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THE CHEMISTRY, DISPERSION, AND TRANSPORT OF AIR POLLUTANTS EMITTED FROM FOSSIL FUEL POWER PLANTS IN CALIFORNIA

GROUND LEVEL POLLUTANT MEASUREMENT AND ANALYSIS

FINAL REPORT

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ABSTRACT

A study of electric power plant plumes sponsored and managed by the California Air Resources Board was conducted by seven contractors in the fall of 1974. Field data were collected between late morning and evening on three days in the relatively clean Monterey Bay area, and six days in the South Coast Air Basin (SCAB), which contains Los Angeles. This report analyzes the dispersion and chemistry data with emphasis on the ground impact of the plumes. On the six days in the SCAB, a well-defined plume followed the same trajectory each afternoon, and it was difficult to distinguish after passing over the Puente Hills 39 km (24 mi) from the plants. One day near Monterey the plume remained above the inversion. Ground level impacts of the primary pollutants in the plumes were well below air quality standards. The dominant chemistry in the plumes was the mixing of NO with ambient ozone to produce NO_2. There was no evidence of photochemical conversion of NO to NO_2 in the first 19 km (12 mi or 1.5 hr), nor of sulfate formation from SO_2. A SO_2 oxidation rate of 2% hr^{-1} would have been clearly measurable. Nitrate concentrations in the SCAB plumes were below background concentrations when the background sulfate concentrations were low.

1.0 ACKNOWLEDGEMENTS

Gary Palo and Charles Bennett of the California Air Resources Board staff made many of the arrangements for this study and coordinated the work of the seven independent, participating contractors. Their work, plus the work and cooperation of the individuals mentioned in the eight final reports from this study contributed significantly to its success. It is also a pleasure to thank the Pacific Gas and Electric Company, Southern California Edison, and the City of Los Angeles Department of Water and Power for their participation and cooperation.

At the Air Monitoring Center, Kathy Kubler, David Dockweiler and Jack Gysbers assisted in the data reduction, and Beverly White typed the report. We also wish to thank John Maloney and Ed Munson of the Monterey Bay Unified Air Pollution Control District for assisting with arrangements near Moss Landing, and Wayne Zwiacher of the Los Angeles Zone of the Southern California Air Pollution Control District for assistance in obtaining emission rate data.

2.0 CONCLUSIONS

2.1 PLUME TRANSPORT AND DISPERSION

During the early afternoon hours, when the majority of the data were taken on the six test days in the South Coast Air Basin, it was found that:

2.1.1 A well defined plume extended from the Haynes Steam Plant and the Alamitos Generating Station to the northeast over Fullerton and toward the Puente Hills. At the Santa Ana Freeway, which is 15 km (9 mi) downwind from the sources, the crosswind standard deviation of the plume was 1046 m on the average. Thus, 90% of the ground level impact of the plume was on the average contained in a crosswind distance of 3½ km (2¼ mi).

2.1.2 The plume was well mixed to the ground by the time it reached the Santa Ana Freeway, so the ground level concentrations of sulfur dioxide and nitrogen oxides were approximately the same as those aloft.

2.1.3 The location of the plume between the source and the Puente Hills was the same on each of the six test days to a remarkable degree. Two ground stations 2.8 km (1.7 mi) apart in Fullerton and Anaheim observed plume impacts differing by a factor of three. In seven crosswind traverses on the Santa Ana Freeway on five test days in which SF_6 tracer was measured, it was found that the location of the maximum plume impact was within a 6½ km (4 mi) wide zone.

2.1.4 The dispersion of the plume was significantly increased on passing over the Puente Hills.

2.1.5 The SF_6 tracer data strongly suggest, but do not prove, that the plume was present in Pomona on all test days, and in either San Bernardino or Riverside on nearly all test days. At these inland locations, the plume is well mixed with the emissions from other sources, hence its presence cannot be deduced from SO_2 and NO_x data alone.

2.1.6 At times other than the early afternoon, the plume is observed less frequently or not at all at the ground stations. Most observations of the plume at the ground stations in Fullerton and Anaheim occurred between 10:00 a.m. and 5:00 p.m., and all occurred between 8:00 a.m. and 9:00 p.m.

2.1.7 The plume transport and dispersion observed on three test days near Moss Landing were more variable. On one day, the plume was above a stable inversion and produced negligible impact at the ground station network. The plume trajectories on the other two days were appreciably different from each other.

2.2 PLUME CHEMISTRY

The following conclusions are based on data taken within 19 km (12 mi) of the source, and hence apply only to this part of the plume.

2.2.1 A mathematical model describing the conversion of the emitted NO into NO_2 due to the mixing of the plume with ambient ozone has been developed and used to show that this process accounts for the NO, NO_2 and ozone concentration profiles to a distance of 16 or 19 km (10 or 12 mi). No evidence was found that photochemical oxidation of NO in the plume is important.

2.2.2 The sulfate concentrations observed in the plume on the ground to distances of 17 km (11 mi) were equal to those calculated with the aid of the SF_6 tracer data from the rate of sulfate emission at the sources. There was no evidence for additional sulfate formation in the plumes during the first 1.5 hr in the atmosphere.

2.2.3 It was observed that the chemistry of the plume caused some of the nitrate to be removed from the ambient aerosol mixed into the plume.

2.2.4 Vanadium concentrations in the plume were barely above the limit of detection, and were approximately those expected if the majority of the vanadium in the fuel were emitted.

2.3 PLUME IMPACT

2.3.1 The ground level impacts of the plumes calculated from the emission rates and the observed SF_6 tracer concentrations are well below the one-hour and 24-hour standards for SO_2 and NO_2.

2.3.2 During the afternoon when the impact is at a maximum, the plumes studied in the South Coast Air Basin contributed 50 to 70% of the total SO_2 observed in Fullerton and Anaheim, 40% of the SO_2 in Pomona, roughly 20% of the total SO_2 in San Bernardino, and 7% in Riverside. The plumes contributed 7% of the total NO_x in Pomona. These locations are directly in the path of the plume; locations on either side of this path show a much smaller impact.

3.0 RECOMMENDATIONS

In the South Coast Air Basin, estimates and projections of the impact of the two power plant plumes between the sources and the Puente Hills should be based on plume dispersion calculations which fit the transport, dispersion, and chemistry data outlined in the preceeding section. The impact between the Puente Hills and San Bernardino is best estimated from emission inventories of the portions of the Basin which contribute pollutants to this region.

The finding that few chemical processes occur in the plume in the first 19 km (12 mi) of travel during the afternoon should not be applied to times or places beyond the scope of this study. In particular, it is known that the pollutants in the plume will participate in the formation of oxidant and sulfate, and perhaps nitrate, in the inland regions where the plume is well dispersed. It is also possible that the chemistry will be different in the portion of the plume carried out over the ocean where the humidity is higher by the air drainage which occurs most nights.

4.0 INTRODUCTION

The early actions of the air pollution control districts in California led to important reductions in the emissions from stationary sources, with the result that the automobile became the dominant source of pollutants leading to photochemical smog. Therefore, the focus of attention shifted to controlling the emissions from the automobile and other mobile sources, and has remained there until recent times. However, attention is now shifting back to stationary sources because of the reductions in automotive emission rates now taking place and the increases in stationary source emissions caused by the lack of availability of natural gas. If the curtailment of supplies of clean fuels such as natural gas continues as projected, the emissions from stationary sources will grow rapidly in importance compared to emissions from mobile sources, and may surpass them in importance in a few years.

Because of these trends, the California Air Resources Board sponsored a field study of fossil fuel power plant plumes in the late summer and early fall of 1974. Plants in coastal locations were selected because many generating stations in California are sited along the coast, and the meteorological conditions there are different from those in which most previous plume studies had been carried out. This program was designed to study the chemistry of the plume as well as its transport and dispersion. To explore the range of conditions found along the coast, power plant plumes were studied near Monterey Bay, which is a relatively clean environment, and in the South Coast Air Basin, where plumes sometimes become mixed with relatively high levels of photochemical smog.

The study was conducted by the ARB staff and seven independent, cooperating contractors, each reporting directly to the ARB. This Final Report is one of eight which, when taken together, form the complete report on this program. The participating contractors and their responsibilities are listed below with reference to their final reports:

Air and Industrial Hygiene Laboratory (AIHL), California Department of Public Health performed the chemical analysis of the filter samples collected on the ground and in the air (1).

Air Monitoring Center (AMC), Rockwell International, measured sulfur dioxide concentrations and collected two-hour filter samples for analysis by AIHL at ten ground stations. The AMC was also responsible for estimating the emission rates of the untested stacks at the participating power plants, and analyzing all the ground level data.

California Air Resources Board (ARB) supervised and coordinated the program, and conducted source tests at the Moss Landing Power Plant (2).

California Institute of Technology (Caltech) released sulfur hexafluoride tracer into one stack at each plant, and measured its concentration at 15 to 19 ground stations downwind as well as on mobile traverses. Caltech also analyzed the SF_6 samples collected by the airplane (3).

Environmental Measurements, Inc. (EMI) operated a mobile laboratory equipped with correlation spectrometers to measure the overhead burden of sulfur dioxide and nitrogen dioxide, as well as instruments to measure ground level concentrations of SO_2 and NO-NO_x (4).

Los Angeles County Air Pollution Control District (now part of the Southern California Air Pollution Control District) conducted source tests at the Haynes Steam Plant and the Alamitos Generating Station (5).

Meteorology Research, Inc. (MRI) flew an airplane to make airborne measurements of meteorological conditions and several trace gases, and to collect SF_6 tracer samples and filter samples for analysis by AIHL. MRI released pibals, and was responsible for the meteorological forecasting and analysis, and the analysis of the airborne data (6).

Systems Applications, Inc. (SAI) is constructing a model based on the data from this study to assess the impact of stationary source plumes on air quality for other plant locations, operating conditions, and meteorological conditions (7).

Experiments were conducted on three consecutive days in September 1974 near the Monterey Bay, and on six non-consecutive test days, between 1 October and 7 November 1974, in the South Coast Air Basin. The activities of the cooperating contractors were coordinated, so that on most test days all participants were collecting data simultaneously. The focus of the study was on the afternoon sea breeze conditions, when the direct inland impact of these plumes is at a maximum. The SF_6 tracer release usually continued between 10:00 a.m. and 5:00 p.m., and most of the field data were taken during the afternoon.

The use of SF_6 as a tracer made it possible to observe the transport and dispersion of the plumes from the participating power plants in the presence of emissions from other sources. It also made it possible to obtain information about the chemical transformations in the plume. By comparing the ratio of the concentration of a chemical species to the SF_6 concentration in the field with the ratio in the stack, it is possible to determine whether chemical processes tend to form or consume that species in the plume. In this calculation, the contribution of other sources to the concentration in the plume of the species of interest must be taken into account.

The chemical process of primary interest in this study is the conversion of sulfur dioxide into sulfate, but the program was designed to study other chemical processes, such as the conversion of NO into NO_2. The analysis of the ground filter samples included the use of x-ray fluorescence to determine the concentration of 18 elements, including sulfur and vanadium, so that the elemental composition of the background aerosol and the presence of trace metals in the plume could be observed.

This report contains the results obtained by the Rockwell Air Monitoring Center from its participation in this cooperative program. The immediately following sections of this report contain a description of the preparations and field operations related to the responsibilities of the AMC. The next sections contain the data which were obtained. Appendices A and B contain the data from the source tests by the ARB and the Los Angeles County APCD, which are not otherwise contained in one of the six major final reports for this program. Subsequent Appendices contain data from other contractors which are extensively used in this report. The remainder of the report is an analysis of these data.

5.0 PREPARATIONS

5.1 POWER PLANT SELECTION AND SCHEDULING

The plant in the clean coastal environment which participated in this study was the Moss Landing Power Plant of Pacific Gas and Electric Company. It is located approximately in the center of the arc which forms Monterey Bay, and is described in Appendix A. The arrangements with all power plants participating in this study were made by the staff of the Air Resources Board. For the Moss Landing part of the program, it was agreed that the tests would be conducted on three successive days selected a week in advance, during which Units 6 and 7 would be operated at full load. On the first two test days these units burned fuel oil, and on the last day they burned natural gas. The other units of the plants burned gas on all test days.

The Haynes Steam Plant of the City of Los Angeles, Department of Water and Power (DWP), and the Alamitos Generating Station of Southern California Edison (SCE) participated in the part of the study conducted in the South Coast Air Basin. These plants are about 900 m apart at the mouth of the San Gabriel River in Long Beach, about 9 km east of the civic center. The plumes from these plants pass over some of the heavily populated portions of the South Coast Air Basin, and therefore are often surrounded by photochemical smog.

The tests at these plants were conducted over a period of five weeks on one or two days each week selected 24-hours in advance on the basis of weather forecasts and other scheduling constraints. During the first three test days, Units 5 and 6 or 4 and 6 at Haynes operated at full load, and SF_6 was injected in the 76 m (250 ft.) stack of Unit 6. On the last three days, Alamitos Unit 5 and 6 operated at full load, and SF_6 was injected in the 67 m (220 ft) stack of Unit 6. Fuel use and load data were supplied by both plants for all test days in the South Coast Air Basin.

5.2 GROUND STATION SITE SELECTION

The Rockwell Air Monitoring Center selected ten sites at which continuous records of sulfur dioxide concentrations were to be obtained. Two-hour filter samples were also collected at these same sites beginning in the middle of the morning on test days. Caltech placed their sequential sulfur hexafluoride (SF_6) samplers at these and other sites in the field.

Preliminary calculations of the Moss Landing Power Plant plume trajectory and location of the touchdown led to the decision to establish ground stations in the Salinas Valley on two arcs approximately 16 and 32 km from the plant. In part, this decision was based on meteorological data in a report supplied by PG&E (8). A nominal length of 4 kilometers (2½ miles) was chosen as the distance along the arcs between successive stations. This value was based upon consideration of the geographical terrain of the Salinas Valley as well as the constraints for ten ground stations with a reasonable area for maintenance between episodes.

When selecting field sites which fit the above plan, consideration was given to power availability, access during as much of the day as possible, the safety of the use of bottled hydrogen, and the suitability of the site for monitoring. The most attractive sites were Air Pollution Control District (APCD) stations, followed by fire, police or other state or local governmental locations, light industry and private homes. In all cases, the instrumentation was located so as to minimize effects due to local sources such as traffic, or local sinks such as vegetation. Whenever possible, the sequential filter samplers were placed on unobstructed flat roofs approximately one story above ground which were well removed from trees and traffic. The sulfur gas analyzers were placed indoors near a window or other opening through the sampling line could pass.

The locations of the sampling sites downwind from the Moss Landing Power plant are described in Table 7-1 and shown in Figure 7-1. These are included in Section 7.0 along with the SO_2 data for ease in later reference. Two numbering systems were used for the stations. One system has only single digit numbers, which was a convenience in the punched card format used by AIHL. The other system was assigned by Caltech in the order of increasing distance from the power plant. Both numbering systems are given in Table 7-1. Because the AIHL system uses the same station number for more than one sampling location in some cases, this report uses the Caltech numbering system.

The sites in the South Coast Air Basin were selected after examining typical wind flow patterns and the data in the Metronics tracer study (9). Data from one SF_6 tracer study were also available (10). It was believed that the plume would pass through the Santa Ana Canyon and go toward Riverside, so the ground stations were initially placed along this route, as described in Table 7-5 and Figure 7-2. However, the results of the first test days showed that the plume followed a path north of the canyon, so the ground stations were moved half-way through the South Coast Air Basin part of the study to the locations in Table 7-6. The site selection criteria were otherwise the same as for the Moss Landing part of the study.

5.3 INSTRUMENT PROCUREMENT AND CALIBRATION

Instrumentation and support equipment for this program were ordered during June and July for receipt by early August. The following subsections describe the specifications and calibration of the sequential filter samplers and the sulfur gas analyzers.

5.3.1 Sequential Filter Samplers

Five sequential filter samplers were available from a previous ARB contract, the Aerosol Characterization Study, and five additional ones were constructed for this program by the shop of the Science Center, Rockwell International. The five new samplers contained minor design improvements, but all units were basically similar. Figure 5-1 shows some of the design features of the sequential sampler, and Figure 5-2 shows the earlier version of the instrument closed for sampling and open so that the internal parts can be seen.

The unit contains nine 47 mm diameter filters. The solenoid valves behind eight of the filter holders are controlled by a cam timer, which can be set so that air is drawn first through one filter then the next for preset time intervals. For this field program, the cam timer was set so that (1) the sampling advanced from one filter to the next at intervals of two hours, and (2) the time of no air flow between filters was less than ten minutes. No air is drawn

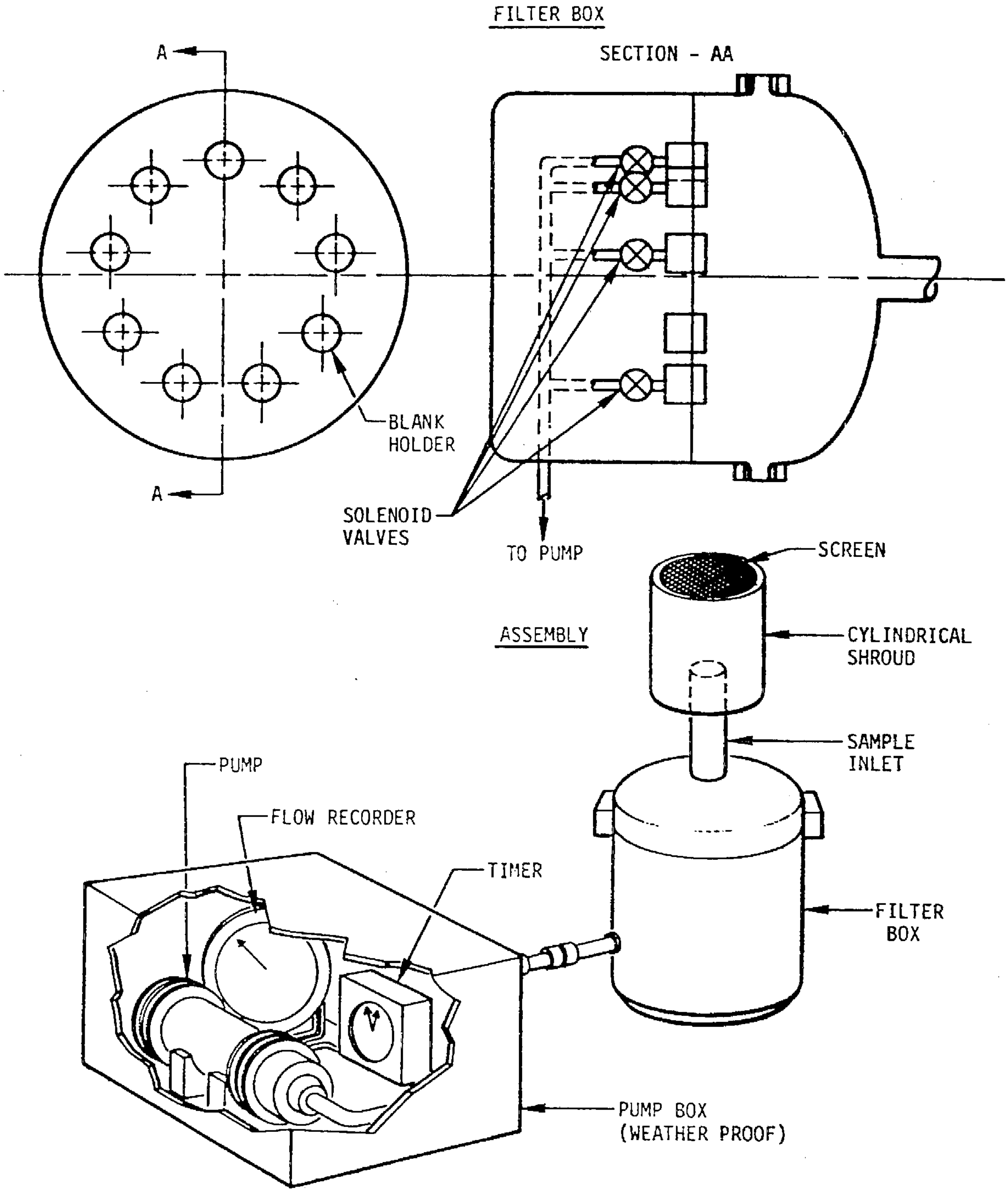

Figure 5-1. Sketch of the Sequential Filter Sampler.

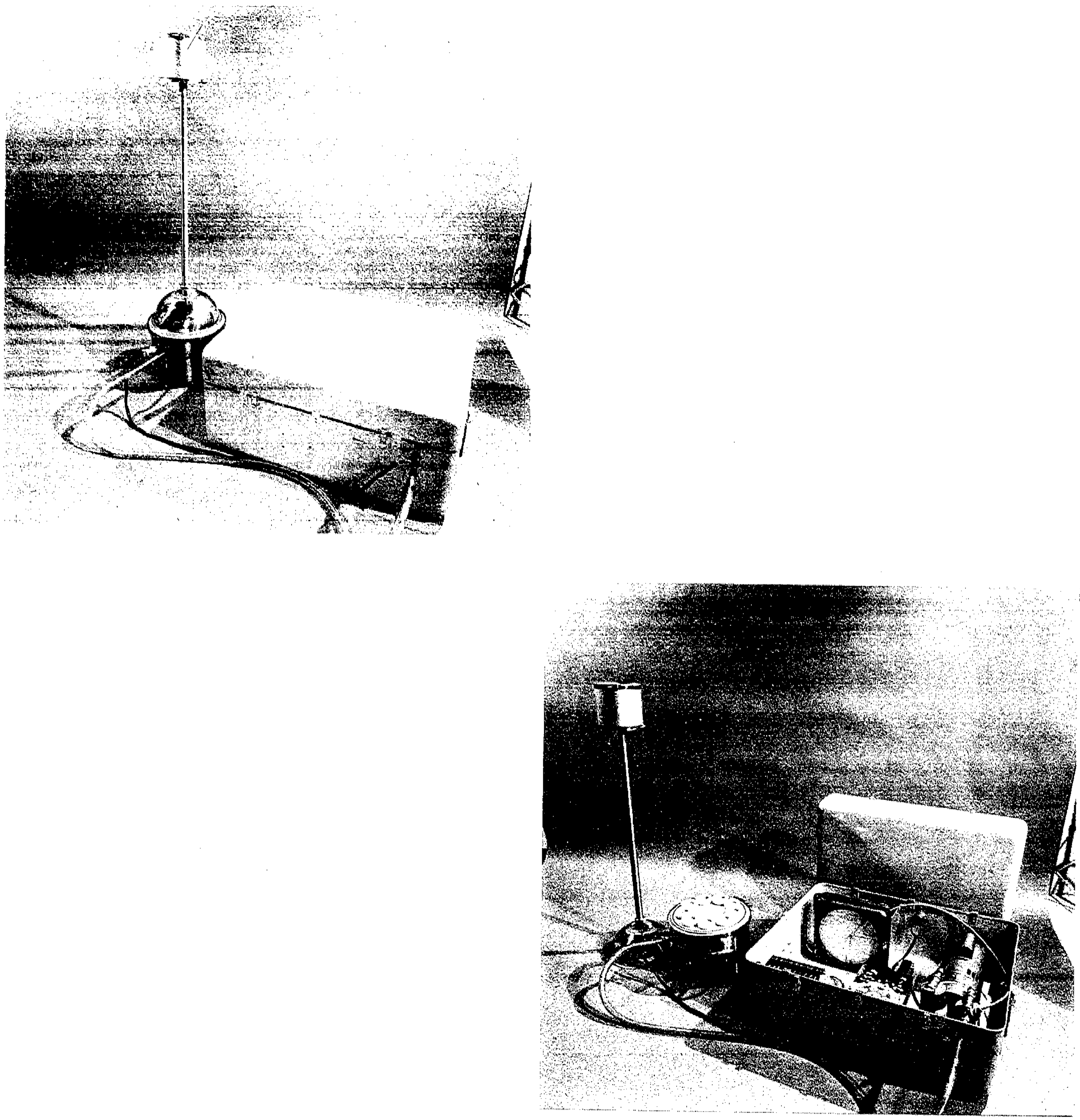

Figure 5-2. Photographs of the Sequential Filter Sampler. Closed for Operation and Open for View.

through the ninth filter, which serves as a field blank. A seven day clock is used to control the time when the sampling sequence begins.

A circular recorder keeps a record of the sample air flow rate as a function of time, and this record can be used to determine the exact times that air passed through each filter as well as the total air flow through each filter. The air flow rate as a function of recorder pen deflection was calibrated with a Rockwell dry test meter, and the resulting calibration curve was linear in all cases. These calibration data as well as the recorder charts from the field were forwarded to AIHL for their use in converting the results of the chemical analyses into ambient concentrations.

5.3.2 Sulfur Gas Analyzers

Meloy Laboratories Model SA160-2 sulfur gas analyzers with thermoelectric coolers, linearizers, automatic re-ignite and automatic hydrogen shut off valves were used. The linearized output signals were recorded on Houston Instruments Omniscribe Model 5111-5 strip chart recorders.

The sulfur gas analyzers were tested to see that they met specifications and were also calibrated according to a protocol established for the Community Health Air Monitoring Program (CHAMP) of the EPA. Each instrument was operated for 72 hours, then checked to see that it met the criteria in Table 5-1. All instruments except one met or exceeded these requirements. That instrument was repaired and retested, and met or exceeded all requirements. The five point calibration used sulfur dioxide concentrations ranging from 25 to 125 ppb. At the end of the field program the instruments were again calibrated at 42.5, 100 and 160 ppb sulfur dioxide.

The field data were taken with the zero adjust knob set to 0.00, so no current was supplied in the instruments to buck out the flame on, zero sulfur signal. This causes the output of the linearizer circuit to become nonlinear at the lowest sulfur levels, as shown in Figure 5-3. However, an analytical expression for the curve in Figure 5-3 can easily be obtained from the calibration data, so that no problem arises from this method of operating the instrument other than a reduced sensitivity at sulfur dioxide concentrations

TABLE 5-1

Instrument Evaluation Specifications for the Sulfur Gas Analyzers

Property	Requirements
Zero Drift	Not to exceed reading equivalent to ± 2 parts per billion sulfur in 24-hours.
Span Drift	Less than ± 2% in 24-hours, using a span gas concentration equivalent to 80% of full scale.
Noise	Should not exceed equivalent of 2 parts per billion.
Detection Limit	5 parts per billion sulfur.
Precision	± 2% of set range.
Response Time	90% of full scale in less than 3 minutes.
Linearity Check	Five point calibration, no point to deviate more than 4% from least squares line.

