ROG emissions from the petroleum production sector, was revised to approximately one-tenth of its original value.