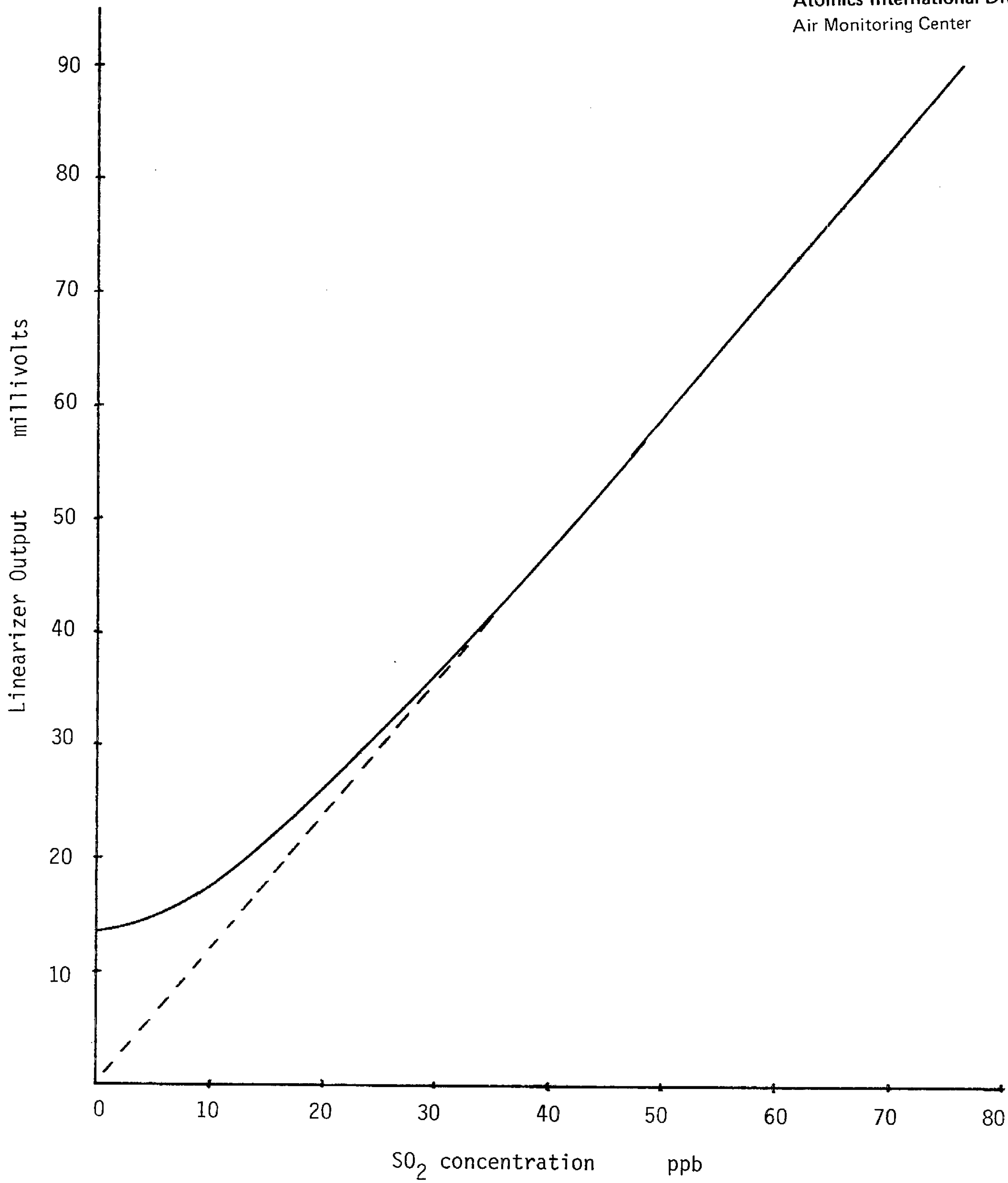

Figure 5-3. Typical Linearizer Output Voltage as a Function of the Sulfur Dioxide Concentration when the Zero Adjust is at 0.00

below about 10 ppb.

The first step in obtaining the equation for the curve in Figure 5-3 is to fit the calibration data in Figure 5-4. This is the customary log-log plot of the net photomultiplier output current (observed current I minus the flame on, zero sulfur current I_0) as a function of the sulfur dioxide concentration. A straight line is obtained for sulfur dioxide concentrations below 1 ppm (1000 ppb), which can be represented by the expression

$$\log (I-I_0) = \log A + \alpha \log [SO_2] \qquad (5\text{-}1)$$

or

$$I-I_0 = A [SO_2]^{\alpha} \quad . \qquad (5\text{-}2)$$

The constants A and α were obtained for each instrument by a linear least squares fit to the data points in the log-log presentation. It should be noted that the values of I and I_0 were actually read on the 0 to 1 volt output of the electrometer amplifier which is part of the sulfur gas analyzer.

The second step in obtaining the equation of the curve in Figure 5-3 is to calibrate the linearizer circuit in the instrument. This can be done by unplugging the photomultiplier output lead and connecting a current generator to the input of the electrometer. Readings at a number of current settings can be obtained for the current I (again measured at the amplifier output) and the linearizer output voltage V. A log-log plot of V vs I gives an excellent straight line represented by the equation

$$\log V = \log B + \beta \log I \qquad (5\text{-}3)$$

or

$$V = B\, I^{\beta} \qquad (5\text{-}4)$$

and the constants B and β were determined by a linear least squares fit.

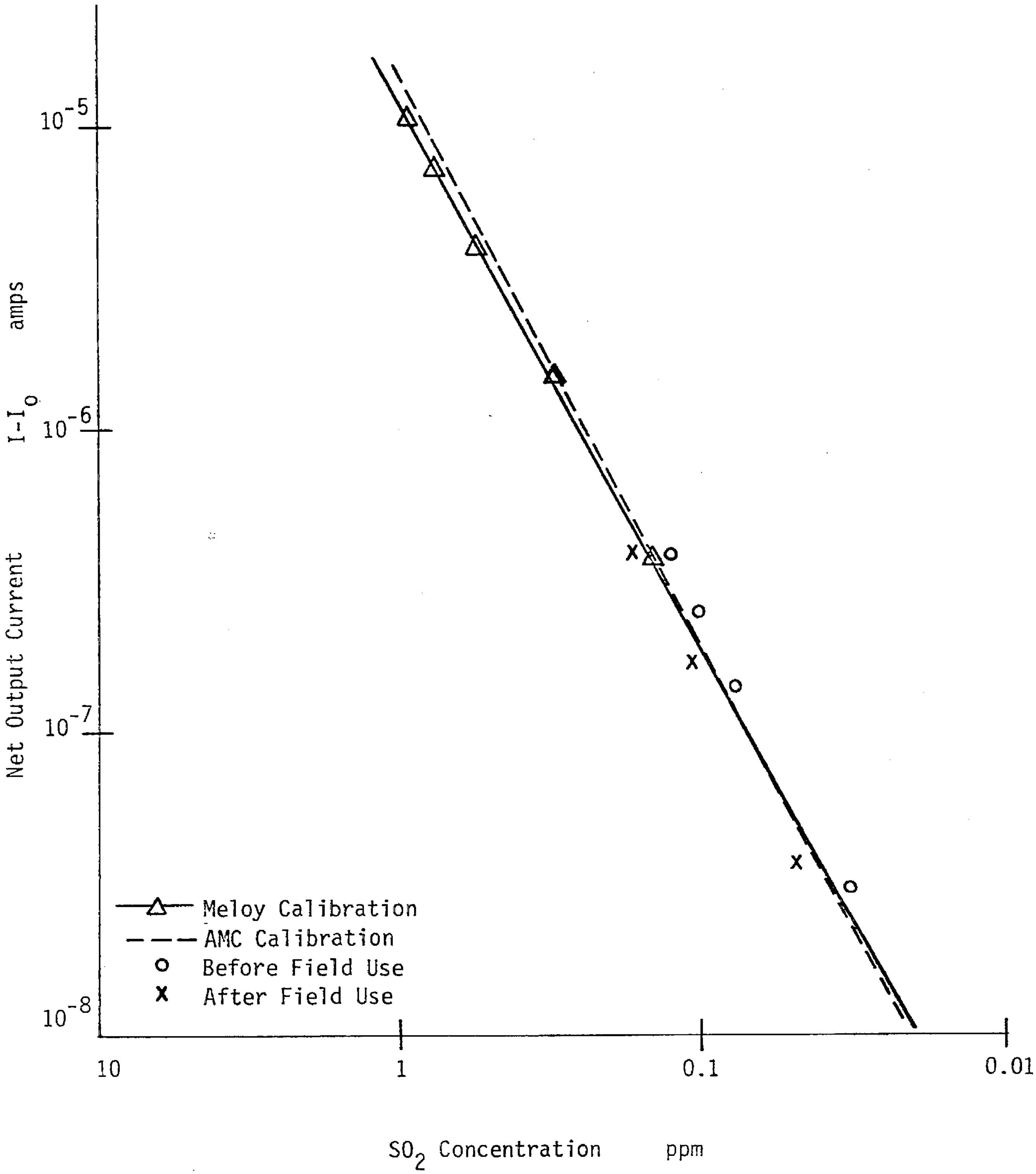

Figure 5-4. Meloy SA 160-2 Sulfur Gas Analyzer Calibration
Serial No. 4H014 ARB Tag No. 4731

Combining Equations 5-2 and 5-4 gives

$$V = B\ (A[SO_2]^{\alpha} + I_0)^{\beta} \qquad (5\text{-}5)$$

which is the analytical expression for the curve in Figure 5-3. The constant occurring in this equation which is most subject to drift is I_0, the flame on, zero sulfur signal.

The linearizer electronics for each instrument was calibrated in November and again in January (after the field program), and was found to be highly stable. The flame photometric detector response was determined both before and after the field program, and both sets of data combined in one least squares analysis. The agreement between the calibrations of the instruments at the factory and at the AMC before and after the field tests provides assurance that the calibrations were reliable. The numerical agreement between the AMC calibration and the Meloy factory calibration is as follows: At an electrical output corresponding to 20 ppb sulfur dioxide according to the Meloy calibration, the AMC calibration curves for each of the eleven instruments gave concentrations ranging from 19 ppb to 24 ppb, with a mean of 22.1 ppb and a standard error of 1.4 ppb. At an electrical output corresponding to 100 ppb sulfur dioxide according to the Meloy calibrations, the AMC calibrations gave concentrations ranging from 87 ppb to 108 ppb with a mean of 99.7 ppb and a standard deviation of 7.4 ppb.

6.0 FIELD OPERATIONS

6.1 GENERAL COMMENTS

The tests at the Moss Landing Power Plant were carried out as soon as it was possible to procure the instruments to be used in the program. Delays in equipment delivery from one vendor required that the tests be started one week later than originally scheduled. Because of the constraint of using a single test interval picked about a week in advance, it was decided to make the tests on 10, 11, and 12 September 1974 in virtually any meteorological condition short of rain. The weather on these days was satisfactory, so the tests were carried out then.

All contactors participating in the field operations conducted tests during these three days. Communication was arranged through the Monterey-Santa Cruz County Unified Air Pollution Control District office.

The operations at Moss Landing were reviewed at a meeting of the cooperating contractors on 24 September 1974, and it was decided to begin operations in the South Coast Air Basin on 1 October 1974. Communication with investigators in the field was directed through the offices of Meteorology Research, Inc.

It was planned to carry out a test on Tuesday and Thursday of each week, but the final decision on whether or not to go ahead with each run was made 24 hours in advance by MRI in consultation with ARB meteorologists on the basis of weather predictions. MRI then communicated this decision to the cooperating contractors. The days on which tests were conducted are listed in Table 6-1, along with information on the times during which filter samples were collected.

6.2 GROUND STATION INSTALLATION AND MAINTENANCE

Installation of the ground station equipment for the tests at Moss Landing began on 5 September 1974. The air flow rate in the sequential filter samplers was checked and, if necessary, adjusted to approximately 3.5 scfm (0.10 m^3 min^{-1}). The sulfur gas analyzers were installed and the hydrogen lines tested for

TABLE 6-1

Times During Which Two-Hour Sequential

Filter Samples Were Collected

Code	Date 1974	Power Plant	Sampler Operation Hours PDT	Sampler Operation Hours PST	Number of Filters
A	10 September	Moss Landing	10-02		90[a]
B	11 September	Moss Landing	10-20		50
C	12 September	Moss Landing	10-20		50
D	1 October	Haynes	10-24	9-23	70
E	4 October[b]	Haynes	10-24	9-23	80[a]
F	11 October	Haynes	10-24	9-23	70
G	17 October	Haynes	10-24	9-23	70
H	25 October	Alamitos	10-24	9-23	70
I	30 October	Alamitos		10-24	70
J	7 November	Alamitos		10-24	70

[a] 10 filters were used as field blanks.

[b] Not a test day; see Section 6.3

leaks. The sample lines for these instruments were 8 ft. to 10 ft. (2.4 to 3.0 m) of 1/8 in. Teflon tubing with a Swagelok adapter on the inlet end. A fine screen was placed in the adapter to keep out insects. No selective scrubber was used on the inlet because it is a good approximation that sulfur dioxide is by far the dominant sulfur containing gas when the plume is present. The sampling line passed through a window or other opening in the building to the outside, and the location of the sampling inlet is described in Tables 7-1, 7-5, and 7-6.

The sulfur gas analyzers were placed in operation, and after a warm-up period, the gas flows and electronics checked. The zero adjust control, which sets the current that compensates for the flame on, zero sulfur photomultiplier current, was set to 0.00. The linearized output was recorded on a strip chart set to 100 mv full scale and a chart speed of 2.5 cm/hr. The initial time was recorded by hand on the strip chart.

Each ground station was visited late in the day before each test day to put filters in the sequential samplers and set their timers, and the day following a test day to remove the filters. On the visit before each test day, the time was written on the sulfur gas analyzer chart by hand, and the recorder zero and gas flows were checked. If necessary, the hydrogen cylinder was changed.

Because of the possibility that the ambient temperature could influence the calibration of the sulfur gas analyzers, seven day temperature thermographs were operated at some stations. These were Gonzales, Verticare, Anderson Ranch, Fire Station No. 5, and Garin Company in the Moss Landing tests, and Palm Harbor Medical Center, Fullerton Fire Station No. 5, Orange Fire Station No. 3, Featherly Park, and Riverside Fire Station No. 8 at the start of the tests in the South Coast Air Basin. The thermographs were later moved to other stations. Environmental testing of the sulfur gas analyzers after the field program showed that their calibration did not significantly depend on the temperature in the range encountered in the field, so it was not necessary to use these data.

6.3 COMMENTS ON INDIVIDUAL TEST DAYS

Test Day A, 10 September 1974. Units 6 and 7 of the Moss Landing Power Plant operated on oil at full load from 9 to 17 hours PDT.

Test Day B, 11 September 1974. Units 6 and 7 of the Moss Landing Power Plant operated on oil at full load from 9 to 17 hours PDT. Filters were collected from the previous day and new filters inserted in the samplers between midnight and 10 on this day. On the advice of AIHL, the filter sampling was restricted to the 10 hour period between 10 and 20 hours PDT.

Test Day C, 12 September 1974. Units 6 and 7 of the Moss Landing Power Plant operated at full load on natural gas from 9 to 17 hours PDT. The filters were changed between 20 hr. on 11 September and 10 hr. on 12 September, and were removed Friday morning, 13 September. The sulfur gas analyzers remained in operation until 14 September, when shutdown and the shipment of the equipment to Los Angeles began. The filters from test days A, B, and C were picked up by a member of the AIHL staff and taken to Berkeley on 13 September.

Test Day D, 1 October 1974. The sulfur gas analyzers were activated on 30 September for the South Coast Air Basin phase of the field operations. On days D, F, and G, sulfur hexafluoride was injected in the stack of Unit 6 of the DWP Haynes Power Plant. Pen failures in some of the flow recorders in the sequential filter sampler units caused the flow rate data for 13 of the 70 exposed filter to be lost on this day. Even though the recommended remedial actions were taken, this problem recurred in some units on subsequent test days. However, it is shown in Section 8.0 that the missing data could be replaced by average flow rates with no significant increase in the standard deviation of the final results.

Day E, 4 October 1974. A master valve failure during the late morning hours on 3 October forced the shutdown of the Haynes Plant. Accordingly, the scheduled episode was cancelled and efforts were made to notify the ground station operating teams. The AMC field crew learned of the change after the sequential samplers had been set to run, so filter samples were collected on the normal schedule. These samples were not analyzed.

Test Day F, 11 October 1974. Rain caused a delay of the second Haynes test day until this date.

Test Day G, 17 October 1974. This is the last test day on which SF_6 was released at Haynes.

On 22 October 1974, the ARB Project Monitor discussed both recent results and future plans for the South Coast Air Basin phase of field operations. The Caltech tracer data showed a consistent wind trajectory following the summer flow pattern. Ground based sampling stations, established for the wind flow patterns generally expected during October through December had, therefore, not been sampling in the general path of the plume emitted from the Haynes Steam Plant. Decisions were made to (1) move SF_6 injections to the Alamitos Generating Station, (2) sample for three more episodes rather than the originally anticipated four, and (3) move three of the ground stations in order to take advantage of the still dominant summer flow pattern. Accordingly, the equipment at the Orange Fire Station No. 3, Anaheim Fire Station No. 8, and Corona Forest Fire Station was moved to the APCD monitoring stations in Whittier, Pomona, and Azusa. All stations were readied for recommencement of operations on 24 October 1974.

Test Day H, 25 October 1974. This was the first test day at Alamitos.

Test Day I, 30 October 1974. Maintenance and preparation of the ground sampling network, normally carried out on the day prior to each episode, were accomplished in the early morning hours immediately prior to the start of testing.

Test Day J, 7 November 1974 was the last day of the field program. Equipment and instrumentation were withdrawn from the field during the week of 11-15 November. All sequential filter samples collected in the South Coast Air Basin were mailed to AIHL in November.

7.0 SULFUR DIOXIDE DATA

This section describes the procedures used to extract the sulfur dioxide data from the strip charts returned from the field and to calculate one-hour averages. The data obtained in the South Coast Air Basin are presented in several formats to increase the ease with which they may be interpreted. The best overview of the data on the test days is obtained from Figures 7-3 through 7-8, and a useful presentation of all data taken between the power plants and the Puente Hills can be found in Tables 7-26 through 7-32. The discussion and interpretation of these results is contained in later sections of this report.

7.1 DIGITIZATION OF THE SULFUR GAS ANALYZER STRIP CHARTS

The records returned from the field for the concentration of the sulfur dioxide were in the form of continuous strip charts with a time resolution of about one minute. A Summagraphics digitizer connected to a PDP-11/20 computer was used to obtain the data from the strip charts. Points were recorded along the pen ink line often enough to characterize its position. In addition, information for the time of day which was marked by hand on the chart paper in the field was also read into the computer. The program which processed the data constructed a time scale by linear interpolation between the time marks recorded in the field and calculated chart positions corresponding to ten minute intervals. The pen position at these ten minute intervals was obtained by a linear interpolation between the digitized points on either side of the position of the ten minute points. The computer then created a disk file of the pen position at the ten minute intervals.

In a later processing of the data, the pen position was converted into a voltage from a knowledge of the strip chart recorder settings, and then into a sulfur dioxide concentration using equation 7-1

$$[SO_2] = \left\{[(V/B)^{1/\beta} - I_0]/A\right\}^{1/\alpha} \qquad (7\text{-}1)$$

which was obtained by rearranging Equation 5-5. The instrument calibration constants A, α, B, β, and I_0 were determined for each individual sulfur gas analyzer as described in Section 5.3.2, and used in this step in the data reduction. One-hour averages were then calculated from the ten minute readings. The sulfur gas analyzer is sensitive to all sulfur containing gases, but the results are reported here as if sulfur dioxide were the only sulfur containing gas present. The data of major interest in this study are the differences between the reading when the plume is present and the readings due to other sources made when the plume is absent. It is believed that no significant error is introduced by assuming that the increases in the sulfur gas analyzer signals due to the plume are caused only by increases in the sulfur dioxide concentrations.

The strip chart recorders used in this study had a friction drive rather than sprockets to drive the chart paper, and in a few cases the paper slipped so that the length of the chart between the field time marks does not correspond to the elapsed time. All such cases are noted in the data tabulations. For the remainder of the data, the length of chart corresponded to the elapsed time to within one-half hour per day. A time mark was made on each chart 12 to 16 hours before the start of each SF_6 release, when the sampling site was visited to prepare the sequential filter sampler.

7.2 ERROR LIMITS FOR THE SULFUR DIOXIDE CONCENTRATIONS

In the Moss Landing portion of the field program, the great majority of the observed sulfur dioxide concentrations were low enough that the data fell in the nearly horizontal portion of the calibration curve shown in Figure 5-3. In these cases, the strip chart records varied by less than one millivolt over periods of many hours to several days. The manufacturers specifications for the sulfur gas analyzer give a minimum detectable concentration of 10 ppb, and it was found that the sulfur dioxide levels in Moss Landing were generally below this. Therefore, most strip chart records provide only an upper limit to the SO_2 concentration near Moss Landing.

In the South Coast Air Basin, the sulfur dioxide concentrations were almost always high enough that readings above the limit of detection were obtained. Here values are reported for concentrations less than 10 ppb, but it should be remembered that these concentrations are below the nominal detection limit of the instrument.

The uncertainty to be associated with all sulfur dioxide concentrations is $\pm$ 10 ppb. Because of the shape of the curve in Figure 5-3, the uncertainty does not tend to diminish at the lowest concentrations. Instead, it rises to the 10 ppb limit.

7.3 SULFUR DIOXIDE CONCENTRATIONS NEAR MOSS LANDING

Nearly all of the strip chart records for September 10, 11, and 12 near Moss Landing showed sulfur dioxide concentrations below the nominal detection limit of the Meloy Sulfur Gas Analyzer. On September 10, neither sulfur dioxide nor sulfur hexafluoride were seen in significant amounts on the ground. On September 12, the plant was burning gas, so again no significant sulfur dioxide concentrations were seen. Sulfur dioxide was observed at two locations on September 11, and the data are in Tables 7-3 and 7-4. For comparison, the SF_6 data recorded at the same times and locations are also given, as well as the sulfur dioxide concentration calculated from the stack gas analysis and the SF_6 data. It should be noted that the background level of SO_2 has not been subtracted from the observed concentrations. It is recommended that 5 ppb be subtracted from each of the observations before comparison with the SF_6 data.

Except for the two readings between 14:00 and 16:00 PDT at Fire Station No. 5 and the reading between 14:00 and 15:00 PDT at Yoder Brothers, the calculated and observed sulfur dioxide concentrations are within the experimental error. The exceptions occur for the highest SF_6 readings, and in these cases the sulfur dioxide concentrations calculated from the SF_6 data are higher than those observed. Sulfur dixoide removal processes would contribute to the observed differences, but they are not fast enough to account for them.

The data obtained from the Moss Landing-Salinas area show that the background levels of SO_2 were low enough during the test days that they could not be reliably measured with the flame photometric detectors commercially available at that time. In many of the records, the linearized output voltage remained constant to within 1 mv for periods of a day or more. Therefore, the SO_2 concentration remained constant to within a few ppb, and was certainly below 10 ppb. A strip chart record from a flame photometric detector operated by the ARB was also made available, and it also showed no change in output voltage with time, in agreement with the above results.

7.4 SULFUR DIOXIDE CONCENTRATIONS FOR THE SOUTH COAST AIR BASIN TEST DAYS

The locations of the ground sampling stations for the study of the plumes from the Haynes and Alamitos generating stations are given in Table 7-5 and 7-6 and shown in Figure 7-2. The one-hour average sulfur dioxide concentrations observed on test days are listed in Table 7-8 through 7-13, and graphically represented in the accompanying Figure 7-3 through 7-8. The figures follow the same format as those for the SF_6 data in the Caltech final report (3), and thus allow a quick comparison of the two sets of results. As previously discussed, the sulfur dioxide concentrations are accurate to $\pm$ 10 ppb, and the times, unless otherwise noted, to within one-half hour. Therefore, the concentrations below 10 ppb have a large relative error, and could be reported as zero. The concentrations when the plume is present, which are the ones of interest, have a relative error which decreases with increasing sulfur dioxide concentration.

7.5 SULFUR DIOXIDE CONCENTRATIONS FOR ALL DAYS IN THE SOUTH COAST AIR BASIN

All sulfur dioxide data taken in the South Coast Air Basin are reported by ground station location in Tables 7-14 through 7-25. The most important data are in Table 7-16 for Fullerton Fire Station No. 2, where the impact of the plumes can be seen on 33 of the 41 days. The second greatest impact of the plumes was observed at Anaheim Fire Station No. 2.

No data are reported for the Pomona APCD station because of two sulfur gas analyzer failures. A replacement instrument which was new but not yet subjected to the performance tests was used, but this instrument was later shown to have a defective linearizer.

TABLE 7-1. Location of the Ground Stations for the Moss Landing Test Days September 10, 11, and 12, 1974

Station Identification Number AIHL	Station Identification Number Caltech	Station Name & Address	Location of Sulfur Analyzer	Location of Sequential Sampler Analyzer
0	3	Unidynamics 520 Crazy Horse Cyn Rd Salinas, CA 93901	In temperature controlled (68 F) room, with port approx. 7' above ground on north wall	On flat roof approx. 8' above ground on western edge
1	5	Anderson Ranch 542 Old Stage Rd Salinas, CA 93901	On floor of back bunkhouse port approx. 8' high on west wall	On west wall woodpile, approx. 7' above ground
2	4	Fire Station No. 5 389 Alvin Dr. Salinas, CA 93901	Garage floor, port approx. 6' above ground on west wall	On rooftop, approx. 20" above ground
3	2	Garin Company Shop McFadden Rd. Salinas CA 93901	On office floor, port approx. 8' high on west wall	On roof, west side, approx. 20' above ground
4	6	Fort Ord Bldg. 36, E. Garrison Fort Ord, CA 93941	On building floor, port approx. 6' high on west wall	In lot adjacent to building housing sulfur analyzer (less than 20' away) on west side of bldg.
5	17	Hollister APCD Sta. % Monterey Bay Unified APCD, Salinas, CA 93901	In APCD trailer, port approx. 8' high on west wall	On trailer roof, approx. 15' above ground
6	16	Verticare 27250 Encinal Rd. Salinas, CA 93901	On garage floor, port approx. 8' high on northeast wall	In field adjacent to garage (less than 40' from sulfur analyzer) on west side of bldg.
7	15	Yoder Brothers Esperanza Rd. Salinas, CA 93901	In cooler trailer, port approx. 10' above ground on west side	On flat roof approx. 50' away from sulfur analyzer ;oof approx. 15' above ground
8	14	Youth Science Center 544 River Rd. Salinas, CA 93901	In auditorium, port approx. 10' high on northwest side of building	On flat roof approx. 20' above ground on northwest side
9	18	Gonzales High School Gonzales, CA	In stadium in perforated shipping crate, port approx. 7' high, S/E portion of stadium	On stadium pressbox roof, approx. 15' above ground on west side of stadium

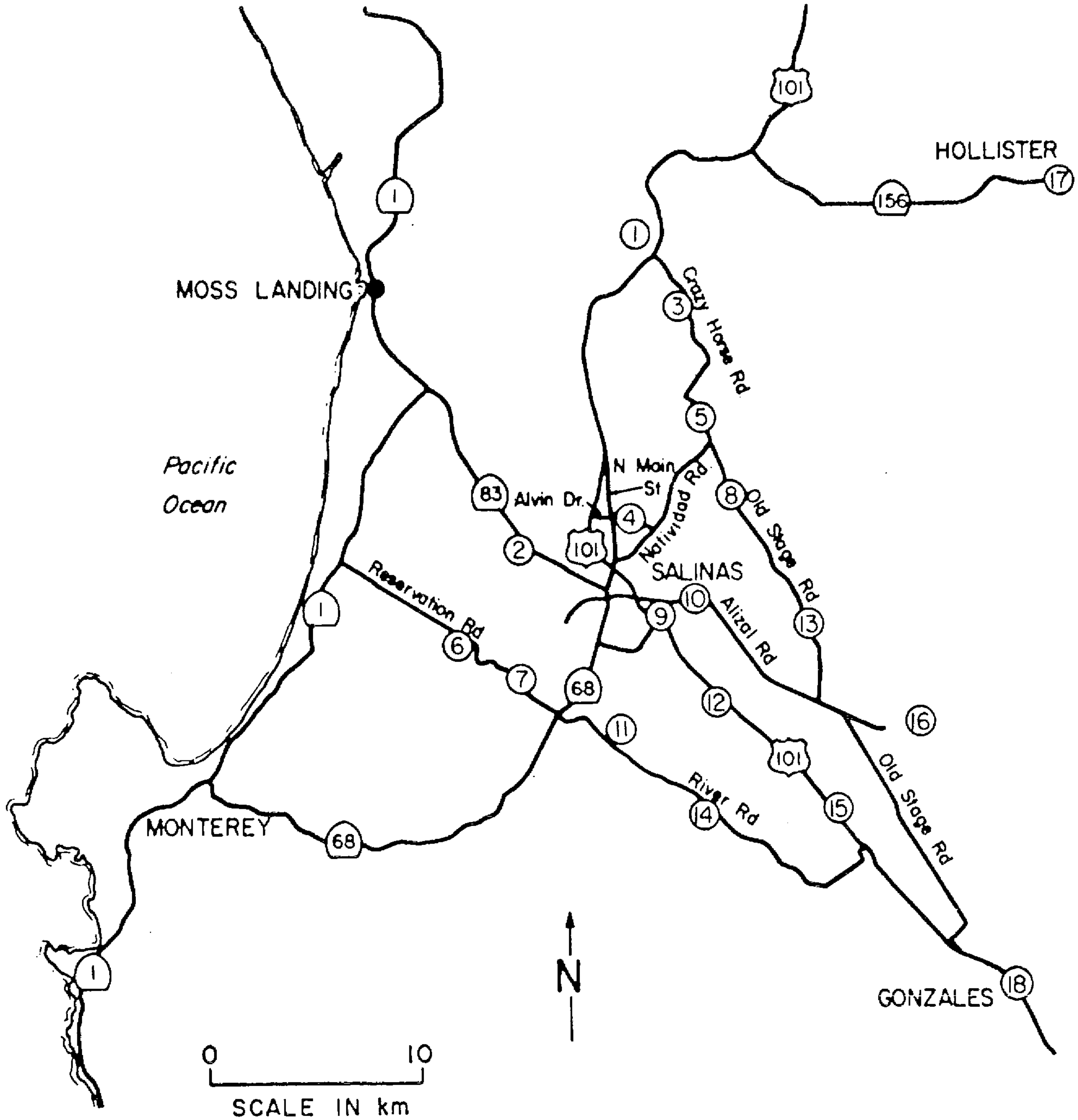

Figure 7-1. Location of the sampling sites in the Moss Landing-Salinas area. (From reference 3).

TABLE 7-2

Key to the SF_6 Sampling Sites Near Moss Landing

Caltech Location Number	Location	Distance from Power Plant Miles	Kilometers
1	Construction Trailer	7.9	12.7
2	School House (Garin Co.)	8.1	13.1
3	Unidynamics	9.1	14.7
4	Fire Station	9.9	16.0
5	Anderson Ranch	10.2	16.4
6	Fort Ord	10.5	16.9
7	Merril Farms	12.0	19.3
8	Duroc's Hogs	12.1	19.5
9	Motel 6	12.7	20.4
10	USDA	13.1	21.1
11	Spreckels	14.5	23.3
12	Firestone	15.7	25.2
13	Pumphouse	15.9	25.6
14	Youth Science Center	17.9	28.7
15	Yoder Bros.	20.1	32.3
16	Verticare	20.3	32.6
17	Hollister	20.7	33.3
18	Gonzales	27.2	43.7

TABLE 7-3

Moss Landing

September 11, 1974

Fire Station No. 5, Salinas
AIHL #2 Caltech #4

One Hour Averages

Pacific Daylight Time	Observed SO_2 ppb	Observed SF_6 ppt	Calculated[a] SO_2 ppb
8-9	8	5.4	
9-10	13	1.1	
10-11	13[b]	51.	7.5
11-12	12[b]	3.	0.4
12-13	17	66.	9.2
13-14	28	100.	15.
14-15	27	420.	62.
15-16	17	290.	43.
16-17	9	160.	24.
17-18	7	10.	1.5
18-19	6	0.	
19-20	6	2.2	

[a] The release of SF_6 began at 10 and ended at 17 PDT.

[b] Observed SO_2 ~ 9 ppb from 10:50 to 11:30

TABLE 7-4

Moss Landing

September 11, 1974

Yoder Brothers
(Between Salinas and Gonzales)
AIHL #7 Caltech #15

One Hour Averages

Pacific Daylight Time	Observed SO_2 ppb	Observed SF_6 ppt	Calculated[a] SO_2 ppb
8-9	9.	0.0	
9-10	11	0.0	
10-11	15	5.5	0.8
11-12	15	10.	1.5
12-13	15	12.	1.8
13-14	22	170.	25.
14-15	26	260.	38.
15-16	24	-	-
16-17	19	150	22.
17-18	15	110	16.
18-19	8	1.2	
19-20	6	0.0	

[a] The release of SF_6 began at 10 and ended at 17 PDT.

TABLE 7-5. Location of the Ground Stations for the Haynes Test Days October 1, 11, and 17, 1974

Station Identification Number AIHL	Station Identification Number Caltech	Station Name & Address	Location of Sulfur Analyzer	Location of Sequential Sampler Analyzer
0	4	Fullerton Fire Station #2 Valencia & Brookhurst Fullerton, CA	On garage floor, with port approx. 7' high in west side of building	On center of roof, approx. 15' above ground
1	2	Anaheim Fire Station #2 Crescent & Brookhurst Anaheim, CA	On top level of hose tower, port approx. 40' above ground on southwest side	On garage roof, approx. 50' from tower, approx. 15' above ground
2	3	Palm Harbor Medical Ctr. 12601 Garden Grove Blvd. Garden Grove, CA	In room of penthouse, port approx. 100' high on north side of building	On roof approx. 30' away from sulfur analyzer, approx. 95' above ground on south side of bldg.
3	8	Fullerton Fire Station #5 2555 Yorba Linda Blvd. Fullerton, CA	On patio at rear of station, port approx. 6' high on north wall	Center of flat roof, approx. 15' above ground
4	7	Orange Fire Station #3 1910 Shaefer Orange, CA	In shop, port approx. 6' high on west side of bldg.	On garage roof, approx. 50' away from sulfur analyzer, approx. 15' above ground on west end of roof
5	9	Anaheim Fire Station #8 Santa Ana Canyon & Pinney Anaheim, CA	In garage, port approx. 7' high on north side of bldg.	Center of roof, approx. 15' high
6	14	Featherly Regional Park 24001 Santa Ana Canyon Rd Anaheim, CA 92806	On garage floor, port approx. 5' on south side of building	In field approx. 50' from sulfur analyzer on west end of building
7	19	Corona Forest Fire Sta. 1511 Hamner Road Norco, CA	On garage floor, port approx. 7' high on north-east side of building	Center of roof, approx. 20' above ground
8	20	Riverside Fire Sta. #8 10121 Pierce La Sierra, CA	On garage floor, port approx. 8' high on south side of building	On southern part of roof, approx. 10' above ground
9	21	Riverside Fire Sta. Central Headquarters 3420 7th Street Riverside, CA	In Arson Room, port approx. 7' high on north wall	In center of flat roof, approx. 35' above ground

TABLE 7-6. Location of the Ground Stations for the Alamitos Test Days October 25 and 30, and November 7, 1974

Station Identification Number		Station Name & Address	Location of Sulfur Analyzer	Location of Sequential Sampler Analyzer
AIHL	Caltech			
0	4	Fullerton Fire Station #2	See Table 7-5	See Table 7-5
1	2	Anaheim Fire Station #2	See Table 7-5	See Table 7-5
2	3	Palm Harbor Medical Center	See Table 7-5	See Table 7-5
3	8	Fullerton Fire Station #5	See Table	See Table 7-5
4	5	Whittier APCD 14427 Leffingwell Whittier, CA	In station, sampling through station manifold, cane in center of roof, approx. 12' above ground	Center of flat roof, approx. 12' above ground and approx. 10' from station sampling cane
5	17	Pomona APCD 924 N. Gary Avenue Pomona, CA	In station, sampling through station manifold, cane on east end of roof, approx. 20' above ground	On west end of roof, approx. 25' above ground
6	14	Featherly Park	See Table 7-5	See Table 7-5
7	16	Azusa APCD 803 N. Loren Road Azusa, CA	In station, sampling through station manifold, cane on southwest portion of roof, approx. 15' above ground	On Southwest portion of flat roof, approx. 20' above ground
8	20	Riverside Fire Station #8	See Table 7-5	See Table 7-5
9	21	Riverside Fire Station Central Headquarters	See Table 7-5	See Table 7-5

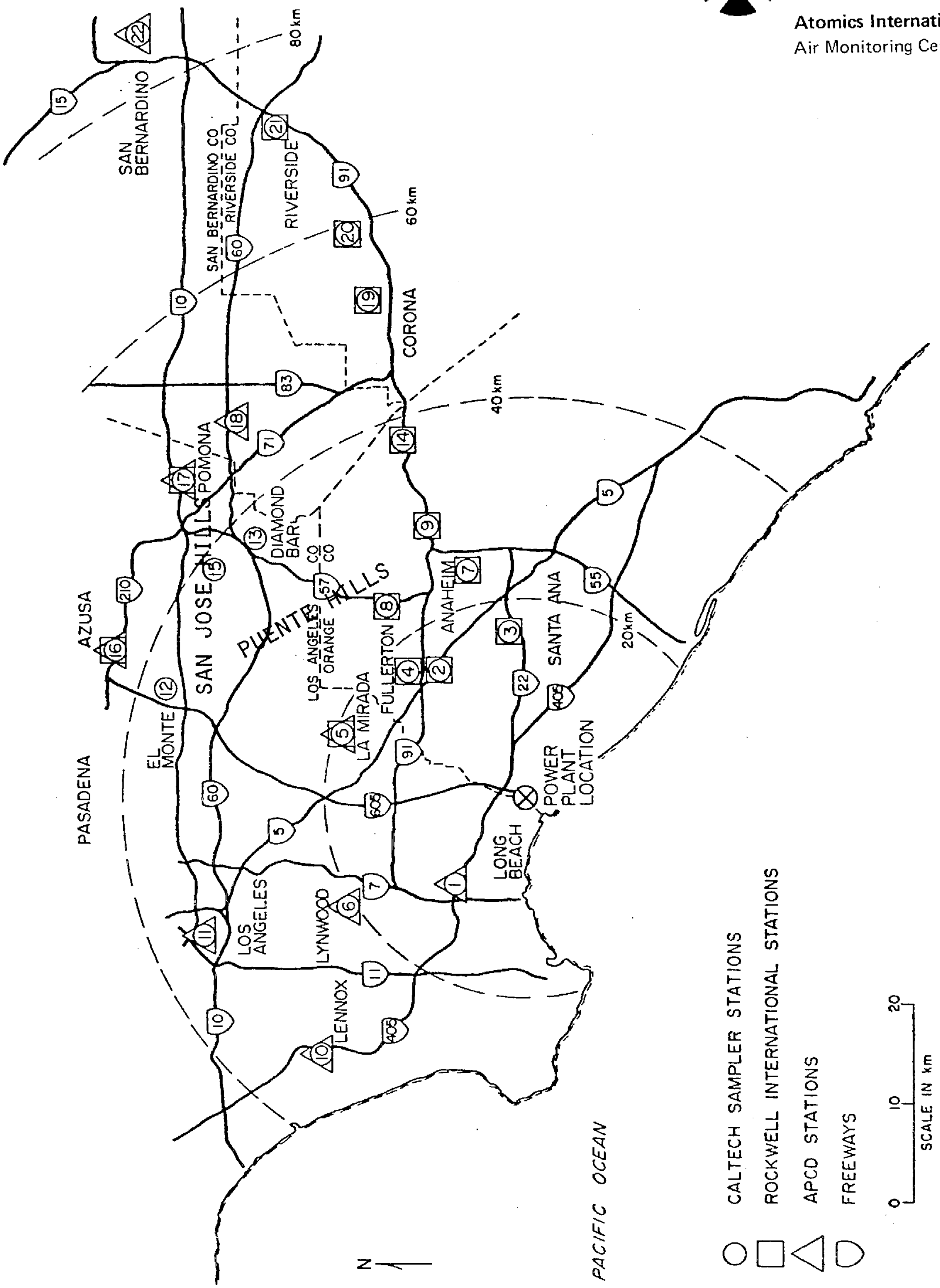

Figure 7-2. Location of the sampling sites in the South Coast Air Basin. (From reference 3)

TABLE 7-7

Key to the SF_6 Sampling Sites in the

South Coast Air Basin

Caltech Location Number	Location	Distance from the Power Plants Miles	Kilometers
1	Long Beach APCD	6.9	11.2
2	Anaheim F.S. #2	9.6	15.4
3	Medical Center	10.5	16.9
4	Fullerton F.S. #2	10.8	17.4
5	Whittier APCD	11.9	19.2
6	Lynwood APCD	13.3	21.5
7	Orange F.S. #3	14.8	23.7
8	Fullerton F.S. #5	14.9	24.0
9	Anaheim F.S. #8	18.1	29.2
10	Lennox APCD	19.7	31.8
11	Central L.A. APCD	21.5	34.6
12	Baldwin Park	23.3	37.5
13	Diamond Bar F.S.	23.3	37.5
14	Featherly Park	23.5	37.8
15	Walnut F.S.	24.0	38.7
16	Azusa APCD	27.6	44.3
17	Pomona APCD	29.0	46.6
18	Chino APCD	29.5	47.5
19	Corona F.S.	32.5	52.3
20	Riverside F.S. #8	36.8	59.2
21	Riverside Central F.S.	44.6	71.8
22	San Bernardino APCD	53.3	85.8

TABLE 7-8

One-Hour Average Sulfur Dioxide Concentrations in ppb for

1 October 1974

Caltech Station #	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11
2																							
3	15	10	12	15	20	18	18	16	16	21	33	32	36	22	12	12	6	6	6	9	9	10	10
4											43	57	51	40	28	35	75	17	11	9	6	9	7
7	8	11	11	10	11	11	9	12	13	15	22	36	39	38	26	18	17	11	7	10	10	11	7
8[a]	0	2	4	6	9	11	14	11	13	17	20	25	25	18	15	13	12	10	12				
9[b]	3	6	6	6	8	9	9	10	11	13	17	22	30	32	22	14	8	1	1	2	0	0	0
14	6	6	7	8	9	9	11	11	11	12	14	20	30	34	22								
19	8	5	8	10	11	11	8	10	12	16	17	20	31	35	30	21	14	13	12	9	8	8	5
20[b]	16	17	18	17	18	19	20	17	19	25	29	26	36	34	27	21	19	15	14	14	12	12	12
21	22	16	16	18	18	15	13	16	18	20	17	23	23	21	28	31	31	23	21	19	15	14	14

Time of Day - Pacific Standard Time

a. Times in the afternoon may contain errors somewhat greater than one-half hour.

b. The strip chart record lost several hours between the start of this test and October 7, but the times here are believed to be accurate to within one-half hour.

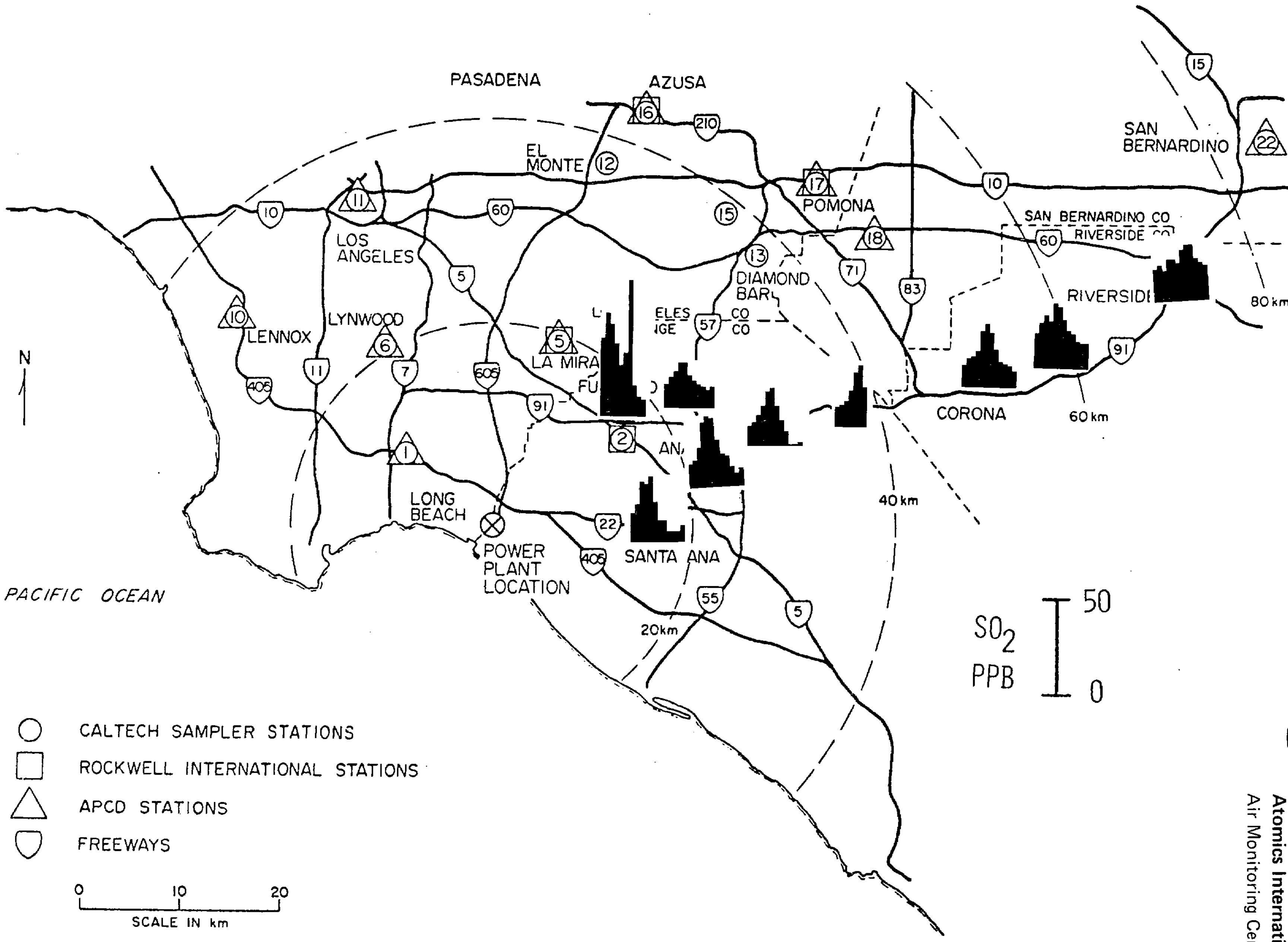

Figure 7-3. Histograms of the one-hour average SO_2 concentrations from 8:00 a.m. to 8:00 p.m. PST on 1 October 1974

TABLE 7-9

One-Hour Average Sulfur Dioxide Concentrations in ppb for

11 October 1974

Time of Day - Pacific Standard Time

Caltech Station #	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11
2	7	15	15	11	13	14	16	12	10	15	15	17	18	21	26	13	8	7	7	7	6	6	6
3	12	12	13	12	12	12	13	14	14	15	15	18	21	22	17	10	11	10	11	9	12	12	12
4	12	13	13	13	13	14	14	17	18	15	15	23	30	31	50	54	32	19	19	14	13	12	12
7	8	9	7	7	7	5	2	6	5	11	9	7	6	17	24	26	24	17	11	6	7	10	9
8a	9	14	15	15	15	16	14	14	12	14	14	14	17	19	29	20	11	6	3	4	2	5	2
9b								10	11	12	12	11	8	16	18	14	10	49	8	14	6	4	5
14	5	5	4	3	5	8	9	9	11	12	13	13	14	16	17	21	17	14	11	9	8	7	5
19																							
20	10	8	8	9	10	7	1	1	8	12	13	12	15	13	16	17	17	17	14	10	10	11	9
21	18	14	15	11	14	16	16	15	18	20	27	28	20	19	19	19	20	18	20	19	19	19	19

a. The strip chart lost several hours between the start of this test and October 16, but the times here are believed to be accurate to one-half hour.

b. Times in the afternoon may contain errors as large as one hour.

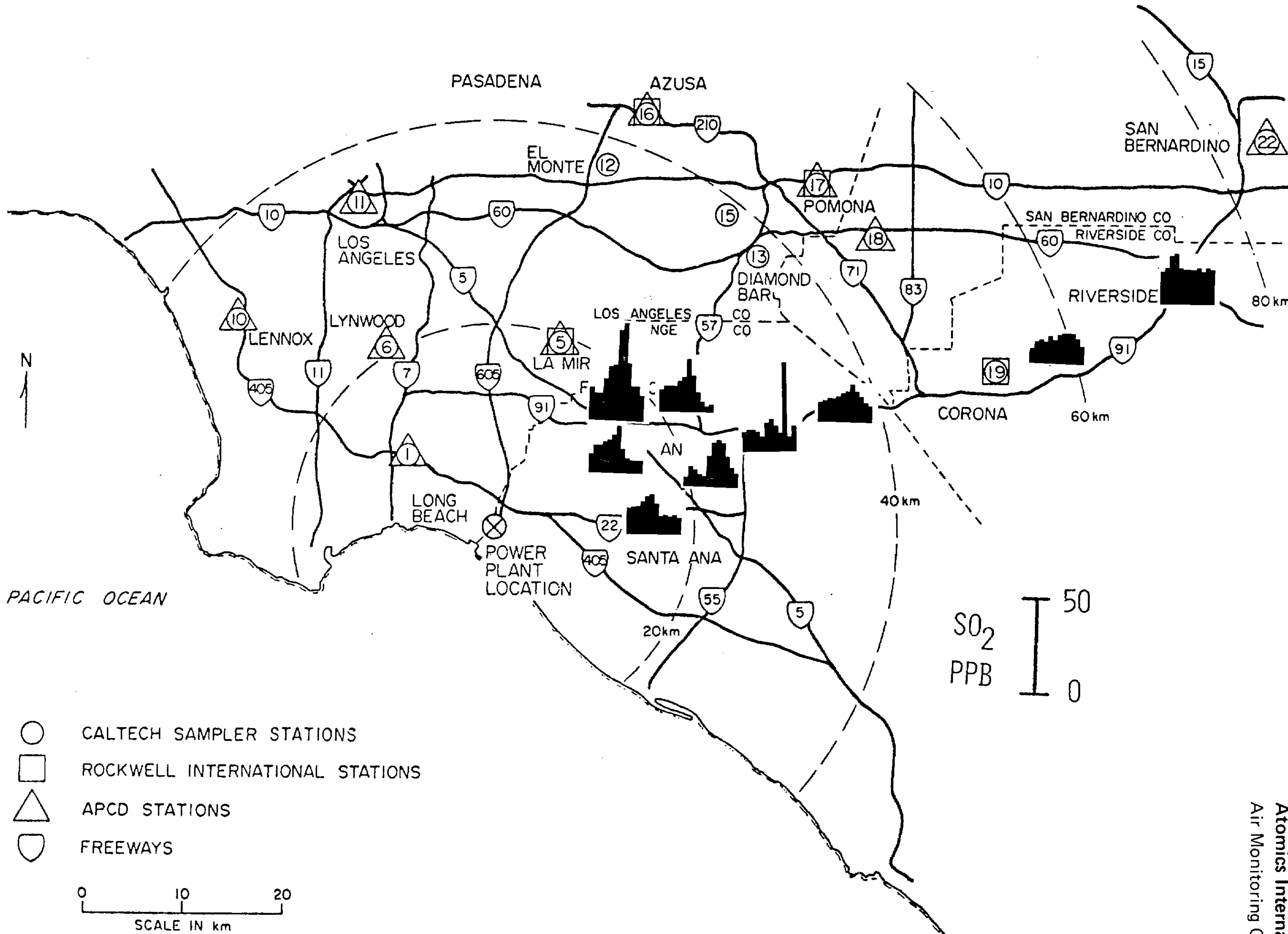

Figure 7-4. Histograms of the one-hour average SO_2 concentrations from 8:00 a.m. to 8:00 p.m PST on 11 October 1974

TABLE 7-10

One-Hour Average Sulfur Dioxide Concentrations in ppb for

17 October 1974

Time of Day - Pacific Standard Time

Caltech	A.M.												P.M.										
Station #	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11
2[a]	14	17	19	15	25	25	27	22	22	17	16	17	13	15	23	28	11	9	8	10	11	10	9
3	21	20	18	15	14	14	17	19	22	19	27	20	15	14	13	14	10	10	10	9	8	10	12
4	6	6	5	3	3	4	8	19	13	12	14	25	53	17	16	39	32	21	17	15	13	15	8
7																							
8[a]	12	12	10	9	11	16	16	17	11	12	12	32	17	13	12	18	17	10	7				
9	10	10	8	8	7	8	9	11	8	14	16	20	15	11	10	11	9	11	5	2	3	4	5
14	9	10	9	9	8	9	10	9	8	10	11	14	20	18	15	16	18	18	20	15	10	6	8
19	6	6	6	5	5	6	5	7	9	6	8	10	12	17	17	13	16	15	16	15	14	11	13
20	19	18	19	18	18	17	21	31	38	45	38	29	25	27	27	26	26	26	25	22	22	22	23
21	15	11	10	10	10	11	20	15	12	13	6	11	13	13	16	13	11	12	14	13	16	17	18

a. Times in the afternoon may contain errors as large as one hour.

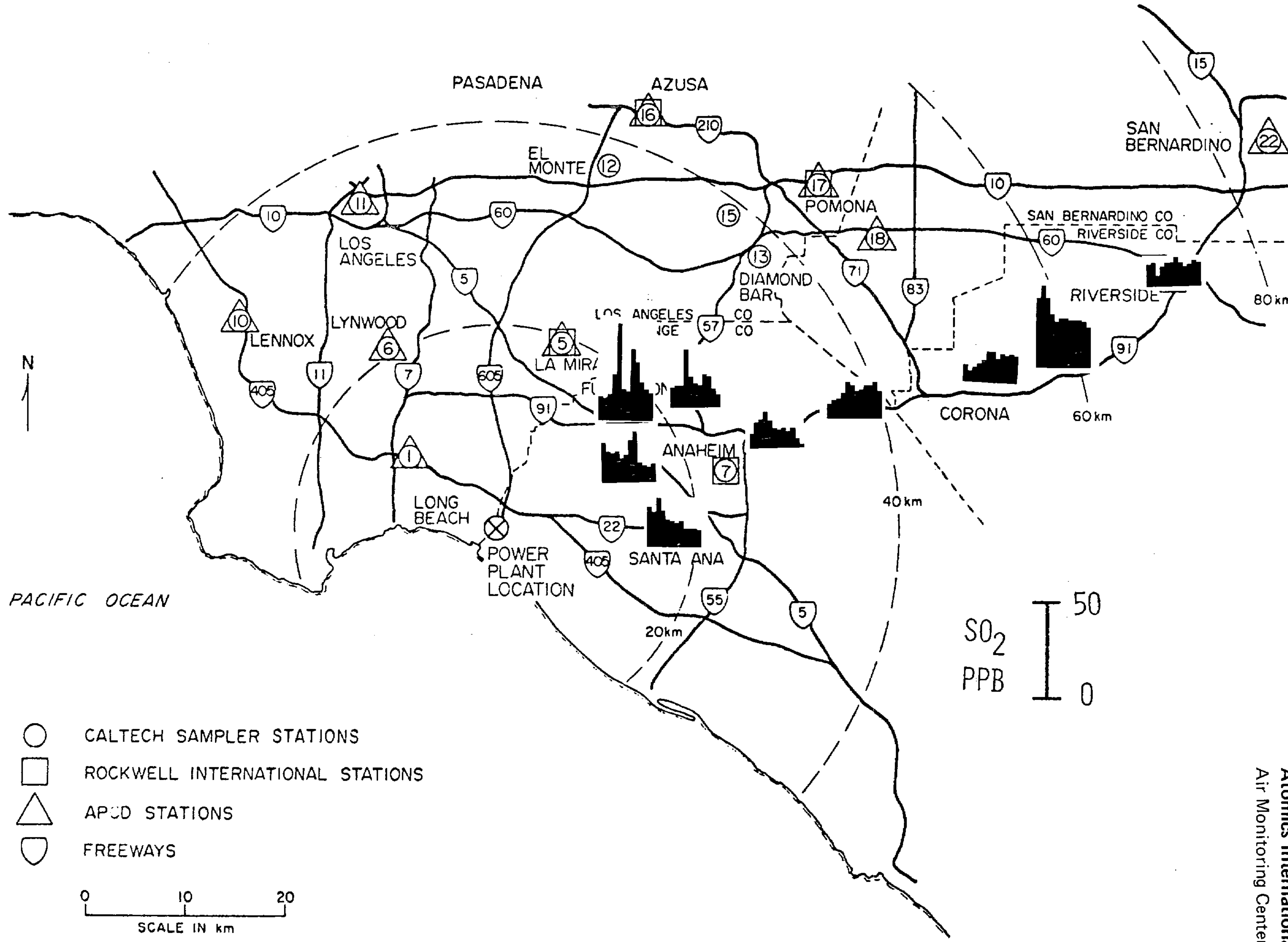

Figure 7-5. Histograms of the one-hour average SO_2 concentrations from 8:00 a.m. to 8:00 p.m. PST on 17 October 1974

TABLE 7-11

One-Hour Average Sulfur Dioxide Concentrations in ppb for

25 October 1974

Time of Day - Pacific Standard Time

Caltech Station #	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11
2	14	19	17	17	12	8	9	10	7	20	15	27	28	18	9	10	19	10	8	8	8	10	8
3	9	10	7	6	7	7	8	12	17	19	18	27	18	8	0	1	5	5	8	13	8	6	7
4	10	11	9	8	7	7	7	11	14	15	13	26	44	39	32	52	40	18	16	14	10	10	10
5	9	7	8	11	10	13	15	16	24	29	20	18	15	16	11	9	8	10	9	9	9	7	7
8[a]	17	16	15	14	13	14	12	13	12	15	16	29	23	14	10	9	13	9	9	9	8	9	8
14	10	11	12	11	12	11	11	13	21	26	28	28	34	35	30	13	11	8	7	6	8	8	6
16	13	13	12	12	12	14	15	17	20	20	19	18	17	14	12	12	11	10	10	8	7	5	8
17																							
20	13	14	15	14	12	13	14	14	19	26	26	25	30	33	31	18	16	14	14	12	14	12	12
21	20	15	16	17	14	14	12	16	17	16	12	12	14	17	17	19	16	18	18	18	24	23	17

a. The strip chart lost several hours between the start of this test and October 28, but times here are believed to be accurate to one-half hour.

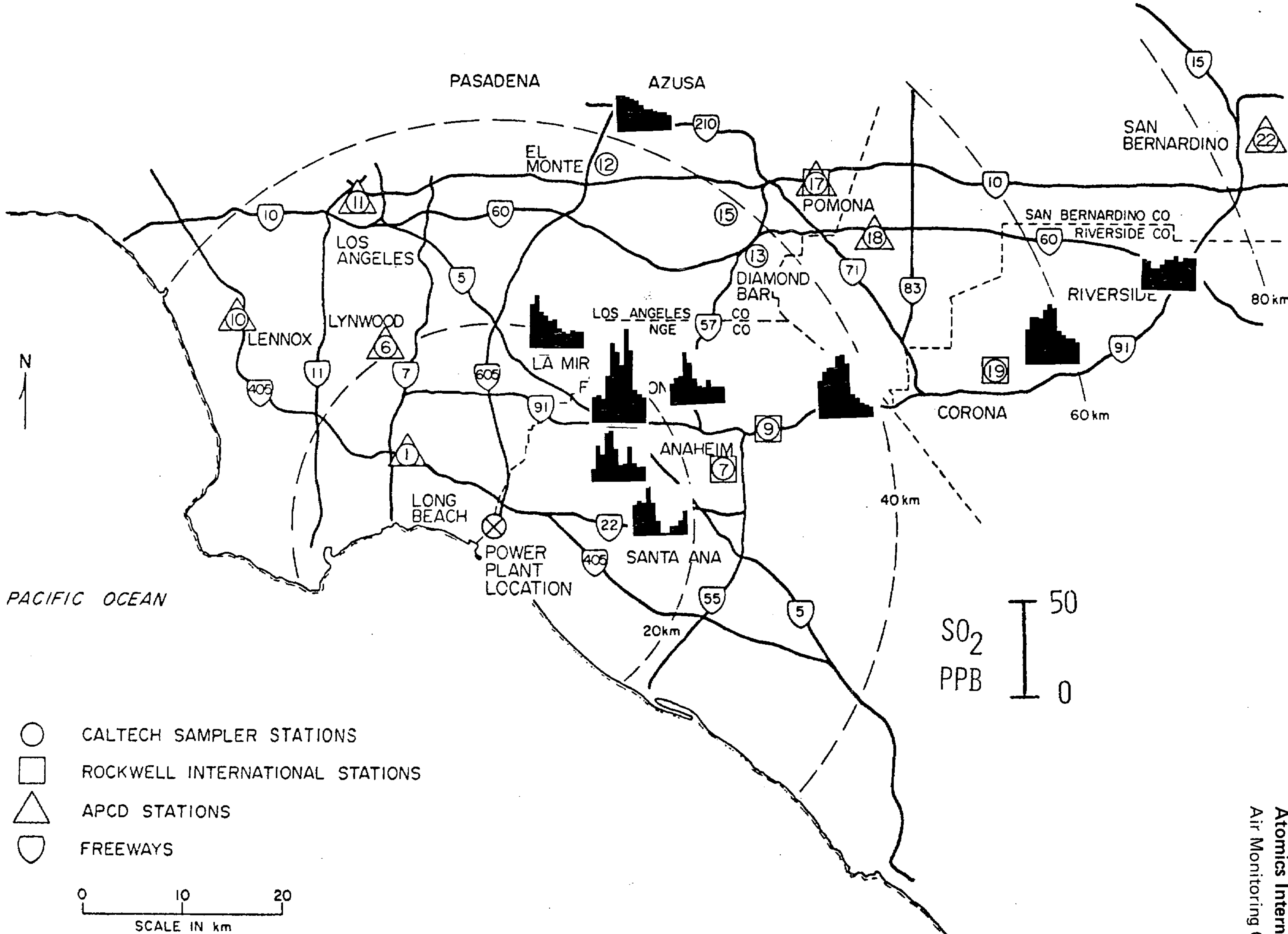

Figure 7-6. Histograms of the one-hour average SO_2 concentrations from 8:00 a.m. to 8:00 p.m. PST on 25 October 1974

TABLE 7-12

One-Hour Average Sulfur Dioxide Concentrations in ppb for

30 October 1974

Time of Day - Pacific Standard Time

Caltech	A.M.												P.M.											
Station #	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
2																								
3	7	7	8	6	6	7	9	10	10	11	11	10	10	9	8	8	8	7	9	10	9	9	9	9
4	12	12	13	12	10	12	12	12	13	14	16	15	18	13	15	35	17	44	46	21	17	14	14	14
5	11	12	12	10	11	11	12	12	13	14	17	12	20	17	15	14	15	14	15	13	16	15	12	10
8																								
14	10	10	11	10	9	9	9	9	11	11	11	15	13	14	13	13	13	13	11	10	9	10	9	8
16	13	13	11	12	11	11	11	11	10	9	9	10	11	11	13	14	16	14	13	13	12	11	11	11
17																								
20																								
21	12	13	13	12	12	9	12	13	14	18	16	14	14	15	15	14	17	18	16	15	13	17	16	16

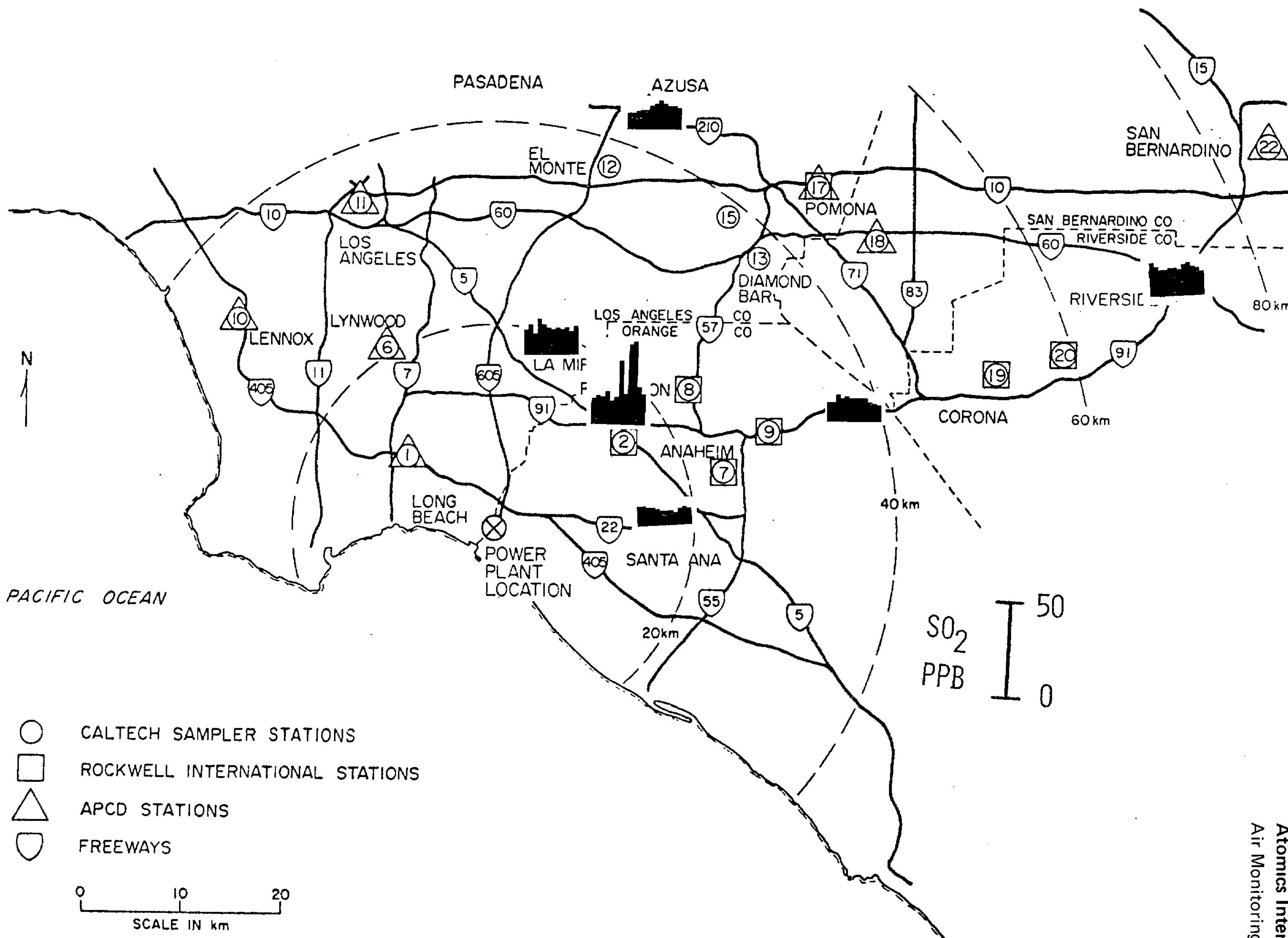

Figure 7-7. Histograms of the one-hour average SO_2 concentrations from 9:00 a.m. to 9:00 p.m. PST on 30 October 1974

TABLE 7-13

One-Hour Average Sulfur Dioxide Concentrations in ppb for

7 November 1974

Time of Day - Pacific Standard Time

Caltech	A.M.												P.M.											
Station #	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
2	16	7	13	16	14	7	18	21	12	20	17	16	10	30	26	53	16	13	10	8	11	11	12	11
3	2	2	4	2	2	0	1	2	7	7	7	7	8	11	16	14	14	20	24	15	15	14	12	8
4	14	13	13	13	12	10	11	13	18	18	16	17	19	20	49	67	24	27	32	28	21	18	16	15
5	10	8	8	9	8	9	13	12	12	12	12	15	20	9	20	20	25	22	18	17	16	14	11	12
8													13	15	32	39	18	17	14	11	7			
14	6	5	0	0	0	0	0	1	4	7	6	5	7	7	10	22	13	17	18	15	8	7	10	7
16	10	10	11	10	8	7	7	8	9	11	12	11	10	10	10	10	10	10	8	9	9	6	6	9
17																								
20																26	33	30	27	23	22	15	15	12
21																								

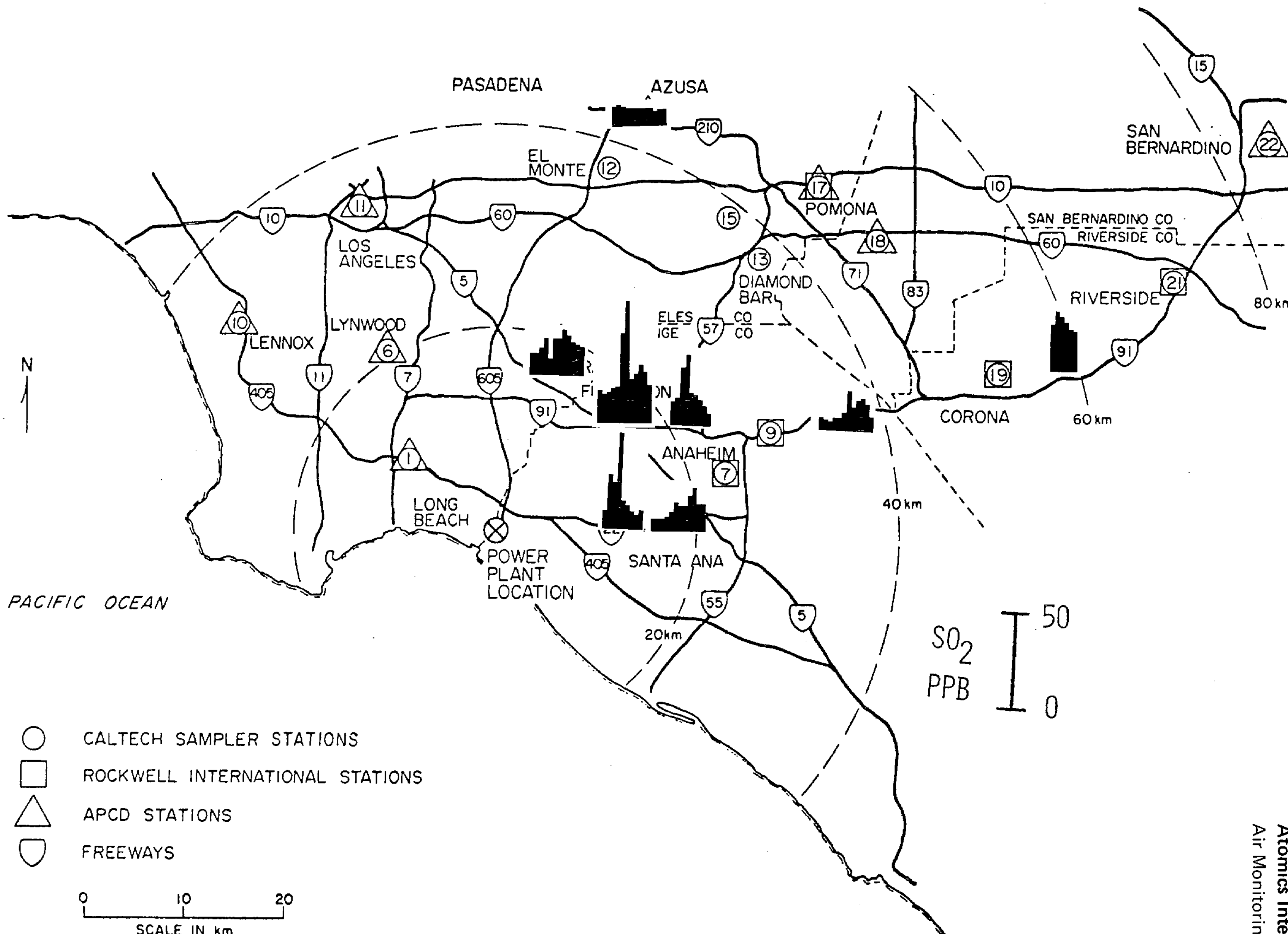

Figure 7-8. Histograms of the one-hour average SO_2 concentrations from 9:00 a.m. to 9:00 p.m. PST on 7 November 1974

TABLE 7-14

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Anaheim Fire Station No. 2

Caltech No. 2 AIHL No. 1

Time of Day - Pacific Standard Time

	A.M.												P.M.											
Date	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-07-74											68	67	26	46	27	17	10	11	11	18	15	14	12	13
10-08-74	14	15	10	14	11	10	12	14	11	13	13	17	16	17	18	13	37	28	11	11	14	12	10	10
10-09-74	10	12	13	13	12	12	13	14	14	13	14	18	21	20	31	33	27	14	10	9	10	12	15	13
10-10-74	17	14	12	12	20	22	18	15	15	15	17	14	12	13	20	17	8	10	10	5	4	6	9	7
10-11-74	7	15	15	11	13	14	16	12	10	15	15	17	18	21	26	13	8	7	7	7	6	6	6	6
10-12-74	9	11	8	10	8	12	14	13	21	21	14	15	15	14	18	20	16	11	13	17	12	11	9	9
10-13-74	9	10	9	10	9	12	11	13	14	12	9	10	25	42	33	12	5	0	4	5	8	9	6	7
10-14-74	12	12	14	12	13	13	13	13	12	14	20	26	36	41	54	43	23	20	25	28	25	27	25	18
10-15-74	7	5	4	6	9	11	10	13	17	13	25	22	5	0	4	3	11	9	5	6	14	13	8	8
10-16-74	8	9	16	15	19	18	16	16	17	23	28	15	6	14	16	11	12	16	15	18	20	17	19	17
10-17-74	14	17	19	15	25	25	27	22	22	17	16	17	13	15	23	28	11	9	8	10	11	10	9	8
10-18-74	11	14	14	12	0	2	0	0	0	13	14	15	18	43	42	26	20	20	13	8	8	6	5	6
10-19-74	3	1	7	8	7	11	12	11	10	11	14	24	21	16	15	17	15	13	12	10	9	10	9	6
10-20-74	7	10	11	11	12	10	11	12	13	12	14	18	14	14	12	12	9	11	10	10	9	10	12	10
10-21-74	9	7	6	8	8	8	10	9	10	8	9	10	8	9	12	15	10	8	10	7	6	11	13	13
10-22-74	10	8	7	8	12	10	9	12	11	11	10	11	11	9	6	9	8	9	7	4	3	2	0	1
10-23-74	8	7	13	14	13	12	16	17	11	8	7	8	13	20	10	42	17	12	8	12	11	8	7	6
10-24-74	6	6	7	7	10	14	18	19	14	10	9	25	45	16	12	12	13	11	9	8	8	12	9	16
10-25-74	14	19	17	17	12	8	9	10	7	20	15	27	28	18	9	10	19	10	8	8	8	10	8	7
10-26-74	7	6	6	6	6	6	8	9	9	9	7	12	18	17	5	6	7	2	0	6	11	8	7	7
11-05-74															24	24	22	22	23	24	25	26	25	15
11-06-74	14	16	17	20	20	18	20	21	16	21	18	16	17	17	14	14	17	15	21	25	23	24	21	22
11-07-74	16	7	13	16	14	7	18	21	12	20	17	16	10	30	26	53	16	13	10	8	11	11	12	11
11-08-74	5	0	2	0	8	13	19	18	16	3	8	11	16	53	60	44	14	8	8	17	20	16	14	17
11-09-74	12	7	14	15	21	19	18	13	14	12	15	12	10	8	6	6	6	8	10	16	19	16	15	19
11-10-74	19	16	16	17	17	18	16	13	10	9	10	17	28	39	16	14	16	19	25	26	26	23	17	20
11-11-74	13	7	2	5	2	5	15																	

TABLE 7-15

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Palm Harbor Medical Center

Caltech No. 3 AIHL No. 2

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
09-30-74																			12	9	8	6	7	17
10-01-74	15	10	12	15	20	18	18	16	16	21	33	32	36	22	12	6	6	6	6	9	9	10	10	7
10-02-74	3	5	4	3	2	2	5	15	21	18	18	19	8	7	5	3	3	2	9	3	4	4	1	3
10-03-74	1	3	6	4	4	5	6	8	10	12	18	14	9	7	8	5	5	2	3	6	11	13	9	8
10-04-74	7	5	3	3	0	1	1	1	4	1	0	2	0	0	2	2	2	3	1	6	9	5	5	6
10-05-74	10	7	9	16	12	9	13	6	8	9	8	6	9	11	9	6	4	9	10	6	7	10	11	16
10-06-74	15	8	15	19	17	12	15	13	10	8	10	12	12	9	8	7	7	7	5	6	8	13	14	13
10-07-74	5	3	3	4	3	4	10	18	3	14	14	12	7	7	18	16	11	12	12	12	12	12	12	11
10-08-74	12	11	12	14	17	16	15	16	15	16	19	23	23	11	8	6	8	10	8	9	10	9	9	9
10-09-74	9	10	8	8	12	16	24	24	22	13	11	12	11	11	9	9	10	13	10	9	8	8	9	9
10-10-74	10	8	9	10	11	13	15	14	14	13	11	10	11	11	5	6	5	5	5	7	8	8	7	7
10-11-74	12	12	13	12	12	12	13	14	14	15	15	18	21	22	17	10	11	10	11	9	12	12	12	9
10-12-74	10	15	13	16	20	26	28	25	38	22	19	17	15	15	12	11	11	12	11	11	10	10	10	8
10-13-74	9	9	9	9	10	10	12	13	12	15	27	30	26	18	12	11	11	11	11	13	13	14	13	14
10-14-74	15	14	12	13	13	12	11	15	19	42	37	34	26	22	20	16	21	29	29	9	10	11	12	12
10-15-74	10	10	9	7	9	12	15	12	11	16	16	13	17	17	24	22	19	19	12	12	11	9	7	8
10-16-74	8	9	9	10	11	10	10	12	13	12	13	22	15	3	11	18	21	19	14	18	18	19	18	17
10-17-74	21	20	18	15	14	14	17	19	22	19	27	20	15	14	13	14	10	10	10	9	8	10	12	12
10-18-74	14	11	11	12	11	11	10	10	12	17	19	19	41	52	47	41	27	19	18	13	8	10	9	9
10-19-74	11	14	13	16	18	18	16	15	15	17	24	25	24	25	21	25	21	19	15	12	12	12	14	13
10-20-74	15	19	21	21	20	22	21	17	15	17	17	17	17	18	16	17	18	11	10	9	10	10	9	10
10-21-74	9	9	7	9	9	9	8	8	10	10	11	12	11	14	13	12	12	15	10	9	11	12	13	11
10-22-74	10	12	11	10	10	10	11	12	12	13	13	14	14	12	12	12	8	6	7	9	6	7	7	11
10-23-74	8	6	8	7	8	8	8	9	10	7	4	5	5	6	4	2	2	5	4	5	6	8	8	5
10-24-74	2	1	1	2	5	6	11	13	12	12	9	9	20	18	17	18	14	2	2	6	5	10	7	6
10-25-74	9	10	7	6	7	7	8	12	17	19	18	27	18	8	0	1	5	5	8	13	8	6	7	12
10-26-74	11	10	10	9	10	10	10	9	7	17	16	11	14	13	9	7	7	5	5	8	6	8	8	8
10-27-74	7	8	9	7	7	9	9	10	10	11	10	10	9	8	8	9	8	7	9	9	6	5	5	7
10-28-74	9	9	9	7	9	9	8	9	9	10	8	8	9	12	11	11	10	14	10	8	6	7	6	8

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TABLE 7-15

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Palm Harbor Medical Center (continued)

Caltech No. 3 AIHL No. 2

Time of Day - Pacific Standard Time

	A.M.												P.M.											
Date	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-29-74	9	10	8	9	8															7	5	6	9	9
10-30-74	7	7	8	6	6	7	9	10	10	11	11	10	10	9	8	8	8	7	9	10	9	9	9	9
10-31-74	9	9	8	7	8	7	7	7	9	10	8	7	7	7	7	5	5	7	9	11	28	26	15	11
11-01-74	9	9	9	8	9	9	9	11	16	22	24	12	7	7	9	8	7	7	7	9	10	8	8	7
11-02-74	5	7	7	6	7	5	7	8	9	9	9	8	7	8	9	9	9	9	8	9	9	8	6	3
11-03-74	7	9	9	7	7	7	8	8	7	11	14	10	7	8	10	11	10	7	8	9	9	9	9	9
11-04-74	9	9	10	10	10	9	9	10	11	12	14	16	18	35	32	20	15	20	14	12	10	12	12	14
11-05-74	14	12	12	10	8	7	8	11	14	17	15	21	65	36	20	14	18	18	17	17	20	17	15	14
11-06-74	15	15	12	10	9	9	9	9	9	8	7	8	7	7	3	13	13	16	11	13	15	15	13	9
11-07-74	2	2	4	2	2	0	1	2	7	7	7	7	8	11	16	14	14	20	24	15	15	14	12	8
11-08-74	6	6	5	3	2	2	5	7	7	7	8	9	9	27	21	10	17	15	12	12	16	16	16	15
11-09-74	15	13	12	10	11	9	8	9	12	12	11	14	17	16	20	17	13	10	19	21	14	12	14	12
11-10-74	12	6	7	6	3	3	2	3	2	7	14	9	9	31	25	7	6	8	13	14	10	13	11	12
11-11-74	11	11	3	0	0	0	0	1	6	7	3													

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TABLE 7-16

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Fullerton Fire Station No. 2

Caltech No. 4 AIHL No. 0

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-01-74											43	57	51	40	28	35	75	17	11	9	6	9	7	13
10-02-74	14	12	12	10	11	11	14	17	22	20	25	42	41	42	42	41	16	11	9	11	11	10	9	10
10-03-74	9	12	10	10	10	12	11	13	12	9	20	40	47	48	16	20	35	85	45	15	14	14	15	17
10-04-74	16	16	15	14	12	11	12	11	15	17	13	13	13	13	21	25	43	70	40	15	15	17	17	16
10-05-74	15	13	15	16	15	15	14	15	19	18	19	27	31	22	32	29	22	20	14	12	10	11	11	11
10-06-74	12	12	17	22	21	20	18	18	18	16	15	15	19	34	28	18	17	13	13	11	17	22	18	15
10-07-74	11	12	11	11	10	11	13	13	11	22	42	55	61	63	23	15	16	17	19	18	19	17	15	16
10-08-74	17	17	14	13	14	15	16	17	16	17	20	21	26	25	27	30	51	44	21	18	19	17	17	17
10-09-74	17	16	15	14	14	14	15	18	16	17	19	21	33	37	30	33	45	19	18	22	24	14	15	11
10-10-74	10	9	7	8	7	9	9	12	17	29	39	34	36	43	54	61	46	44	25	16	14	14	13	12
10-11-74	12	13	13	13	13	14	14	17	18	15	15	23	30	31	50	54	32	19	19	14	13	12	12	14
10-12-74	14	15	15	15	15	19	20	20	29	38	33	29	40	34	35	41	26	36	33	29	21	20	19	18
10-13-74	17	16	18	19	20	18	19	21	20	22	28	29	38	42	42	25	20	19	19	20	20	21	19	21
10-14-74	23	21	21	20	20	21	22	23	23	51	72	55	62	87	88	64	47	41	37	28	29	26	22	21
10-15-74	20	19	14	15	13	15	18	20	26	33	50	23	18	21	27	28	28	28	29	26	22	19	16	15
10-16-74	14	14	13	13	14	14	20	18	17	20	37	23	22	15	14	18	27	29	33	21	18	13	8	10
10-17-74	6	6	5	3	3	4	8	19	13	12	14	25	53	17	16	39	32	21	17	15	13	15	8	7
10-18-74	9	6	8	2	10	11	12	15	16	22	22	21	23	56	63	40	34	31	31	21	16	13	12	11
10-19-74	11	10	10	10	9	11	10	10	13	19	24	33	50	31	26	28	30	24	23	22	20	13	13	11
10-20-74	9	11	14	16	17	19	19	19	23	23	25	23	27	25	19	16	15	14	10	8	8	12	14	11
10-21-74	8	7	7	7	7	7	9	15	13	6	5	11	11	12	15	19	19	15	20	12	10	9	9	8
10-22-74	10	10	8	9	9	12	13	15	11	10	12	11	14	11	8	9	12	11	11	11	11	9	8	9
10-23-74	9	10	8	8	9	8	9	9	9	2	1	5	11	20	40	47	47	19	13	15	16	12	11	10
10-24-74	8	7	9	7	7	5	5	10	15	20	16	16	19	23	29	18	19	20	17	16	16	13	13	12
10-25-74	10	11	9	8	7	7	7	11	14	15	13	26	44	39	32	52	40	18	16	14	10	10	10	15
10-26-74	14	15	15	14	13	14	14	19	17	16	16	17	24	28	20	13	16	15	13	13	13	14	13	13

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TABLE 7-16

One-Hour Average Sulfur Dioxide Concentrations in ppb
at Fullerton Fire Station No. 2 (continued)

Caltech No. 4 AIHL No. 0

Time of Day - Pacific Standard Time

A.M.

Date	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-27-74	11	13	14	12	12	15	18	13	17	21	12	14
10-28-74	18	13	12	11	12	10	10	10	9	7	6	2
10-29-74	12	13	6	7	8	11	7	7	8	10	6	7
10-30-74	12	12	13	12	10	12	12	12	13	14	16	15
10-31-74	16	16	16	17	17	14	13	12	9	10	12	15
11-01-74	22	21	22	20	19	19	17	17	11	14	16	19
11-02-74	17	15	16	16	16	15	14	15	17	17	20	17
11-03-74	16	15	15	17	17	16	16	15	15	17	19	23
11-04-74	16	15	16	14	10	9	7	8	14	17	20	23
11-05-74	12	11	12	10	8	6	5	13	14	18	17	19
11-06-74	10	11	8	6	5	5	4	8	10	17	24	19
11-07-74	14	13	13	13	12	10	11	13	18	18	16	17
11-08-74	13	13	12	11	10	8	7	7	11	17	13	17
11-09-74	17	17	15	15	14	11	10	13	17	22	31	24
11-10-74	18	16	13	12	13	13	13	15	16	18	20	41
11-11-74	19	19	19	17	15	14	16	24	20			

P.M.

Date	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-27-74	15	15	15	11	8	10	9	10	10	10	10	14
10-28-74	2	6	10	15	16	15	14	12	13	11	12	12
10-29-74	6	13	17	19	24	26	20	22	21	18	16	17
10-30-74	18	13	15	35	17	44	46	21	17	14	14	14
10-31-74	13	8	7	16	12	22	58	45	41	27	24	23
11-01-74	20	21	36	39	37	23	20	19	23	24	22	20
11-02-74	22	21	23	22	21	20	19	18	19	20	18	18
11-03-74	31	30	28	32	39	48	54	20	19	18	18	15
11-04-74	26	23	34	23	24	33	31	33	22	20	17	15
11-05-74	21	39	34	29	24	27	24	21	18	17	14	12
11-06-74	19	19	19	21	21	25	26	23	17	15	15	15
11-07-74	19	20	49	67	24	27	32	28	21	18	16	15
11-08-74	24	34	35	52	25	20	19	17	16	13	12	13
11-09-74	25	25	22	23	23	27	28	24	28	17	17	18
11-10-74	31	38	60	33	23	29	29	21	20	21	22	20
11-11-74												

TABLE 7-17

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Whittier APCD

Caltech No. 5 AIHL No. 4

Time of Day - Pacific Standard Time

Date	A.M.												P.M.											
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-24-74											16	23	25	19	18	15	17	18	18	21	18	16	13	13
10-25-74	9	7	8	11	10	13	15	16	24	29	20	18	15	16	11	9	8	10	9	9	9	7	7	12
10-26-74	13	12	9	11	10	10	11	10	12	12	10	10	10	8	8	6	7	10	11	9	10	11	12	12
10-27-74	12	14	13	12	11	10	12	12	13	15	20	9	11	14	8	8	29	25	22	11	13	10	9	7
10-28-74	8	8	6	6	0	3	7	3	9	9	11	16	12	9	5	7	8	6	7	8	6	0	4	8
10-29-74	9	8	7	2	6	7	8	10	11	9	7	8	10	11	12	18	16	44	17	12	14	13	12	12
10-30-74	11	12	12	10	11	11	12	12	13	14	17	12	20	17	15	14	15	14	15	13	16	15	12	10
10-31-74	8	6	7	7	9	9	11	13	10	10	12	10	10	12	9	10	11	16	15	17	16	14	14	12
11-01-74	10	9	11	10	10	9	7	10	13	15	13	16	15	12	14	9	4	7	10	12	5	7	6	7
11-02-74	9	9	8	7	7	8	10	10	11	22	21	19	22	32	26	14	5	7	9	12	12	11	10	11
11-03-74	10	10	8	8	10	8	9	9	11	22	29	35	37	41	31	23	12	13	12	10	13	12	10	8
11-04-74	9	11	8	9	6	7	9	16	18	26	28	19	12	20	19	27	8	5	6	5	6	6	5	6
11-05-74	7	8	8	6	7	8	10	14	11	14	10	27	12	14	19	15	12	15	16	14	12	11	9	9
11-06-74	7	8	8	1	3	7	7	10	12	17	10	10	5	8	8	9	21	17	20	13	9	8	10	5
11-07-74	10	8	8	9	8	9	13	12	12	12	12	15	20	9	20	20	25	22	18	17	16	14	11	12
11-08-74	11	12	11	11	7	8	5	7	8	8	11	30												

TABLE 7-18

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Orange Fire Station No. 3

Caltech No. 7 AIHL No. 4

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-01-74	8	11	11	10	11	11	9	12	13	15	22	36	39	38	26	18	17	11	7	10	10	11	7	4
10-10-74										13	15	15	17	16	16	22	16	26	11	12	10	10	9	6
10-11-74	8	9	7	7	7	5	2	6	5	11	9	7	6	17	24	26	24	17	11	8	7	10	9	8
10-12-74	11	9	16	19	15	15	18	18	25	26	25	39	26	19	17	16	15	15	14	12	13	11	11	13
10-13-74	10	13	11	12	11	11	11	10	9	10	13	13	15	35	44	39	21	16	10	13	13	12	10	12
10-14-74	14	8	8	12	11	11	12	11	11	13	19	19	26	46	43	41	37	32	24	18	19	19	17	16
10-15-74	14	13	12	12	12	12	13	16	19	14	10	11	10	12	17	11	21	15	12	13	13	9	9	9
10-16-74	7	2	3	1	1	1	0	0	0	0	0	8												

TABLE 7-19

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Fullerton Fire Station No. 5

Caltech No. 8 AIHL No. 3

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-01-74	0	2	4	6	9	11	14	11	13	17	20	25	18	15	13	12	10	12	10	13	15			
10-02-74			11	12	11	12	14	14	14	12	16	18	15	19	27	22	22	18	18	9	10	10	9	8
10-03-74	9	10	10	10	10	9	6	9	10	10	10	12	20	28	20	13	14	21	13	13	11	13	15	17
10-04-74	18	16	14	15	15	14	11	10	9	8	9	8	7	8	8	13	20	24	27	21	17	19	19	16
10-05-74	13	10	10	9	11	11	10	10	10	10	11	14	17	19	16	17	17	15	12	8	8	8	9	10
10-06-74	12	13	13	12	11	12	14	14	17	16	15	14	14	19	18	16	14	10	8	9	10	12	10	9
10-07-74	11	11	11	9	6	3	5	9	11	15	17	20	54	33	33	15	12	11	7	8	10	10	8	7
10-08-74	8	10	9	7	3	8	11	14	18	20	19	18	22	20	21	19	16	23	14	10	12	10	9	8
10-09-74	8	7	9	12	13	14	15	17	17	16	16	12	14	21	25	26	22	10	9	9	8	9	11	12
10-10-74	12	12	12	12	11	13	17	16	13	17	20	20	18	19	27	28	12	9	7	9	6	9	9	11
10-11-74	9	14	15	15	15	16	14	14	12	14	14	14	17	19	19	20	11	6	3	4	2	5	2	9
10-12-74	13	15	15	15	16	17	17	17	13	16	15	16	20	19	16	16	16	13	10	12	13	13	15	15
10-13-74	15	11	11	14	14	13	12	10	10	9	11	10	13	14	21	25	17	14	16	15	14	5	5	6
10-14-74	7	9	10	15	13	11	10	6	8	13	16	17	27	24	27	46	35	41	32	25	19	18	15	14
10-15-74	12	11	12	13	14	16	17	20	18	17	17	16	9	11	12	16	18	9	8	11	10	10	10	14
10-16-74	14	14	12	10	3	2	3	8	9	7	7	13	13	17	23	32	23	17	18	12	15	16	15	13
10-17-74	12	12	10	9	11	16	16	17	12	12	12	32	17	13	12	18	17	10	7					
10-22-74																			10	13	14	18	18	18
10-23-74	18	18	19	16	18	17	18	16	17	17	15	15	15	17	24	29	31	37	29	19	15	15	13	14
10-24-74	13	13	14	14	13	13	17	17	16	17	18	14	15	23	16	15	18	17	14	12	14	14	14	15
10-25-74	17	16	15	14	13	14	12	13	12	15	16	29	23	14	10	9	13	9	9	9	8	9	8	9
10-26-74	10	11	10	10	10	13	16	17	16	16	15	18	19	19	13	13	16	11	10	11	10	10	11	11
10-27-74	6	7	6	8	8	9	10	12	13	15	15	14	15	9	9	12								
10-28-74	13	13	16	14	14	15	14	14	12	9	12	11	9	8	5	8								
11-07-74													13	15	32	39	18	17	14	11	7			
11-08-74	23	16	12	10	12	8	8																	
11-11-74							12	19	36	19														

TABLE 7-20

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Anaheim Fire Station No. 8

Caltech No. 9 AIHL No. 5

	Time of Day - Pacific Standard Time																							
	A.M.												P.M.											
Date	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-01-74	3	6	6	6	8	9	9	10	11	13	17	22	30	32	22	14	8	1	1	2	0	0	0	0
10-11-74								10	11	12	12	11	8	16	18	14	10	49	8	14	6	4	5	5
10-17-74	10	10	8	8	7	8	9	11	8	14	16	20	15	11	10	11	9	11	5	2	3	4	5	5

TABLE 7-21

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Featherly Regional Park

Caltech No. 14 AIHL No. 6

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-01-74	6	6	7	8	9	9	11	11	11	12	14	20	30	34	22									
10-10-74												13	14	15	15	13	15	12	9	7	7	8	5	5
10-11-74	5	5	4	3	5	8	9	9	11	12	13	13	14	16	17	21	17	14	11	9	8	7	5	7
10-12-74	9	11	12	11	12	12	11	13	13	15	9	9	24	25	24	23	23	16	13	12	12	10	9	7
10-13-74	8	8	6	7	7	8	9	9	8	9	10	9	11	13	34	43	37	14	10	10	11	10	7	7
10-14-74	4	5	3	1	2	7	6	10	11	12	13	14	17	24	32	38	35	38	27	18	13	13	12	15
10-15-74	14	14	13	13	13	11	12	10	11	11	11	9	9	7	8	14	21	20	15	13	14	12	8	8
10-16-74	7	9	8	6	7	8	6	7	9	10	10	9	9	9	22	22	16	16	13	10	9	10	10	12
10-17-74	9	10	9	9	8	9	10	9	8	10	11	14	20	18	15	16	18	18	20	15	10	6	8	9
10-18-74	9	8	9	8	9	8	7	9	12	12														
10-24-74													15	17	32	30	24	15	14	13	15	11	10	8
10-25-74	10	11	12	11	12	11	11	13	21	26	28	34	35	30	30	13	11	8	7	6	8	8	6	7
10-26-74	6	7	10	12	11	11	12	18	17	15	16	16	9	11	13	13	11	10	8	10	13	18	20	20
10-27-74	21	12	12	13	10	9	9	7	10	11	10	6	7	6	7	6	7	7	4	5	4	4	5	6
10-28-74	5	4	5	6	6	4	4	4	7	7	6	5	5	9	13	13	12	11	9	8	9	9	8	6
10-29-74	9	10	10	10	11	11	10	10	12	11	11	12	11	10	11	12	13	12	10	11	12	12	11	10
10-30-74	10	10	11	10	9	9	9	9	11	11	11	15	13	14	13	13	13	13	11	10	9	10	9	8
10-31-74	9	8	8	7	7	7	6	8	11	10	10	12	13	13	14									
11-06-74														10	10	11	14	14	12	10	10	9	9	8
11-07-74	6	5	0	0	0	0	0	1	4	7	6	5	7	7	10	22	13	17	18	15	8	7	10	7
11-08-74	4	0	3	4	5	5	4	2	8	9	10	10	9	10	15	32	24	19	19	13	6	6	7	8
11-09-74	11	8	10	10	10	7	9	8	8	10	8	7	8	8	8	17	20	15	11	9	9	9	9	8
11-10-74	8	7	5	4	3	5	3	3	5	7	8	7	8	7	15	21	17	16	11	8	11	9	6	5
11-11-74	3	2	2	0	0	1	3	1	4	5	3	5												

TABLE 7-22

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Azusa APCD

Caltech No. 16 AIHL No. 7

Time of Day - Pacific Standard Time

Date	A.M.												P.M.											
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
10-24-74											13	13	12	12	14	14	13	13	17	17	15	13	13	12
10-25-74	13	13	12	12	12	14	15	17	20	20	19	18	17	14	12	12	11	10	10	8	7	5	8	9
10-26-74	11	9	10	12	14	14	13	13	15	13	10	11	10	7	8	8	8	8	10	9	11	10	12	11
10-27-74	11	10	13	13	11	11	11	12	11	11	9	11	13	13	14	14	12	10	12	10	9	9	8	9
10-28-74	8	7	7	6	13	12	12	11	10	10	9	11	11	10	12	10	8	8	8	8	6	6	3	6
10-29-74	8	6	6	6	6	5	5	4	6	6	5	7	9	8	3	6	11	12	13	11	15	20	18	14
10-30-74	13	13	11	12	11	11	11	11	10	9	9	10	11	11	13	14	16	14	13	13	12	11	11	11
10-31-74	10	9	8	9	8	11	12	12	12	10	10	9	9											
11-06-74											10	9	11	12	12	13	14	13	14	12	11	10	11	10
11-07-74	10	10	11	10	8	7	7	8	9	11	12	11	10	10	10	10	10	10	8	9	9	6	6	9
11-08-74	7	8	9	9	8	10	11	11	15	13	13													

TABLE 7-23

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Corona Forest Fire Station

Caltech No. 19 AIHL No. 7

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
09-30-74															24	43	37	26	24	20	13	9	9	7
10-01-74	8	5	8	10	11	11	8	10	12	16	17	20	21	35	30	21	14	13	12	9	8	8	5	1
10-02-74	0	5	8	10	8	9	12	16	18	21	22	22	22	16	15	15	14	9	5	7	7	5	6	8
10-03-74	8	8	8	6	6	10	12	11	14	13	18	23	24	21	22	20	15	14	12	10	10	10	13	13
10-04-74	12	14	13	13	12	12	13	14	15	14	14													
10-06-74								5	12	15	18	16	15	15	16	17	15	15	14	13	11	13	14	14
10-07-74	12	11	11	12	13	12	11	14	18	18	18													
10-16-74																	21	22	19	14	12	10	10	10
10-17-74	6	6	6	5	5	6	5	7	9	6	8	10	12	17	17	13	16	15	16	15	14	11	13	11
10-18-74	9	11	9	6	3	0	0	0	5	0	13	14	13	14	16	37	32	39	30	24	21	19	15	12
10-19-74	13	12	9	7	7																			

TABLE 7-24

One-Hour Average Sulfur Dioxide Concentrations in ppb

at Riverside Fire Station No. 8

Caltech No. 20 AIHL No. 8

Time of Day - Pacific Standard Time

	A.M.												P.M.											
Date	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
09-30-74														24	29	31	43	36	29	26	26	23	18	12
10-01-74	16	17	18	17	18	19	20	17	19	25	29	26	36	34	27	21	19	15	14	14	12	12	12	11
10-02-74	11	8	10	12	12	14	13	15	16	19	23	24	21	20	22	17	15	14	12	10	9	11	13	14
10-03-74	14	14	12	12	12	15	15	15	18	20	17	16	24	27	23	23	22	17	17	16	14	13	14	14
10-04-74	15	16	15	15	16	17	17	17	18	18	17	15	15	14	12	10	6	2	10	13	14	12	13	11
10-05-74	12	12	11	10	9	7	13	16	15	19	19	17	15	16	19	17	15	17	16	14	14	14	14	12
10-06-74	12	14	14	15	14	12	13	16	18	18	20	19	17	17	17	17	16	15	14	13	13	12	12	14
10-07-74	14	14	14	14	14	14	14	16	17	18	20	21	20	19	20	2	8	8	3	6	8	5	8	6
10-08-74	9	10	10	9	8	7	7	4	5	7	8	10	8	9	10	13	12	14	13	10	10	10	10	10
10-09-74	7	7	7	8	8	3	8	7	9	11	11	14	13	11	11	15	17	15	13	10	7	8	10	5
10-10-74	9	10	7	8	8	10	5	5	3	13	19	17	13	12	17	17	16	13	12	10	9	9	9	9
10-11-74	10	8	8	9	10	7	1	1	8	12	13	12	15	13	16	17	17	17	14	10	10	11	9	9
10-12-74	7	8	10	11	8	10	8	11	10	8	9	13	11	0	5	18	21	17	13	12	12	14	12	12
10-13-74	7	10	13	10	11	11	11	8	10	12	15	18	19	13	12	22	32	23	19	14	9	9	7	7
10-14-74	6	4	2	4	1	0	5	12	14	13	12	15	12	12	18	16	21	23	27	18	15	14	12	10
10-15-74	13	14	13	12	8	11	13	15	18	14	15	19	15	13	14	14	15	16	15	11	10	10	8	6
10-16-74	5	8	10	8	7	7	8	3	8	12	14	15	15	15	16	23	23	28	27	12	22	22	21	20
10-17-74	19	18	19	18	18	17	21	31	38	45	38	29	25	27	27	26	26	26	25	22	22	22	23	21
10-18-74	20	21	19	19	20	20	19	20		218	127	7	0	0	0	6	31	27	25	23	17	9	3	3
10-25-74	13	14	15	14	12	13	14	14	19	26	26	25	30	33	31	18	16	14	14	12	14	12	12	12
11-07-74																26	33	30	27	23	22	15	15	12

TABLE 7-25

One-Hour Average Sulfur Dioxide Concentrations in ppb at Riverside Fire Station Central Headquarters

Caltech No. 21 AIHL No. 9

Time of Day - Pacific Standard Time

Date	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
09-30-74													15	16	15	22	35	40	28	27	26	23	21	21
10-01-74	22	16	16	18	18	15	13	16	18	20	17	23	23	21	28	31	31	23	21	19	15	14	14	15
10-02-74	15	11	13	15	13	12	10	13	17	20	16	17	20	20	20	19	15	14	14	10	3	8	10	11
10-03-74	10	8	12	13	10	9	6	13	12	9			19	26	23	19	16	17	11	14	17	16	16	15
10-04-74	13	10	13	12	13	13	14	7	12	15	16	15	12	16	12	17	18	19	17	17	14	14	16	17
10-05-74	15	13	13	8	9	8	9	14	12	14	12	13	16	15	14	15	13	14	14	15	14	13	13	14
10-06-74	15	14	17	17	15	13	17	14	15	15	15	12	11	14	16	16	11	12	12	12	15	12	13	12
10-07-74	13	6	5	6	8	10	10	8	2	15	16	18	25	21	27	33	32	31	28	21	20	18	19	17
10-08-74	21	20	18	19	17	18	18	21	19	21	23	27	24	22	24	23	21	18	17	19	18	16	13	18
10-09-74	20	19	16	14	17	18	18	21	18	21	19	20	20	16	20	21	23	26	19	18	16	16	14	17
10-10-74	19	15	15	13	14	13	11	13	14	20	21	24	21	17	22	24	23	18	20	19	18	17	14	17
10-11-74	18	14	15	11	14	16	16	15	18	20	27	28	20	19	19	19	20	18	20	19	19	19	19	19
10-12-74	18	14	13	16	17	17	16	12	12	11	11	12	6	13	13	12	16	18	24	21	20	18	16	15
10-13-74	15	13	13	17	15	14	17	12	14	14	16	16	12	15	15	17	29	26	26	22	21	17	22	21
10-14-74	19	19	15	16	14	12	15	21	23	20	18	15	11	14	14	16	26	32	36	40	34	31	30	22
10-15-74	17	14	13	14	12	14	21	26	17	16	13	13	14	11	9	7	11	14	13	16	16	17	15	14
10-16-74	10	5	15	13	10	10	12	17	15	16	13	12	12	10	11	10	21	22	20	21	18	19	18	15
10-17-74	15	11	10	10	10	11	20	15	12	13	6	11	13	13	16	13	11	12	14	13	16	17	18	14
10-18-74	14	12	15	15	12	8	8	12																
10-22-74											21	25	23	20	20	20	17	16	15	14	18	17	16	16
10-23-74	11	11	10	9	10	8	14	13	13	14	14	19	17	19	19	16	16	15	13	13	13	17	13	12
10-24-74	11	13	17	16	16	15	14	17	17	16	14	17	22	23	24	22	20	19	13	12	12	28	23	20
10-25-74	20	15	16	17	14	14	12	16	17	16	12	12	14	17	17	19	16	18	18	18	24	23	17	15
10-26-74	13	12	10	14	14	13	13	9	10	10	9	8	7	12	12	9	9	12	16	16	17	16	10	10
10-27-74	11	13	9	8	12	13	13	12	8	14	13	13	13	10	18	18	17	15	12	14	13	11	12	11
10-28-74	14	14	11	10	7	16	16	13	14	10	10	11	9	11	9	10	11	13	14	12	14	11	9	11
10-29-74	6	11	11	10	10	12	16	16	15	14	11	13	12	12	13	15	16	16	16	15	18	18	17	14
10-30-74	12	13	13	12	12	9	12	13	14	18	16	14	14	15	15	14	17	18	16	15	13	17	16	16
10-31-74	18	16	19	17	17	14	13	13	13	14	13	13	12	12										

7.6 FREQUENCY OF OCCURRENCE OF ELEVATED SO_2 CONCENTRATIONS AS A FUNCTION OF STATION LOCATION AND TIME OF DAY

Table 7-26 through 7-32 are designed to show the station locations and times of day when elevated sulfur dioxide concentrations were observed. Only ground stations between the power plants and the Puente Hills are included in these tabulations, because it is only for these stations that the impact of the plumes is great enough to show well in this data format.

TABLE 7-26

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations as a Function of Time of Day at Anaheim Fire Station No. 2

Caltech No. 2 AIHL No. 1

SO_2 Concentration Range ppb	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	25	25	25	25	25	25	25	24	24	24	24	24	23	18	21	21	25	26	26	26	26	26	26	26
30 to 39													1	2	2	1	1							
40 to 49													1	4	1	3								
50 to 69											1	1		1	2	1								
70 & up																								
Total	25	25	25	25	25	25	25	24	24	24	25	25	25	25	26	26	26	26	26	26	26	26	26	26

(Number of Observations, PST)

TABLE 7-27

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations as a Function of Time of Day at Palm Harbor Medical Center

Caltech No. 3 AIHL No. 2

Number of Observations (PST)

SO_2 Concentration Range ppb	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	42	42	42	42	42	41	41	41	40	40	39	37	37	36	38	39	40	40	41	42	42	42	42	42
30 to 39									1		2	3	1	3	1									
40 to 49										1			1		1	1								
50 to 69													1	1										
70 & up																								
Total	42	42	42	42	42	41	41	41	41	41	41	40	40	40	40	40	40	40	41	42	42	42	42	42

TABLE 7-28

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations

as a Function of Time of Day at Fullerton Fire Station No. 2

Caltech No. 4 AIHL No. 0

SO_2 Concentration Range	Number of Observations																							
	PST																							
	A.M.												P.M.											
ppb	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	41	41	41	41	41	41	41	41	41	37	33	33	25	23	24	23	26	31	30	39	40	41	41	41
30 to 39										2	4	2	7	10	8	8	7	3	6	1				
40 to 49											2	3	4	5	4	4	6	5	3	1	1			
50 to 69										1	1	3	5	2	4	6	1		2					
70 & up											1			1	1		1	2						
Total	41	41	41	41	41	41	41	41	41	40	41	41	41	41	41	41	41	41	41	41	41	41	41	41

TABLE 7-29

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations

as a Function of Time of Day at Whittier APCD

Caltech No. 5 AIHL No. 4

SO_2 Concentration Range	Number of Observations																							
	PST																							
	A.M.												P.M.											
ppb	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	15	15	15	15	15	15	15	15	15	15	16	14	14	13	14	15	15	14	15	15	15	15	15	15
30 to 39												2	1	1	1									
40 to 49														1				1						
50 to 69																								
70 & up																								
Total	15	15	15	15	15	15	15	15	15	15	16	16	15	15	15	15	15	15	15	15	15	15	15	15

TABLE 7-30

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations

as a Function of Time of Day at Orange Fire Station No. 3

Caltech No. 7 AIHL No. 4

SO_2 Concentration Range	Number of Observations																							
	PST																							
	A.M.												P.M.											
ppb	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	7	7	7	7	7	7	7	7	7	8	8	6	6	4	5	5	6	6	7	7	7	7	7	7
30 to 39												2	1	2		1	1	1						
40 to 49														1	2	1								
50 to 69																								
70 & up																								
Total	7	7	7	7	7	7	7	7	7	8	8	8	7	7	7	7	7	7	7	7	7	7	7	7

TABLE 7-31

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations

as a Function of Time of Day at Fullerton Fire Station No. 5

Caltech No. 8 AIHL No. 3

SO_2 Concentration Range	Number of Observations																							
	A.M. PST												P.M.											
ppb	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	23	23	24	24	24	24	25	24	24	24	23	22	23	23	22	21	20	20	22	22	22	20	20	20
30 to 39												1		1	2	2	2	1	1					
40 to 49																1		1						
50 to 69													1											
70 & up																								
Total	23	23	24	24	24	24	25	24	24	24	23	23	24	24	24	24	22	22	23	22	22	20	20	20

TABLE 7-32

Frequency of Occurrence of Elevated Sulfur Dioxide Concentrations

as a Function of Time of Day at Anaheim Fire Station No. 8

Caltech No. 9 AIHL No. 5

SO_2 Concentration Range ppb	A.M. 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	P.M. 12-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Below 30	2	2	2	2	2	2	2	3	3	3	3	3	2	2	3	3	3	2	3	3	3	3	3	3
30 to 39													1	1										
40 to 49																		1						
50 to 69																								
70 & up																								
Total	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Number of Observations (PST)

8.0 FILTER CHEMISTRY DATA

Two-hour sequential filter samples of the ambient aerosol were collected at ten ground stations on each test day during the time periods listed in Table 6.1. These filters were sent to the Air and Industrial Hygiene Laboratory (AIHL), California Department of Public Health, for analysis as described in their final report (1). The filters were weighed to determine the aerosol mass concentration, wet chemical methods were used to determine sulfate and nitrate, and α-particle excited x-ray fluorescence analysis was used by the University of California at Davis (11) to determine the following elemental concentrations: Na, Mg, Al, Si, S, Cl, K, Ca, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, and Pb. The resulting data are voluminous enough that they are reported in Appendix C. This section provides information on data reduction work at the AMC to obtain these results; their interpretation is discussed in later sections.

As noted earlier, there were some cases in the South Coast Air Basin portion of the study in which the pens in the flow recorders of the sequential samplers failed to record the sample air flow rate. However, the statistical analysis of all flow rate records obtained in the South Coast Air Basin showed that the mean flow rate was 3.44 cfm (97.4 l min^{-1}), and that the standard deviation about this mean was 0.26 cfm, or 7.5% of the mean. Furthermore, when the flow settings for each individual sampler were considered, the variability of the results was appreciably reduced. The missing flow rate data were interpolated between the existing flow rate data, and supplied to AIHL. If a standard error of 7% in the flow rate is added to the analytical uncertainty of 10% reported by AIHL (1), the combined error is only 12.5%. Since the interpolated flow rates have much less than a 7% standard error, it is believed that the necessity of estimating some of the flow rate data introduced a negligible uncertainty into the final results.

The analytical data were received from AIHL on a magnetic tape. Each line of data contained a code for the monitoring site, test day, filter number, filter identification, date of sampling, sampler type, start and end time of sampling, analyst, date of analysis, chemical species, volume of air sample, analytical result, and standard deviation of the analytical result. The tabulations in Appendix C contain only the analytical result sorted according to the sampling time, sampling station, test day, and chemical species. When the species was present in amounts below the limit of detection, the tabulations in Appendix C give the limit of detection preceeded by a less than sign.

In the later interpretation of the data, it is also helpful to have tables of the fraction of the total aerosol mass represented by some of the more important chemical species. This information is contained in Appendix D for sulfate, nitrate, Na, Si, S, Cl near Moss Landing, and Pb in the South Coast Air Basin. As in Appendix C, the less than sign preceeds the tabulated values when the concentration of the species was below the limit of detection.

9.0 DETERMINATION OF THE EMISSION RATES

This chapter contains tabulations of the emission rates of sulfur dioxide and nitrogen oxides from the participating power plants for the times when the field studies were conducted. The sources of the data on which these results are based and the assumptions and approximations used in the calculations are also described.

For the emissions of sulfur oxides and the sulfur hexafluoride tracer, the quantity most directly known is the mass flow rate. Therefore, all emissions are tabulated in units of pounds per hour. The field data for the gaseous species are expressed as volume fractions, so a ratio of molecular weights must be used to convert the ratio of pollutant to tracer emissions into a ratio of pollutant to tracer field concentrations.

9.1 DATA SOURCES

The ARB Source Test Report (2) for the emissions from the Moss Landing Power Plant is complete enough that no further information is necessary to calculate the emission rates of sulfur dioxide and oxides of nitrogen. The data for vanadium emissions were based on the fuel analyses by AIHL (1).

The data for the Haynes Steam Plant and the Alamitos Generating Station came from several sources. Source tests were conducted on units 4, 5, and 6 at Haynes and units 5 and 6 at Alamitos by the LA-APCD (5). In addition, operating data during the test days were submitted by the power plants to the ARB (12), and fuel analyses were performed by AIHL (1). The LA-APCD maintains tabulations of daily fuel use and emissions by power plants in the District, and copies of these were obtained for the months of October and November 1974 (13).

9.2 OXIDES OF SULFUR EMISSION RATES

The source tests gave the expected result that the emission rate for sulfur dioxide can be reliably calculated from the flow rate and the sulfur content of the fuel. In general, the fraction of the sulfur which is emitted as SO_3 depends on the combustion conditions, so this information was obtained from the source tests at each of the plants.

9.2.1 Moss Landing Power Plant

Only natural gas was burned in boilers 1 through 8 on the three test days, so the sulfur emissions of consequence came from units 6 and 7, for which source test results are available. The fraction of the sulfur emitted as sulfuric acid was determined from the source test results by calculating the SO_2 concentration in the stack which would contain the same amount of sulfur as the observed sulfuric acid emissions. The results are given in Table 9-1.

TABLE 9-1.
SO_2 Concentrations Equivalent to the Observed Sulfuric Acid Concentrations in the Stack

	Unit 6	Unit 7
9-10-74	6.4 ppm	4.6 ppm
9-11-74	4.6 ppm	5.2 ppm

Comparison of these values with the SO_2 concentrations observed in the source tests shows that 2.9% of the emitted sulfur is in the form of sulfur trioxide or sulfuric acid. The sulfur emission rate can be compared with the rate of consumption of sulfur in the fuel by adding the SO_2 concentrations in Table 9-1 to those observed in the source tests, and comparing the sum of the concentrations in the ARB report calculated on the assumption that all fuel sulfur is converted to SO_2. The data in Table 1 of reference (2) shows that excellent agreement is obtained. On the average, the sulfur emissions as determined by the source tests are 1.5% larger than the fuel sulfur consumption.

Because the fuel consumption data are more reproducible than the source test data, the emissions rates in Table 9-2 are based on fuel use, and were calculated from the equation

$$\text{lb/hr } SO_2 = \text{ppm } SO_2 \times \text{stack flow in } 10^6 \text{ SCFM} \times \frac{\text{mol. wt. } SO_2}{379.4 \frac{\text{SCF}}{\text{lb mole}}} \times \frac{60 \text{ min}}{\text{hr}}$$

$$= \text{ppm } SO_2 \times \text{stack flow in } 10^6 \text{ SCFM} \times 10.13 \frac{\text{lb/hr}}{\text{ppm}10^6\text{SCFM}}$$

TABLE 9-2

Moss Landing Sulfur Dioxide Emission Rates

Date	Unit	ppm SO_2 From Fuel Use: For 100% Conversion to SO_2 [a]	ppm SO_2 From Fuel Use: For 97% Conversion to SO_2	lb/hr SO_2: By Unit	lb/hr SO_2: Total
9-10-74	6	176	171	2270.	4520.
	7	163	158	2250.	
9-11-74	6	199	193	2520.	5000.
	7	194	188	2480.	
9-12-74	6	-	1.32 [b]	17.2	29.5
	7	-	0.99 [b]	12.3	

(a) From reference (2)

(b) From source tests, reference (2)

TABLE 9-3

Haynes and Alamitos SO_x Source Test Data

Date	Unit	Emissions as lb/hr SO_2: SO_2	H_2SO_4	$SO_4^=$	Total	Emissions as lb/hr S: From Source Test	From Fuel Flow	Ratio
Haynes								
10-01-74	5[a]	786	12.4	4.7	803	402	625	0.64
	6	1270	18.3	4.0	1292	646	652	0.99
10-04-74	5(A)	1415	15.0	0.0	1430	715	667	1.07
	5(B)	1300	35.3	4.7	1340	670	667	1.00
10-11-74	4	1093	6.5	2.0	1101	551	534	1.03
	6	1192	17.0	4.0	1213	606	644	0.94
10-17-74	4	1176	6.5	2.7	1185	593	524	1.13
	6	1346	26.8	2.7	1376	688	657	1.05
Alamitos								
10-25-74	5	2107	12.4	4.7	2124	1062	1034	1.03
	6	2210	59.4	4.7	2274	1137	1096	1.04
10-30-74	5	2130	17.0	5.3	2152	1076	1040	1.04
	6	2180	60.1	6.7	2247	1123	1080	1.04
11-07-74	5	2182	23.5	10.	2216	1108	1085	1.02
	6	2137	105.8	12.	2255	1127	1080	1.04
Haynes Average		98.4%	1.38%	0.22%				1.029
Alamitos Average		97.6%	2.10%	0.33%				1.034
Combined Average		97.9%	1.80%	0.28%				1.032

[a] This test result not included in averages.

9.2.2 Haynes Steam Plant

It is necessary to determine the sulfur dioxide emission rates at the Haynes and Alamitos plants from the fuel sulfur data because source tests were not carried out on all units. However, the results of the source tests which were done are in good agreement with the fuel sulfur data, as shown in Table 9-3. The one exception is the test on Haynes unit 5 on October 1, 1974. In this case, the source test found appreciably lower sulfur oxide emissions than those calculated from the fuel sulfur data, so the result is not included in the averages.

The source tests for both Haynes and Alamitos showed that 98% of the sulfur was emitted as sulfur dioxide, and 2% in the form of sulfates, when rounded to the nearest percent. When calculating the source strengths for the units not tested, it was assumed that these same percentages are valid. Some of the untested Haynes units were burning a mixture of oil and natural gas, so it is not certain that 2% of the sulfur was emitted as sulfate by each unit. The hourly emission rates are given in Table 9-4, and are based on the reported data for the hourly fuel consumption in each unit (12) and the fuel sulfur analyses carried out at AIHL (1), which agreed with the fuel analyses reported by the APCD (13) to within 0.02% sulfur for all Haynes and Alamitos data. When an AIHL fuel analysis was not available, the fuel sulfur content reported in the APCD tabulation (13) was used.

9.2.3 Alamitos Generating Station

A summary of the sulfur oxide source test data for Alamitos is shown in Table 9-3. The results are similar to those obtained at Haynes. When the percentages are rounded, it is again found that in units 5 and 6, 98% of the fuel sulfur was emitted as sulfur dioxide, and the remainder as sulfate.

All Alamitos units burned only oil on the test days so the source test results can be used for the untested units more reliably than was the case at Haynes. The calculation methods were identical to those used for the Haynes data, except that only partial fuel use data are available for October 1 and 11. Therefore, the average ratio of fuel flow rate to load was calculated for all units from the data for October 17, 25, and 30 and November 7. These ratios

TABLE 9-4

Haynes and Alamitos Sulfur Dioxide and Sulfate Emission Rates

Time PDT	Haynes	SO_2 (lb/hr) Alamitos	Total	$SO_4^=$ (lb/hr) Total
October 1, 1974				
9		5090		
10	3170	5960	9130	280
11	3170	4790	7960	245
12	3170	5080	8250	250
1	3170	5590	8760	270
2	3350	5870	9220	280
3	3480	5870	9350	285
4	3440	5670	9110	280
5	3420	5140	8560	260
6	3530			
Average	3320	5450	8770	265
October 11, 1974				
9		5060		
10	4190	5020	9210	280
11	4190	4750	8940	275
12	4190	4350	8540	260
1	4190	4990	9180	280
2	4190	5230	9420	290
3	4190	4730	8920	275
4	4190	3920	8110	250
5	4190	3250	7440	230
6	4190			
Average	4190	4590	8780	270

TABLE 9-4 (continued)

Time PDT	Haynes	SO_2 (lb/hr) Alamitos	Total	$SO_4^=$ (lb/hr) Total
October 17, 1974				
10	3690	5120	8810	270
11	3690	5130	8820	270
12	3510	5100	8610	265
1	3540	5750	9290	285
2	3600	5630	9230	285
3	3760	5510	9270	285
4	3800	5830	9630	295
5	3800	5960	9760	300
6	3740	5770	9510	290
Average	3680	5530	9210	280
October 25, 1974				
9		5800		
10	3100	5740	8840	270
11	3130	5650	8780	270
12	3260	5610	8870	270
1	3750	5690	9440	290
2	3850	5490	9340	285
3	3880	5540	9420	290
4	3680	5500	9180	280
5	2920	5020	7940	245
6	3070			
Average	3400	5600	9010	275

TABLE 9-4 (continued)

Time PDT	SO_2 (lb/hr) Haynes	Alamitos	Total	$SO_4^{=}$ (lb/hr) Total
October 30, 1974				
9		5120		
10	4130	5090	9220	280
11	4170	5070	9240	285
12	4180	5190	9370	285
1	4170	5660	9830	300
2	4160	5630	9790	300
3	4080	5540	9620	295
4	4060	5380	9440	290
5	4170	5500	9670	295
6	4200			
Average	4170	5350	9520	290
November 7, 1974				
9		6690		
10	4210	6990	11200	345
11	4220	6550	10770	330
12	4220	6120	10340	315
1	4240	6170	10410	320
2	4250	6120	10370	315
3	4250	6170	10420	320
4	4260	6160	10420	320
5	4270	6470	10740	330
6	4260			
Average	4240	6380	10620	325

were then used to calculate the fuel flow rate from the load data. The estimated fuel flow rates were compared with those portions of the fuel flow data which were available and good agreement was found, except for unit 5 on October 1. In this case, the unit was operating at about half the load at which the fuel flow rate to load ratio was calculated, so the actual fuel flow data were used.

The sulfur dioxide emission rates calculated from the fuel flow and sulfur concentration data for Alamitos are given in Table 9-4 along with the totals for Haynes and Alamitos combined. For all entries in this table, 98% of the sulfur is emitted as sulfur dioxide, and 2% as sulfate. Therefore the two emission rates are related by

$$\text{lb/hr } SO_4^= = \frac{3}{98} \text{ lb/hr } SO_2 \quad .$$

The sulfate emissions for the separate plants are not tabulated, but can easily be obtained from the sulfur dioxide data with the aid of this relation.

9.3 OXIDES OF NITROGEN EMISSION RATES

The formation of oxides of nitrogen is highly sensitive to the flame temperature, and also responds to combustion conditions such as the oxygen concentration in the regions of maximum temperature. Therefore, the NO_x emission rates of a power plant are not as reliably estimated from load and fuel data as are the SO_x emissions. In addition, inconsistencies in the available data provide further evidence that these emission rates are less well known. All data in this section follow the convention that the oxides of nitrogen emission rates are reported as pounds per hour of NO_2.

9.3.1 Moss Landing

Emission data are available for all operating units in the ARB report (2), so it is only necessary to sum this information to obtain reliable values for the NO_x emissions. The results are given in Table 9-5.

TABLE 9-5

Moss Landing Oxides of Nitrogen Emission Rates
as lb/hr NO_2

Time PDT	Boilers 1-8	Unit 6	Unit 7	Total
September 10, 1974				
9	232.9	1720	1363	3316
10	253.9	1720	1363	3337
11	217.0	1720	1363	3300
12	250.9	1125	1363	2739
1	262.8	1125	1363	2751
2	453.9	1125	1363	2942
3	523.1	1125	1363	3011
4	526.8	1125	1363	3015
5	515.8	1125	1363	3004
September 11, 1974				
9	253.7	1060	1090	2404
10	335.1	1060	1090	2485
11	356.4	1060	1090	2506
12	301.2	1060	1090	2451
1	226.1	1060	1090	2376
2	281.1	1060	1090	2431
3	303.1	1060	1090	2453
4	306.4	1060	1090	2456
5	443.0	1060	1090	2593
September 12, 1974				
9	181.5	1014	589	1784
10	181.5	1014	589	1784
11	177.3	1014	589	1780
12	178.6	1014	589	1782
1	220.7	1014	589	1824
2	107.3	1014	589	1710
3	130.7	1014	589	1734
4	104	1014	589	1707
5	109.5	1014	589	1712

9.3.2 Haynes Steam Plant

The oxides of nitrogen source test results for Haynes and Alamitos are summarized in Table 9-6. To aid in estimating the NO_x emission rates of the untested units, the ratio of the NO_x emissions to the load is tabulated for each test day and an average value calculated. The ratios of the NO_x emissions to fuel flow rates were also calculated, but were found to be no more nearly constant. It is believed that these source test results are not directly applicable to all units at Haynes because some of them were burning a mixture of gas and oil, which can lead to higher NO_x emissions than if one or the other fuel is burned alone (14). Therefore, the LA-APCD tabulations (13) of the daily emissions of NO_x and SO_2 were also consulted.

Table 9-7 gives the total tons per day of NO_x and SO_2 emitted on each of the test days as obtained from the LA-APCD tabulations, and their ratio. To assist in interpreting the data, column 5 of the table gives the daily NO_x emissions in units of pounds per hour. The following column gives the NO_x emissions calculated from the SO_2 emission rates in Table 9-4 and the assumption that the SO_2 and NO_x emissions remain proportional to each other throughout the day. The next to last column gives the NO_x emission rates calculated from the assumption that 2.4 lb/hr of NO_x are emitted per megawatt of load, as was observed in the source that results. Since NO_x emissions per unit load are likely to be higher for the units burning a mixture of gas and oil than for the tested units, it is recommended that the data in column 6 be used in this study. Only the average for the day is given here, but the emission rate at any hour can be determined by multiplying the ratio of the NO_x to SO_2 emissions in Table 9-7 by the hourly SO_2 emissions in Table 9-4.

9.3.3 Alamitos Generating Station

The oxides of nitrogen source test results for Alamitos are summarized in Table 9-6 and the total daily emissions of SO_2 and NO_x tabulated in 9-8. An attempt to estimate the hourly emissions from Alamitos in the same manner as was used for the Haynes plant led to an inconsistency. The emissions rates calculated from the source tests (5) for units 5 and 6 accounted for such a large fraction

TABLE 9-6

Haynes and Alamitos NO_x Source Test Data

	Date	Unit	NO_x as NO_2 ppm	NO_x as NO_2 lb/hr	Load GMW	$\left(\frac{\text{lb/hr } NO_x}{\text{Load}}\right)$
Haynes						
	10-01-74	5	150	662	300	2.21
		6	145	677	330	2.05
	10-04-74	5(A)	117	526	300	1.75
		5(B)	118	512	300	1.71
	10-11-74	4	181	643	236	2.72
		6	144	716	327	2.19
	10-17-74	4	207	745	236	3.16
		6	160	789	350	2.25
Alamitos						
	10-25-74	5	189	1307	480	2.72
		6	110	831	463	1.79
	10-30-74	5	164	1140	470	2.43
		6	195	1400	459	3.05
	11-07-74	5	148	1070	473	2.26
		6	180	1380	452	3.05
Haynes Average						2.26
Alamitos Average						2.55
Combined Average						2.38

TABLE 9-7

Haynes Oxides of Nitrogen Emission Rates

	Daily Emission Rates[a]				Calculated Emission Rates lb/hr		
Date	NO_x tons/day	SO_2 tons/day	NO_x/SO_2	NO_x lb/hr	From Proportion to SO_2[b]	From Load	From Source Tests for Tested Units Only
10-01-74	32.3	36.53	0.884	2700	2930	2500	1339
10-11-74	28.9	42.72	0.676	2400	2830	2400	1359
10-17-74	34.5	38.55	0.894	2880	3290	~2900	1534
10-25-74	35.9	35.58	1.01	3000	3430	2500 2800	--
10-30-74	32.4	48.19	0.672	2700	2800	2500	--
11-07-74	34.6	52.35	0.661	2880	2800	2400	--

[a] From LA-APCD tabulations (13)

[b] It is recommended that these values be used.

TABLE 9-8

Alamitos Oxides of Nitrogen Emission Rates

Date	Daily Emission Rates[a]				Calculated Emission Rates		
	NO_x tons/day	SO_2 tons/day	NO_x/SO_2	NO_x lb/hr	From Proportion to SO_2	From Load	From Source Tests for Tested Units Only
10-01-74	27.7	59.76	0.464	2308		3000	-
10-11-74	20.0	43.78	0.457	1670		2600	-
10-17-74	25.2	59.72	0.422	2100	2333	2900	-
10-25-74	24.5	57.52	0.426	2042	2385	2900	2138
10-30-74	23.9	54.53	0.438	1990	2345	3000	2540
11-07-74	29.2	69.65	0.419	2433	2674	3400	2450

[a] From LA-APCD Tabulations (13)

of the NO_x emissions in the APCD daily tabulations (13) that unreasonably small emission factors were obtained for the units not tested. Since all Alamitos units were burning only oil on the test days, it is believed that a more accurate estimate of the emissions can be obtained by applying the emission factor determined for the tested units to all units. Therefore, the source strength of Alamitos was taken to be 2.4 lb NO_x as NO_2 per hour per megawatt of load. The resulting emission rates, somewhat smoothed in time, are reported in Table 9-9. The average NO_x emission rates for each test day are given in Table 9-10.

9.4 VANADIUM EMISSION RATES

Vanadium is sometimes considered to be a tracer for fuel oil combustion (15). To determine the extent to which the vanadium in the fuel does appear in the plume, the rate at which vanadium was consumed was calculated. In addition, the vanadium to SF_6 ratio in the plumes was calculated on the assumption that all vanadium in the fuel is emitted.

The calculation of the vanadium consumption rates was simplified by making use of the similar calculations for sulfur. The vanadium to sulfur ratios in the fuel were determined, then the average vanadium consumption rate calculated from the average SO_2 emission rates reported in Table 9-2 and 9-4. Vanadium analyses for the fuel are available only for the plant at which SF_6 was injected, but in the South Coast Air Basin, the vanadium emissions from both plants are of interest on all six test days. The average of all fuel analysis results at each plant were used for those days for which no test result was available, and these averages are enclosed in parentheses in Table 9-11.

The vanadium to SF_6 ratio in the plumes was calculated on the assumption that all vanadium in the fuel is emitted. The values are tabulated for each plant separately, on the assumption that the emissions from all stacks at that plant are mixed together, and then for both plants combined, again on the assumption of complete mixing.

TABLE 9-9

Alamitos Oxides of Nitrogen Emission Rates

Pounds/Hour NO_x as NO_2

	PDT				PST	
Date	10/1	10/11	10/17	10/25	10/30	11/7
Time						
9	2900	2900		3000	2900	3600
10	2800	2900	2800	3000	2900	3600
11	2700	2700	2800	2900	2900	3600
12	2900	2500	2800	2900	3100	3300
1	3200	2800	3000	2900	3100	3300
2	3400	3000	3000	2900	3100	3300
3	3400	2700	3000	2900	3100	3300
4	3200	2200	3000	2900	3100	3300
5	2900	1800	3000	2900	3100	3300
Average	3000	2600	2900	2900	3000	3400

TABLE 9-10

Haynes and Alamitos Oxides of Nitrogen Emission Rates

Average lb/hr NO_x as NO_2 for Test Day

Date	Haynes[a]	Alamitos[b]	Total
10-01-74	2930	3000	5900
10-11-74	3830	2600	6400
10-17-74	3290	2900	6200
10-25-74	3430	2900	6300
10-30-74	2800	3000	5800
11-07-74	2800	3400	6200

(a) From LA-APCD Tabulation in Proportion to SO_2 Emissions.

(b) Calculated as 2.4 lb/hr NO_2 per megawatt load.

TABLE 9-11

Vanadium Emission Rates

Date 1974	Plant	Fuel Oil Analysis: Sulfur %	Fuel Oil Analysis: Vanadium μg/g	Vanadium Consumption Rate lb/hr	Vanadium/SF_6 Ratios[a] $\frac{\mu g/m^3\ V}{ppt\ SF_6}$: Each Plant	Vanadium/SF_6 Ratios[a] $\frac{\mu g/m^3\ V}{ppt\ SF_6}$: Combined Plants
10 Sept	Moss Landing	0.35	13.6	8.5	0.66×10^{-3}	
11 Sept	Moss Landing	0.40	13.4	8.7	0.67	
1 Oct	Haynes	0.45	9.1	3.4	0.50×10^{-3}	
11 Oct	Haynes	0.46	10.6	4.9	0.77	
17 Oct	Haynes	0.47	10.5	4.2	0.61	
25 Oct	Haynes	0.46	(10.1)	3.8	0.32	
30 Oct	Haynes	0.46	(10.1)	4.7	0.54	
7 Nov	Haynes	0.47	(10.1)	4.7	0.45	
1 Oct	Alamitos	0.41	(16.1)	10.9	1.6×10^{-3}	2.1×10^{-3}
11 Oct	Alamitos	0.42	(16.1)	9.0	1.4	2.2
17 Oct	Alamitos	0.45	(16.1)	10.1	1.5	2.1
25 Oct	Alamitos	0.46	14.5	9.0	0.76	1.1
30 Oct	Alamitos	0.43	13.4	8.5	0.98	1.5
7 Nov	Alamitos	0.45	20.5	14.8	1.4	1.9

[a] These calculations assume that all vanadium in the fuel is emitted.

9.5 RATIO OF EMISSION RATES TO SF_6 RELEASE RATES

Table 9-12 gives the average rate of emission of sulfur dioxide, sulfate (including SO_3), and nitrogen oxides as NO_2 each test day, as well as the sulfur hexafluoride release rate. These numbers provide the basis for calculating the ratio of the concentrations of these pollutants to the SF_6 concentration in the plumes before any chemical processes have an opportunity to take place. The molecular weight ratios used in these calculations are

$$\frac{SF_6}{SO_2} = \frac{146.05}{64.06} = 2.28$$

volumes sulfur dioxide per volume SF_6 at equal mass concentrations, and

$$\frac{SF_6}{NO_2} = \frac{146.05}{46.01} = 3.17$$

volumes NO_2 per volume SF_6 at equal mass concentrations.

The values for the separate plants are tabulated because SF_6 was injected at only one stack on a given day, and on some days the plumes remained distinguishable in the locations where the sampling was carried out. The ratios for the total emissions from both plants are useful at the larger distances from the stacks, where the two plumes are reasonably well mixed together.

TABLE 9-12

Ratio of Emission Rates to SF_6 Release Rates

	Emission or Release Rates								Ratio to SF_6 Release Rate						
	SO_2 lb/hr			$SO_4^=$ lb/hr^{-1}	NO_x as NO_2 lb/hr			SF_6 lb/hr	ppb SO_2/ppt SF_6			$\mu g/m^3$ $SO_4^=$ / ppt SF_6	ppb NO_x/ppt SF_6		
Date	Haynes	Alamitos	Total	Total	Haynes	Alamitos	Total	Total	Haynes	Alamitos	Total	Total	Haynes	Alamitos	Total
10-1	3320	5450	8770	265	2930	3000	5900	40.8	0.186	0.305	0.490	0.0388	0.228	0.233	0.459
10-11	4190	4590	8780	270	3830	2600	6400	38.3	0.249	0.273	0.523	0.0421	0.317	0.215	0.530
10-17	3680	5530	9210	280	3290	2900	6200	40.9	0.205	0.308	0.513	0.0409	0.255	0.255	0.481
10-25	3400	5600	9010	275	3430	2900	6300	71.2	0.109	0.179	0.289	0.0231	0.153	0.129	0.281
10-30	4170	5350	9520	290	2800	3000	5800	51.6	0.184	0.236	0.421	0.0335	0.172	0.185	0.357
11-7	4240	6380	10620	325	2800	3400	6200	61.4	0.157	0.237	0.394	0.0316	0.145	0.176	0.321
Moss Landing															
9-10			4250	191			3050	77.3			0.125	0.0147			0.125
9-11			5000	225			2450	77.5			0.147	0.0173			0.100
9-12			29.5	1.3			1760	77.7			0.001	0.0001			0.072

10.0 DATA FROM APCD STATIONS AND FROM OTHER PROGRAMS

10.1 INTRODUCTION

There are several APCD monitoring stations near the path of the studied plumes in the South Coast Air Basin which were not included in the ground station network of this program. The locations of these additional APCD and ARB monitoring stations are shown by black dots in Figure 10.1. This section presents the data from these stations relevant to this study, and to some extent comments on these results.

At the outset, it is worth noting that greatly elevated sulfur dioxide levels were present throughout most of the area of the South Coast Air Basin considered in this study on 13 and 14 October 1974. The Whittier, LaHabra, and Pomona stations all reported the highest SO_2 concentrations for the month on one of these days. The geographical distribution of this SO_2 and the concentrations of other trace gases make it apparent that this sulfur dioxide did not come primarily from the plumes under study. Therefore, these two days have been omitted from the following discussion.

Most sulfur dioxide concentrations in this report are given in units of ppb. However, the basic tabs report concentrations in units of pphm, and several tables of these data are reproduced in this section. Therefore, for convenience, all sulfur dioxide concentrations in this section are given in units of pphm.

The results from the APCD stations are discussed in the order of their increasing distance from the power plants, except that stations generally outside the plumes are discussed as a group at the end.

10.2 LOS ALAMITOS-ORANGEWOOD APCD STATION

This APCD station is in Orange County on Orangewood Boulevard near the golf course at the eastern side of the Los Alamitos Naval Air Station. It is 7 km northeast of the power plants, and quite close to the trajectory that the

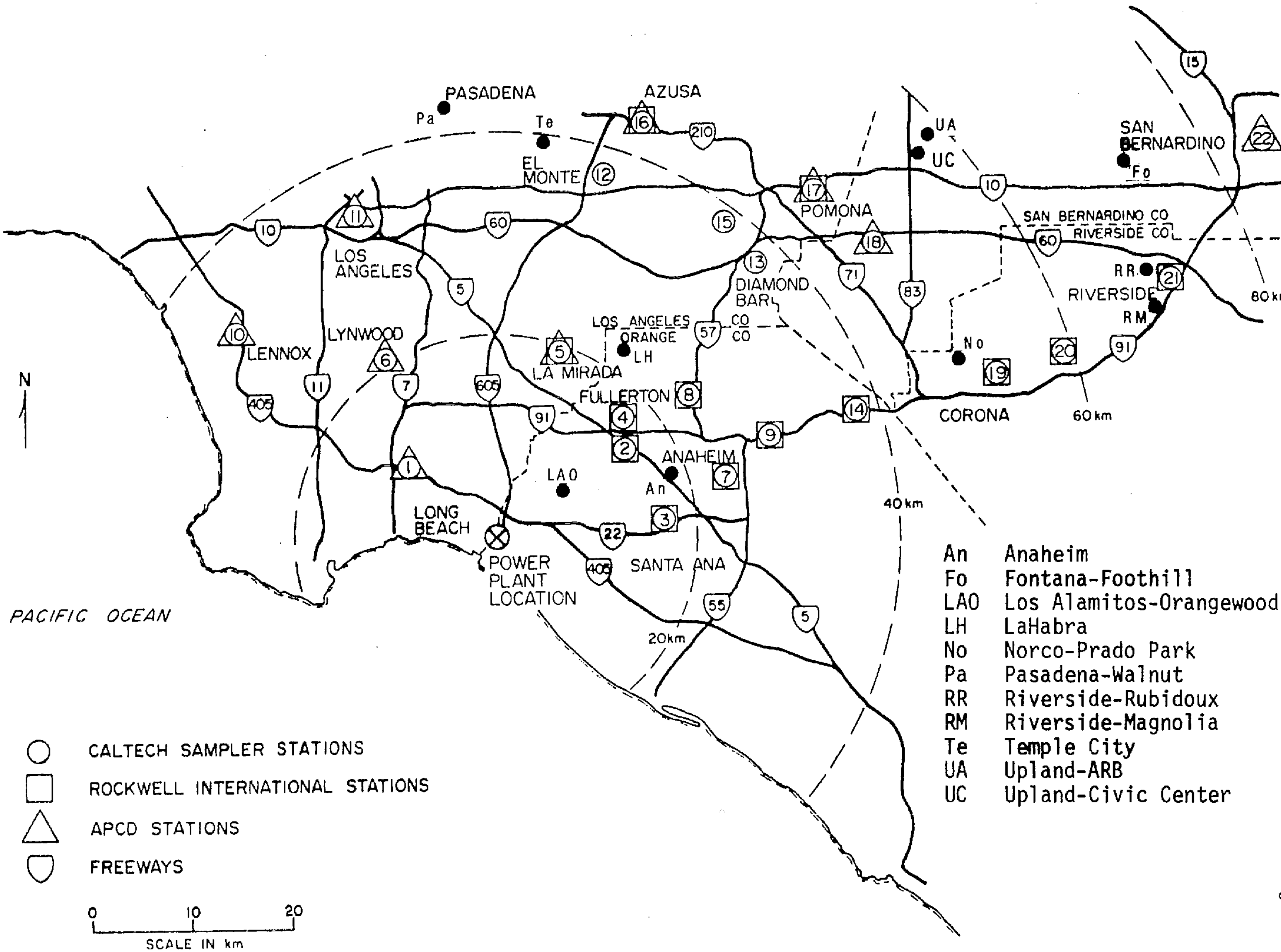

Figure 10-1 The Location of Additional APCD and ARB Monitoring Stations Near the Plum Trajectory

power plant plumes followed during this study.

Tabulations of the sulfur dioxide and Dasibi ozone levels at this station were obtained for March through December 1974. In addition, tabulations of chemiluminescent NO and NO_2 levels were available for October through December 1974. The data for these gases taken during October are reproduced in Tables 10-1 through 10-4.

All of these data were examined for times when the plume was present at the station in appreciable concentrations for times longer than one hour, and the results of this search are given in Table 10-5. For the months of March through September, when NO_x data were not available, events were included in the table only if the sulfur dioxide concentration was high and the ozone concentration was appreciably depressed when compared to nearby times with lower SO_2 concentrations. In the data for the subsequent months, it was also required that the NO_x concentration was elevated during the tabulated times. October 1 is the only test day which appears in Table 10-5.

In these data, the highest sulfur dioxide peak of 28 pphm occurred on 20 December, the highest one-hour average of 18 pphm occurred on 22 September, and the highest 24-hour average of 3.2 pphm on 11 April. These maxima are higher than any calculated from the SF_6 data, and the one-hour average is higher than any observed at the ten ground stations operated for this program. The instantaneous peak reading is exceeded by one value of about 29 pphm sulfur dioxide measured on a mobile traverse along Interstate 605 and reported in Figure 35 of reference 4, and the 24-hour average is exceeded by an average of 3.8 pphm recorded 14 October 1974 at ground station No. 4, Fullerton Fire Station No. 2. There are days, such as 16 October, when elevated sulfur dioxide concentrations occur for only one hour, but in no case were the maxima greater than those just listed.

The time of day at which the sulfur dioxide peaks occur gives information on the SO_2 sources and the processes which cause its transport to the monitoring station. Table 10-6 gives the number of times the sulfur dioxide concentration exceeds 10 pphm during each hour of the day during each month. Table 10-7 gives the same information, except that the events are omitted if they are not accom-

TABLE 10-1

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

SULFUR DIOXIDE
HOURLY AVERAGE IN PPHM
LOS ALAMITOS-ORANGEWOOD
OCTOBER , 1974

BASIC TAB
SOUTH COAST BASIN 5
SULFUR DIOXIDE 18

LOS ALAMITOS-ORANGEWOOD 30190
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1					1	1	1	1	3	2	7	4	2	1	2	14	9	2	1	1	1				2.2	24	V	14	15		16	15
2								1	2	2	6	4	1	1	1	6	5	1		1	1	1	1	1	1.5	24	V	6	10	M	8	10
3								1	1	3	6	5	5	8	5	4	5	4	1	1					2.0	24	V	8	13		10	13
4	1	1	1													1	2	2	1						0.4	24	V	2	16	M	5	16
5X								1	1	1	1	1	3	3	1	1	2	1					1	1	0.8	24	V	3	12	M	3	12
6X	1	1			1	1	1	1	2	1	1	1	1	1					1						0.6	24	V	2	08		2	08
7												2	3	4	2	1	1	1	1	1	1	1	1	1	0.8	24	V	4	13		7	13
8	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	2	5	1	1	1	1	1	1	1	1.5	24	V	5	16		8	16
9	1						1	1	1	2	3	3	1	2	5	4	2	1	1	1	1	1	1	1	1.4	24	V	5	14		6	14
10	1	1	1	1	1	1	1	1	1	2	2	1	2	2	3	5	5	1	1	1	1	1	1	1	1.6	24	V	5	15	M	10	15
11					1	1	1	1	1	1	3	3	2	1	3	1	1								0.8	24	V	3	10	M	5	14
12X	1	1	1	1	1	1	1	2	2	2	3	3	1	2	5	2				1	1	1		1	1.4	24	V	5	14		9	14
13X	1	1	1	1	1	1	1	1	1	1	1	2	8	11	5	2	1	1	1	1	1	1	1	2	2.0	24	V	11	13		12	12
14	1	1	1	1	1	1	1	1	1	2	2	7	7	6	4	2	2	2	2	2	2	1			2.1	24	V	7	11	M	9	11
15					1	1	1	1	3	4	5	2	1	2	1	2	1	1	1	2	1	1			1.3	24	V	5	10		8	10
16	1	1	1	1	1	1	1	1	2	3	1	1	2	12	2	1	2	2	1	1	1	1	1	1	1.8	24	V	12	13		14	13
17	1					1	1	1	1	1	1	1	1	1	1	1									0.5	24	V	1	00	M	2	12
18									2	2	6	10	5	5	3	1	1	1							1.5	24	V	10	11		12	11
19X						1	1	1	1	3	6	4	5	2	2	3	2	1	1						1.4	24	V	6	10		7	10
20X		1	1		1			1	1	1	2	2	1	1											0.5	24	V	2	10	M	2	10
21														2	1	1									0.2	24	V	2	13		2	13
22											1														0.0	24	V	1	10		1	10
23														1			1								0.1	24	V	1	13	M	3	13
24								1	1	1		1	9	7	2	1	1								1.0	24	V	9	12		12	12
25									1	2	3	2	1		2	2	1								0.6	24	V	3	10		6	14
26X										1	1	1		2	1	1				1					0.3	24	V	2	13		4	13
27X																									0.0	24	V	0	00	M		00
28																									0.0	24	V	0	00	M		00
29																	1								0.0	24	V	1	16		2	16
30														2	2	7	4	1							0.7	24	V	7	15		10	15
31															5	4	1			1					0.5	24	V	5	14		7	14
AVE	0.3	0.3	0.3	0.2	0.4	0.4	0.4	0.6	0.9	1.2	2.0	2.0	2.0	2.6	2.0	2.2	1.8	0.7	0.5	0.5	0.4	0.3	0.3	0.3	1.0			4.7			6.5	
N	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	744	31	31			31	
MAX	1	1	1	1	1	1	1	2	3	4	7	10	9	12	5	14	9	4	2	2	2	1	1	2	2.2			14	15			
PEAK																															16	15

TABLE 10-2

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

NITRIC OXIDE
HOURLY AVERAGE IN PPHM
LOS ALAMITOS-ORANGEWOOD
OCTOBER , 1974

BASIC TAB
SOUTH COAST BASIN 5
NITRIC OXIDE 23

LOS ALAMITOS-ORANGEWOOD 30190
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1	1	1	1	1	1	1	1	1	2	2	4	1			3	16	15	6	1	1	1	1	1	3	2.7	24	V	16	15		22	16
2	3	3	9	10	8	8	8	7	4	4	6	5	1	2	1	10	8	4	1	3	2	3	3	5	4.9	24	V	10	03	M	12	15
3	11	8	5	5	14	16	35	30	6	3	5	2	2	8	6	5	8	9	6	5	3	1	1	1	8.1	24	V	35	06		49	06
4	1	1	1	1	1	1	3	3	3	2						1	5	5	2	1	2	2	2	1	1.6	24	V	5	16	M	9	16
5X	1	1	1	1	1	1	3	3	3	2	1	1	2	1	1	1	1	1	1	2	2	5	15	21	3.0	24	V	21	23		23	23
6X	24	16	6	1	2	3	2	2	2	1					1	1	1	1	1	2	2	2	2	2	3.1	24	V	24	00		26	00
7	6	4	4	4	11	11	17	7	6	7	4	1	2	3	4	2	2	2	2	6	7	7	0	5	5.5	24	V	17	06		20	06
8	5	2	2	2	2	2	3	5	4	3	4	4	4	3	3	3	8	5	4	4	4	8	5	4	3.9	24	V	8	16	M	13	16
9	7	13	14	17	15	22	37	11	6	2	4	3	2	2	4	2	2	3	3	6	8	16	26	28	10.5	24	V	37	06		41	06
10	29	24	17	15	14	20	25	27	14	3	3	1	1	1	1	4	6	2	4	11	22	27	26	26	13.5	24	V	29	00		33	07
11	19	17	13	6	4	5	7	3	2	2	2	2	1	1	1	1	1	1	2	5	9	15	18	31	7.0	24	V	31	23		31	23
12X	30	22	16	13	15	2	2	4	3	1	1	1	1	1	2	2	1	1	1	1	13	6	2	2	6.0	24	V	30	00		30	00
13X	2	2	2	2	2	2	2	2	2	1	1	1	4	5	2	2	1	1	2	2	2	2	8	6	2.4	24	V	8	22		11	22
14	1	1	1	1	1	1	2	3		3	3	7	3	3	2	2	2	1	2	2	3	5	1	3	2.3	23		7	11		12	21
15	9	11	10	7	6	8	13	22	19	9	3	2	2	3	3	4	3	3	11	4	13	14	19	30	9.5	24	V	30	23		40	23
16	30	29	48	52	39	55	70	68	52	40	7	1	1	3	2	2	2	2	4	17	43	48	70	73	31.6	24	V	73	23		83	07
17	52	39	40	44	37	29	37	45	32	7	2	1													30.4	12		52	00			
18																																
19X																																
20X																																
21																																
22																																
23																																
24	2	3	5	6	9	12	32	37	20	5	1	1	6	9	1	1	1	1	3	7	8	12	7	13	8.4	24	V	37	07		52	06
25	10	17	18	18	19	20	26	30	10	5	3	2	1	1	3	1	2	1	1	1	2	10	17	15	9.7	24	V	30	07		35	07
26X	11	10	5	4	1	1	4	5	1	2	1	1	1	2	1	1	1	1	2	4	6	11	9	6	3.8	24	V	11	00	M	14	00
27X	5	11	12	6	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	5	7	8	9	7	4.4	24	V	12	02		15	01
28	5	5	4	3	2	2	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	24	V	5	00	M	6	00
29	2	2	2	2	2	2	3	6	4	2	2	2	1	1	1	1	1	2	2	2	9	10	7	7	3.1	24	V	10	21		12	21
30	7	6	5	5	4	5	10	13	7	2	1	1	1	1	2	6	4	1	2	10	18	20	21	26	7.4	24	V	26	23		27	22
31	15	8	7	7	8	11	11	6	2	2	1	1	1	1	6	6	2	3	3	4	5	6	9	12	5.7	24	V	15	00		17	00
AVE	11.5	10.2	9.9	9.3	8.9	9.7	14.4	13.8	8.7	4.6	2.5	1.8	1.7	2.3	2.3	3.3	3.4	2.5	2.7	4.5	8.0	10.0	12.0	13.7	7.6			23.2			26.4	
N	25	25	25	25	25	25	25	25	24	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	25	587	23	25			24	
MAX	52	39	40	52	39	55	70	68	52	40	7	7	6	9	6	16	15	9	11	17	43	48	70	73	31.6			73	23		83	07
PEAK																																

TABLE 10-3

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

NITROGEN DIOXIDE
HOURLY AVERAGE IN PPHM
LOS ALAMITOS-ORANGEWOOD
OCTOBER , 1974

BASIC TAB
SOUTH COAST BASIN 5
NITROGEN DIOXIDE 21

LOS ALAMITOS-ORANGEWOOD 30198
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1	5	3	3	3	4	4	4	5	8	6	10	6	5	3	3	8	6	6	5	6	5	4	5	4	5.0	24	V	10	10		10	10
2	4	4	3	3	4	4	5	5	5	8	7	7	4	4	4	2	5	6	6	6	6	6	6	4	4.9	24	V	8	09		8	10
3	4	4	5	4	3	3	5	10	7	7	7	8	5	9	6	5	2	6	6	6	7	6	6	5	5.7	24	V	10	07		10	07
4	5	5	5	3	2	3	4	5	4	3	2	2	1	1	2	4	3	6	7	6	6	7	5	5	4.0	24	V	7	18	M	7	00
5X	6	6	6	7	6	6	5	5	5	3	3	2	8	7	5	6	6	4	5	6	7	6	3	5	5.3	24	V	8	12		8	03
6X	6	8	7	6	7	6	5	6	7	4	5	5	4	4	3	3	4	8	8	7	5	7	9	9	6.0	24	V	9	22	M	9	22
7	8	9	8	8	6	6	5	13	8	11	11	6	8	9	8	6	7	6	7	8	8	8	8	8	7.9	24	V	13	07		13	07
8	6	4	4	4	4	4	4	6	6	5	4	5	4	5	5	4	7	7	6	5	6	7	6	6	5.2	24	V	7	16	M	7	16
9	6	5	5	5	5	4	8	7	8	7	5	5	2	4	8	8	7	6	7	8	8	9	7	8	6.3	24	V	9	21		9	21
10	8	7	7	6	7	5	8	10	7	7	9	5	5	7	8	9	9	11	10	10	10	8	8	8	7.9	24	V	11	17		11	17
11	6	7	8	9	8	9	10	12	8	8	10	10	8	5	7	4	4	4	10	10	11	11	4	9	8.0	24	V	12	07		12	07
12X	9	9	11	12	9	5	8	8	9	9	9	7	5	5	13	7	6	7	9	11	13	9	5	8	8.5	24	V	13	14	M	13	14
13X	10	7	4	2	3	3	3	3	5	5	5	9	16	16	11	9	8	6	7	8	8	8	9	11	7.3	24	V	16	12	M	16	12
14	8	6	6	6	6	7	9	9		11	14	18	15	14	10	8	13	14	18	15	15	10	13	8	11.0	23		18	11	M	18	11
15	11	12	13	15	15	13	13	19	28	37	42	19	8	14	5	9	10	13	20	17	17	14	11	14	16.2	24	V	42	10		42	09
16	14	13	13		12		8	13	28	50	38	5	9	19	8	9	15	22	16	17	16	15	11	14	15.2	24	V	50	09		55	09
17	20	13	15	13	13	14	14	17	29	33	32	10													18.6	12		33	09			
18																																
19X																																
20X																																
21																																
22																																
23																																
24	3	3	4	3	3	3	3	3	6	11	5	6	10	7	5	5	5	5	4	3	4	4	4	3	4.7	24	V	11	09		11	18
25	3	4	3	3	3	3	5	6	8	9	9	5	3	1	4	1	4	2	3	3	3	2	3	2	3.8	24	V	9	09	M	11	10
26X	3	2	2	2	29	30	5	3	3	3	5	4	8	3	6	3	5	2	6	4	4	4	2	3	5.9	24	V	30	05		48	04
27X	5	4	6	7	1	2	2	2	2		1	1					1	2	3	2	3	3	3	3	2.2	24	V	7	03		7	03
28	3	2	2	1	2	2	2	2	2	1	1	2	1	1	1	1	1	2	2	2	2	2	2	2	1.7	24	V	3	00		3	00
29	1	1	2	1	1	1	2	2	3	3	1	1	2	2	2	2	4	4	4	3	4	4	4	5	2.5	24	V	5	23		5	20
30	3	3	3	2	31	45	30	8	5	3	3	2		1	5	4			10	11	6	15	10	11	9.6	22		45	05			
31	10	11	7	3	3		1	11	10	3	3	1	1	1	7	4	4	7	9	8	6	6	4	4	5.2	24	V	11	01	M	11	01
AVE	6.7	6.1	6.1	5.1	7.5	7.3	6.7	7.6	8.8	9.9	9.6	6.0	5.5	5.9	5.7	5.0	5.9	6.8	7.8	7.6	7.5	7.3	6.2	6.6	7.1			15.9			15.0	
N	25	25	25	25	25	25	25	25	24	25	25	25	24	24	24	24	23	23	24	24	24	24	24	24	25	588	22	25			23	
MAX	20	13	15	15	31	48	30	19	29	50	42	19	16	19	13	9	15	22	20	17	17	15	13	14	18.6			50	09			
PEAK																															55	09

Table 10-4

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

OZONE
HOURLY AVERAGE IN PPHM
LOS ALAMITOS-ORANGEWOOD
OCTOBER , 1974

BASIC TAB
SOUTH COAST BASIN 5
OZONE DASIBI 36
LOS ALAMITOS-ORANGEWOOD 30190
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1	2	1	2	3	3	3	2	3	3	3	2	7	9	9	5										2.4	24	V	9	12	H	10	12
2									1	1	1	1	2	2	2										0.4	24	V	2	12	H	3	11
3						1	1	1	2	2	1	2	2			1									0.5	24	V	2	08	H	4	11
4			1	2	2	1			1	2	3	4	4	4	3	2								1	1.3	24	V	4	11	H	4	11
5X		1	1					1	2	4	5	5	2	5	7	6	2	2	1						1.8	24	V	7	14		8	15
6X				1			2	3	4	8	9	9	9	10	8	6	5	2	1	1	2	1			3.4	24	V	10	13		11	13
7								1	1	1	3	4	3	1		2	1	1	1	1	1	1	1		1.0	24	V	4	11		5	12
8		1	1	1	1	1			1	2	2	2	2	3	3	2									0.9	24	V	3	13	H	4	13
9							1		1	3	3	3	6	5	2	3	3	3	1				1	1	1.5	24	V	6	12		7	12
10	1	1	1	1		1	2	2	3	4	5	8	7	7	6	3					1	1	1	1	2.3	24	V	8	11		9	14
11	1	1	1	1	1	1	1	2	5	6	5	8	10	13	7	11	10	8	3	1	1	1	1	2	4.2	24	V	13	13		14	13
12X	2	1	1	1	2	5	4	6	7	11	12	11	13	12	7	9	8	6	3	2	1	2	5	2	5.5	24	V	13	12		15	13
13X	2	3	5	8	8	7	7	6	6	8	12	9	4	5	11	10	7	6	6	5	2	2	1	1	5.9	24	V	12	10		16	14
14	2	3	3	3	2	1	1	2	2	4	8	5	9	11	13	14	13	13	3	3	3	2	1		5.0	24	V	14	15		17	14
15		1	1	1	1	2	2	3	7	13	24	23	17	20	9	7	7	3	1	1	1	1	1	2	6.2	24	V	24	10		31	13
16	2	2	2	2	2	2	2	2	4	9	10	8	13	8	15	11	8	2	2	1	2	2	3	3	4.9	24	V	15	14		22	14
17	2	2	2	2	2	2	2	3	5	7	11	12	12	12	11	11	9	9	7	4	3	3	1	1	5.6	24	V	12	11	H	13	10
18	1	1	1	1	1	1	1	2	3	4	5	7	16	16	17	14	10	7	2	2		3	1	1	4.9	24	V	17	14		21	14
19X	3	3	2	2	2	1	1	2	2	2	2	3	5	11	16	15	13	9	4	2	2	1	1	1	4.4	24	V	16	14		17	14
20X	1	2	3	6	5	5	5	6	8	8	9	11	11	11	12	10	7	6	6	6	7	8	8	9	7.1	24	V	12	14		14	12
21	9	9	9	9	9	8	6	6	7	7	7	7	7	5	6	6	7	4	1	1	1	2	1	2	5.7	24	V	9	00	H	9	00
22	4	5	6	4	3	2	1	2	5	6	6	7	7	7	6	4	3	1							3.3	24	V	7	11	H	8	12
23								1	1	2	3	2	4	2	4	2	1								0.9	24	V	4	12	H	4	12
24								2	2	4	9	10	2	1	5	6	2								1.8	24	V	10	11		11	11
25		1	1	1	1	1	2	2	2	3	5	4	3	2	1	2		1					1		1.4	24	V	5	10		6	10
26X					1				1	1	1	1	1	1	2	1	1	1			1	1			0.6	24	V	2	14		2	14
27X									1	3	3	4	4	4	4	4	2	1							1.3	24	V	4	11	H	4	11
28									1	1	2	1	3	2	2	2	2	1	1	2	1	1	1	1	1.0	24	V	3	12		3	12
29	2	1	1	1	1	1				2	3	3	4	4	4	4	2			1	1	1	1	1	1.6	24	V	4	12	H	5	12
30			1	1	1	1	1	1	1	2	3	4	4	4	2			3	3	4	5	6	6	5	2.4	24	V	6	21	H	7	21
31	2	1	1	1	1	1	1	1	1	2	1	2	3	3			2		1	1	1	1	1		1.2	24	V	3	12	H	3	12
AVE	1.2	1.3	1.5	1.7	1.6	1.5	1.5	1.9	2.9	4.4	5.6	6.0	6.4	6.5	6.1	5.4	4.0	2.9	1.5	1.2	1.2	1.3	1.2	1.1	2.9			8.4			9.9	
N	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	744	31	31			31	
MAX	9	9	9	9	9	8	7	6	8	13	24	23	17	20	17	15	13	13	7	6	7	8	8	9	7.1			24	10			
PEAK																															31	13

TABLE 10-5

Major Plume Touchdowns at the Los Alamitos-Orangewood APCD Station

Date 1974	Inclusive Hours	Average SO_2 pphm	Average No. of Hours	Maxima 1 hr.	Maxima Peak	Maxima 24 hr.	Comment
11 April	11-18	6.8	8	13	17	3.2	Highest 24 hr. Average
26 June	7-9	8	3	10	14	1.9	
13 September	11-15	4.8	5	6	7	1.8	
15 September	10-12	10.7	3	13	15	1.9	
22 September	11-13	11	3	18	23	2.1	Highest 1 hr. Average
23 September	13-14	7.5	2	9	15	1.0	
25 September	12-14	7	3	8	9	1.7	
1 October	{15-16 {10-16	11.5} 5.6}	2 7	14	16	2.2	Test Day
3 October	10-16	5	7	8	10	2.0	
13 October	12-14	8	3	11	12	2.0	
14 October	11-13	6.7	3	7	9	2.1	
27 November	10-12	8	3	15	17	1.3	
20 December	13-14	13	2	16	28	1.8	Highest Peak
25 December	11-14	8	4	12	16	1.8	

TABLE 10-6

Time of Day for Sulfur Dioxide Daily Peak Concentrations
Greater than 10 pphm at Los Alamitos-Orangewood

Number of Events

Month 1974	Hour 8	9	10	11	12	13	14	15	16	17	Total
March								1			1
April						1					1
May				1		1	1			1	4
June	1				2						3
July								1			1
August							1	1			2
September			1	1	3	3	1	1			10
October				1	2	2		3			8
November				1		1		1			3
December				1	1	1	2				5
Total	1		1	5	8	9	5	8		1	38

TABLE 10-7

Time of Day for Sulfur Dioxide Daily Peak Concentrations
Greater than 10 pphm at Los Alamitos-Orangewood
Non-Plume Events are Omitted
Number of Events

Month 1974	Hour 8	9	10	11	12	13	14	15	16	17	Total
March											0
April						1					1
May						1	1			1	3
June	1				2						3
July								1			1
August								1			1
September			1		2	1					4
October					2	2		3			7
November				1		1		1			3
December				1	1	1					3
Total	1		1	2	7	7	1	6		1	26

panied by a dip in the ozone concentrations, or, when NO_x data are available, if they are not accompanied by appropriate NO_x concentrations. Table 10-7 is somewhat subjective, but it does eliminate events in Table 10-8 which are almost certainly not due to the studied plumes. No peaks equal to or above 10 pphm were observed during the hours not included in the tables. Both tables show that the major impact is in the early afternoon when the dispersion due to radiant heating of the ground is at a maximum, and the sea breeze carries the plume in the direction of the station.

For the period between June 1973 and October 15, 1974, data were also being collected at this site by T. A. Cahill and co-workers at the University of California at Davis. A two-stage impactor with a backup filter was used to collect particulates in three size ranges: 0.1 to 0.5 μm, 0.5 to 5 μm, and 5 to 15 μm. Elemental analyses for a series of elements were then obtained by α-particle excited x-ray fluorescence (11). The tabulations of the data include ratios of elemental concentrations and correlation coefficients for all combinations of elements for each size category and for the totals obtained by summing the results for each size range.

The data were examined, with special emphasis on sulfur and vanadium, for correlations with the days in Table 10-5, during which the plume was present in significant concentrations for more than one hour at the monitoring station. No correlations could be found. In part, the lack of correlation could be due to the averaging of the elemental analyses for an entire day, because the plume was rarely present for more than three hours. As a result of this lack of correlation, it is believed that the plumes from the Haynes and Alamitos plants do not significantly affect the daily average elemental composition of the 0.1 μm to 15 μm aerosol at this site.

Even so, the plume will have an effect on the sulfate levels during the times it is present. In Section 9.0, it is shown that about 2% of the sulfur is emitted as sulfate. Therefore, an upper limit to the contribution of the plume to the sulfate concentration can be determined by assuming that the emitted sulfate is conserved in the plume, and that all of the sulfur dioxide observed at the monitoring station is due to the plume. In this case, the instantaneous SO_2 reading of 280 ppb would be accompanied by 22 $\mu g/m^{-3}$ sulfate, and the one-hour average of 180 ppb SO_2 would be accompanied by 14 $\mu g/m^{-3}$ sulfate. At the time of these maxima, it is likely that the plume sulfur dioxide dominates the sulfur dioxide reading, and therefore that the actual sulfate due to the plume is not far below these values.

It is also possible to put an upper limit on the vanadium concentrations due to the plume which might be found at this site. On 1 October, when the fuel composition was known, a one-hour average of 180 ppb SO_2 was observed. Hence, a one-hour average vanadium concentration of 0.7 $\mu g/m^3$ would be expected if all the vanadium in the fuel were emitted in the plume. The 24-hour average vanadium concentration in particles larger than 0.1 μm observed by University of California at Davis was 0.276 $\mu g/m^3$, which is consistent with this upper limit. In contrast to this, the 24-hour average vanadium concentration was only 0.045 $\mu g/m^3$ on 22 September, when the one-hour average SO_2 reached 280 ppb. Thus, the amount of vanadium collected on this day was well below the estimated upper limit. As already noted, the daily average vanadium concentrations observed at this site do not correlate with the data in Table 10-5. The vanadium data obtained in the present study do show a correlation, and are discussed in Section 13.3.3.

10.3 WHITTIER APCD STATION

The APCD station in Whittier is 19 km north and slightly east of the power plants, and near enough the plume trajectory that the data are of interest. Small concentrations of SF_6 tracer were observed there on most test days.

One of the AMC ground stations was moved to this site on 24 October, and the sulfur gas analyzer collected data there until 8 November. When the one-hour averages from this instrument are compared with the APCD data in the basic tabs, all but six of the 360 readings agree with each other to within the experimental error ($\pm$ 1 pphm in each reading). The AMC readings were lower than the APCD data in the six cases of lack of agreement. The basic tab for SO_2 in October is included as Table 10-8 to make the SO_2 data available for the times when the AMC was not recording data at this location.

The SO_2 levels at Whittier are generally higher than at the Los Alamitos-Orangewood and Anaheim APCD stations, but it is shown in Section 14.1 that only

TABLE 10-8

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

SULFUR DIOXIDE
HOURLY AVERAGE IN PPHM
WHITTIER
OCTOBER , 1974

BASIC TAB
SOUTH COAST BASIN 5
SULFUR DIOXIDE 18

WHITTIER 70080
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1	1	1	1	1	1	1	2	3	3		4	5	6	4	3	2	2	1	1	2	1	1	1	1	2.1	23		6	12		7	12
2	1	1	1	1	1	1	2	2	2	2	2	2	2	1	2	2	1	1	1	1	1	1	1	1	1.4	24	V	2	06	M	3	09
3	1	1	1	1	1	1	1	1	1	1	1	3	3	2	2	2	1	1	1	1	2	2	1	2	1.4	24	V	3	11	M	5	12
4	2	2	2	2	1	1	1	1	1	1	1		2	3	2	2	2	2	1	2	2	2	2	2	1.7	23		3	13		3	13
5X	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3	2	2	1	1	1	1	1	1	1	2.0	24	V	3	07	M	3	12
6X	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	2	1	1	2.3	24	V	3	11	M	3	19
7	1	1	1	1	1	1	1	2	2	2	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1.5	24	V	3	10	M	5	12
8	1	1	1	1	1	1	1	1	2	2	2	2		1	1	1	1	1	1	1	1	1	1	1	1.2	23		2	08	M	2	08
9	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1.5	24	V	2	08	M	3	13
10	1	1	1	1	1	1	2	2	2	3	3	3	3	3	3	2	2	2	2	2	2	1	1	1	1.9	24	V	3	09	M	3	14
11	1	1	1	1	1	1	2	2	3	3	3	3		3	3	3	2	2	2	2	2	2	2	2	2.0	23		3	08	M	4	13
12X	2	2	2	2	2	2	2	3	3	4	4	4	4	3	4	4	2	2	2	2	2	2	2	2	2.6	24	V	4	09	M	7	12
13X	2	2	2	2	2	2	2	2	2	3	3	8	7	8	4	3	3	2	2	2	2	2	2	2	3.0	24	V	8	11	M	19	11
14	1	2	2	2	2	2	1	1	2	2	5	6	7	8	7	6	5	2	2	2	2	2	2	2	3.1	24	V	8	13		18	13
15	2	2	2	3	4	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2.1	24	V	4	04		6	05
16	1	1	1	1	1	1	1	1	3	2	2	1	2	2	4	2	2	2	2	2	2	2	2	2	1.8	24	V	4	14		5	14
17	1	1	1	2	2	2	2	2	2	2	3	5	2	2	3	5	5	2	1	1	1	1	1	1	2.1	24	V	5	11	M	9	06
18	1	1	1	1	2	2	2	2	2	3	5	5		5	4	2	2	2	1	2	1	1	1	1	2.2	23		5	10	M	6	10
19X	1	1	1	1	1	1	1	1	2	2	3	3	4	4	8	5	3	2	2	2	1	1	1	1	2.2	24	V	8	14		10	14
20X	1	2	2	2	2	2	2	2	2	2	2	2	3	5	4	4	3	2	2	1	1	1	1	1	2.1	24	V	5	13		5	13
21	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	1.8	24	V	3	16	M	5	16
22	2	2	2	2	2	2	2	2	3	3	3	3	4		4	4	2	2	2	2	2	1	1	1	2.3	23		4	12	M	5	14
23	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	4	3	2	2	2	2	1	1	1.7	24	V	4	16		5	16
24	1	2	2	2	2	3	3	3	3	3	3	4	4	3	3	2	3	2	3	3	2	2	1	1	2.5	24	V	4	11	M	5	11
25	1	1	1	1	1	1	1	1	1	4	3	2	2	2	2	2	2								1.6	17		4	09		6	09
26X																																
27X																																
28										2	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1.3	15		3	11		6	11
29	1	1	1	1	1	1	1	1	1	1	2	2	2		2	3	3	7	2	3	4	2	2	2	2.0	23		7	17		12	17
30	2	2	2	2	1	1	2	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2.2	24	V	4	07		5	07
31	2	1	1	1	1	1	1	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1.3	24	V	2	00	M	3	07
AVE	1.3	1.3	1.4	1.5	1.5	1.5	1.6	1.9	2.1	2.3	2.7	3.1	3.1	3.0	2.9	2.6	2.3	2.0	1.7	1.8	1.7	1.5	1.3	1.4	2.0			4.1			6.1	
N	28	28	28	28	28	28	28	28	28	28	29	28	26	27	29	29	29	28	28	28	28	28	28	28	29	673	20	29			29	
MAX	2	2	2	3	4	3	3	4	3	4	5	8	7	8	8	6	5	7	3	3	4	2	2	2	3.1			8	11	M		
PEAK																															19	11

a small portion of the SO_2 is due to the studied plumes on the test days. It is possible that the plumes had a significant impact on Whittier on 14 November, when SO_2 reached a peak of 19 pphm and a one-hour average of 14 pphm at 14 hr. The NO and NO_2 concentrations were elevated at the same time, and had one-hour averages of 7 and 14 pphm, respectively, at 14 hr.

In general, the data from this station show that it is perhaps near, but not in, the path of the plume during October and November 1974. Therefore, these data establish a northwestern limit to the plume trajectory.

10.4 LA HABRA APCD STATION

The tabulations of the sulfur dioxide data for October is shown in Table 10-9. The large blank areas in the table show that the SO_2 readings are often below 1 pphm. The average SO_2 reading for the month is 0.6 pphm, compared to 2.0 pphm at Whittier. The high readings on 13 and 14 October are not due to the plumes, as mentioned in Section 10.1. However, it is shown in the discussion that the mid-day readings on 1 October, as well as the other test days, are due primarily to the studied plumes.

It is interesting to note that more sulfur dioxide is observed on the test days of 1, 11, 17, 25, and 30 October than during the rest of the month. The daily peak readings for the month have a mean of 3.29 pphm and a standard deviation about the mean of 2.40 pphm. The peak readings for the five October test days have a mean of 5.40 pphm. The standard deviation of 2.40 pphm implies that there is only a 5% chance that five days picked at random from the month would have a mean equal to or larger than 5.40 pphm observed on the test days.

10.5 POMONA APCD STATION

The SF_6 data show that the plume is present at the Pomona APCD station on all test days, and the data in the basic tabs are consistent with this result. However, the plume impact at this station is small enough that the presence of the plume there could not be reliably demonstrated in the absence of SF_6 data. As shown in Table 10-10, the highest peak sulfur dioxide concentration for the

TABLE 10-9

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

SULFUR DIOXIDE
HOURLY AVERAGE IN PPHM
LA HABRA
OCTORER , 1974

BASIC TAB
SOUTH COAST BASIN 5
SULFUR DIOXIDE 18

LA HABRA 30177
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1									1	2	2	4	6	6	4	3									1.2	24	V	6	12	M	7	13
2									1	1	2	1	1	1	1	1									0.4	24	V	2	10		3	15
3												1	2	1	1	1	1								0.3	24	V	2	12		2	12
4															1										0.0	24	V	1	14		2	14
5X													1	2	2	1									0.3	24	V	2	13	M	2	13
6X									1	1	1	1	1	1	2	3	2	1							0.6	24	V	3	15		3	15
7										1	1	1	1	1											0.2	24	V	1	09	M	2	12
8												1	1	1	1	1	1								0.3	24	V	1	11	M	2	15
9											1	1	2	2	2	2	2	1	1						0.6	23		2	12	M	2	12
10								1	2	3	3	3	3	3	2	2	3	2	1						1.2	24	V	3	09	M	4	08
11					1	1	1	1	1	2	2	3	3	3	3	3	3	3	2	1					1.4	24	V	3	11	M	4	14
12X					1	1	1	3	3	3	3	3	5	5	5	4	3	2	1	1	1		1	1	2.0	24	V	5	12	M	6	13
13X	1	1	1	1	1	1	1	1	2	2	3	4	4	6	6	4	3	2	1	1	1	1			2.0	24	V	6	13	M	7	13
14									1		3	6	6	7	7	6	5	3	2	1	1				2.1	23		7	13	M	9	13
15							2	3	2	2	2	2	3	2	2	2	1	1	1	1	1	1	1		1.2	24	V	3	07	M	4	12
16	1						1	1		1	1	1	1	2	2	3	1	1	1	1	1	1	1	1	0.9	24	V	3	15		4	15
17								1	1	1	2	3	5	4	2	3	2	1			1				1.1	24	V	5	12		8	13
18								1			1	2	3	3	4	2	1								0.7	24	V	4	14		5	14
19X											1	1	3	4	2	2	2	1							0.7	24	V	4	13		5	13
20X												2	2	2	3	1	1								0.5	24	V	3	14		3	14
21																									0.0	24	V	0	00	M		00
22											1														0.0	24	V	1	10		1	10
23																									0.0	24	V	0	00	M		00
24													1	1	1										0.1	24	V	1	12	M	1	12
25											1		1	1	3	1	2								0.4	24	V	3	14		5	14
26X													1												0.0	24	V	1	12		1	12
27X																									0.0	24	V	0	00	M	1	09
28																									0.0	24	V	0	00	M		00
29																	1								0.0	24	V	1	16		1	16
30							1	1	2	2	2	2	3	2	1	1		1							0.8	24	V	3	12		3	12
31									2	2	2	1	1	2	3	2	1	2							0.8	24	V	3	14		5	15
AVE	0.1	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.6	0.8	1.1	1.4	1.9	2.0	1.9	1.5	1.1	0.7	0.3	0.2	0.2	0.1	0.1	0.1	0.6			2.5			3.3	
N	31	31	31	31	31	31	31	31	31	29	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	742	29	31			31	
MAX	1	1	1	1	1	1	2	3	3	3	3	6	6	7	7	6	6	3	2	1	1	1	1	1	2.1			7	13			
PEAK																															9	13

TABLE 10-10

CALIFORNIA AIR RESOURCES BOARD
AIR QUALITY DATA

SULFUR DIOXIDE
HOURLY AVERAGE IN PPHM
POMONA
OCTOBER , 1974

BASIC TAB
SOUTH COAST BASIN 5
SULFUR DIOXIDE 18

POMONA 70075
OCTOBER , 1974

DAY	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DAILY AVE	N	V	MAXIMUM HOURLY AVE CONC	HR	M	PEAK CONC	HR
1	1	1	1	1	1	1	2	3	3	3	2	2	3	3	5	3	3	2	2	1	1	1	1	1	2.0	24	V	5	14		5	14
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	24	V	1	00	M	1	14
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	2	1	1	1	1	3	2	1	1	1.3	24	V	3	14	M	3	19
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	24	V	1	00	M	1	15
5X	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	24	V	1	00	M	1	10
6X	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	24	V	1	00	M	2	14
7	1	1	1	1	1	1	1	1	1	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1.7	24	V	3	10		3	10
8	1	2	3	2	3	2	1	1	1	1	2	2	2	2	2	2	2	3	4	2	2	2	1	1	1.9	24	V	4	18		5	17
9	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	2	1.5	24	V	2	08	M	3	16
10	1	1	1	1	1	1	1	2	2	2	3	2	2	2	2	3	3	2	2	2	1	1	1	2	1.7	24	V	3	10	M	4	16
11	1	1	1	1	1	2	2	2	2	1	1	1	1	2	2	2	2	3	3	1	1	1	1	1	1.5	24	V	3	17	M	4	17
12X	1	1	1	1	2	1	1	1	1	2	1	1	1	2	2	2	2	1	1	1	2	1	1	1	1.3	24	V	2	04	M	3	15
13X	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1.2	24	V	2	08	M	3	15
14	1	1	1	1	1	1	1	2	2	2	3	1	1	1	1	3	5	5	4	3	3	3	3	2	2.1	24	V	5	16	M	6	16
15	2	2	2	2	3	3	3	4	4	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1.8	24	V	4	07	M	5	07
16	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	2	1	1	2	2	1.3	24	V	2	07	M	2	07
17	2	3	3	2	1	2	2	2	2	3	4	2	1	4	3	3	4	4	5	5	4	3	3	3	2.9	24	V	5	18	M	5	18
18	2	2	2	2	2	3	3	5	3	2	2	2	2	2	3	3	3	2	3	3	3	3	2	2	2.5	24	V	5	07		5	07
19X	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	3	2	2	2	1	1	1	1	1.9	24	V	3	14	M	3	14
20X	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1.1	24	V	2	13	M	3	16
21	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	2	1.8	24	V	3	19	M	4	20
22	2	2	2	2	2	2	1	2	2	2	2	2	3	3	2	2	1	1	1	1	1	1	1	1	1.7	24	V	3	12	M	3	12
23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	2	2	2	2	1.4	24	V	3	19		3	19
24	2	2	2	2	1	1	1	2	3	2	2	2	1	1	1	3	2	2	2	2	2	2	2	2	1.8	24	V	3	08	M	3	08
25	2	2	2	2	2	2	2	2	2	1	2	1	2	2	2	2	1	1	1	1	1	1	1	1	1.6	24	V	2	00	M	3	15
26X	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1.1	24	V	2	09	M	2	10
27X	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1.2	24	V	2	07	M	2.10	
28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.0	24	V	1	00	M	1	11
29	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	3	3	2	2	2	1	1	1	1.3	24	V	3	16	M	4	16
30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	4	3	2	1	1.3	24	V	4	20		4	20
31	2	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2	2	3	2	2	3	2	2	2	1.6	24	V	3	17	M	3	17
AVE	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.6	1.6	1.5	1.7	1.4	1.4	1.6	1.7	1.8	1.9	1.8	1.8	1.7	1.7	1.5	1.4	1.4	1.5			2.8			3.2	
N	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	744	31	31			31	
MAX	2	3	3	2	3	3	3	5	4	3	4	2	3	4	5	3	5	5	5	[illegible]	4	3	3	3	2,9			5	14	M		
[illegible]																															6	18

month of October was 6 pphm on 14 October, when other sources were contributing significantly to the SO_2 concentration. However, peak readings of 5 pphm SO_2 were observed on 1, 8, 15, and 17 October, which includes two test days. As in LaHabra, peak SO_2 readings on the test days in October were higher than for the month as a whole.

The fact that the plume passed over Pomona each test day provides an explanation for the large difference between the oxidant levels in Pomona and Upland. As shown in Table 10-11, the oxidant maxima in Upland were generally 60% larger than those in Pomona in October 1974. In part, the oxidant deficit in the plume due to the emitted NO could contribute to this difference. However, it is shown in Section 13.1.2 that the maximum effect of such chemical processes is an order of magnitude too small to account for the observations.

The main reason for the Upland-Pomona oxidant difference is that the Pomona air arrives from regions with lower oxidant readings than does the air over Upland. The SF_6 data in Figure 12-1, and in Figures E-3 and E-4 in Appendix E show that air flows from LaHabra to Pomona on the test days in this study. Therefore, oxidant data from LaHabra and nearby stations are included in Table 10-11. This study does not provide direct evidence for the source of the air over Upland. On some test days, the surface winds reported by MRI (6) would transport air to Upland from Temple City and Azusa. On other days, the surface winds near Upland do not follow a clear pattern. However, it is clear from Table 10-11 that oxidant levels in Pomona are comparable to those in LaHabra, and the oxidant levels in Upland are in line with those in Azusa and Temple City.

10.6 OTHER APCD STATIONS

Anaheim, Azusa, and Upland (which is not far from Cucamonga) are the remaining APCD and ARB stations close enough to the plume trajectory that their data were reviewed. In agreement with the SF_6 data, the Anaheim data show no evidence of a significant impact of the plume. This station is only 17.8 km from the power plants, so significant plume impact would show as periods of increased SO_2 and NO_x, and depressed oxidant concentrations.

The Azusa and Upland are far enough from the plants that the impact of the

TABLE 10-11

Average Daily Maximum Oxidant Readings for

October 1974

Station	Measured	Average Daily One-Hour Maximum pphm	Average Daily Peak pphm
Anaheim *	Oxidant	4.1	5.0
Whittier	Oxidant	4.8	6.1
LaHabra *	Oxidant	6.5	7.9
Pomona	Oxidant	8.1	9.4
Temple City	Oxidant	10.5	13.0
Azusa	Oxidant	10.4	11.4
Upland-Civic Center *	Ozone (Chemiluminescent)	11.9	13.9
Upland ARB*	Ozone (Dasibi)	13.8	15.5
Upland ARB*	Oxidant	13.2	14.8

* Readings for these stations have been reduced by 20% to correct for differences in the calibration procedures.[28]

plume would not be expected to show in the data in the basic tabs. In addition, SO_2 data were not available for these sites. Examination of the data which were available gave no evidence of the presence of the plume, but this information alone cannot be used to rule out the presence of the plume.

11.0 REVIEW OF THE DATA FROM EACH TEST DAY

An early step in the analysis of the data from each of the seven cooperating contractors was the assembly of a set of notes for each test day. These summaries contained a comparison of the data from different sources, and listed the events which deserve special attention. The data presented in this way were especially useful in identifying the few readings which were inconsistent.

It had been planned to discuss one or two days in some detail in this section of the report. However, after the other sections of the report were written, it was found that such a discussion was sufficiently redundant that its inclusion was not warranted.