WIND TUNNEL STUDY OF STACK GAS DISPERSAL AT WELSH POWER STATION, UNITS 1, 2, and 3

by

R.N. Meroney*
J.E. Cermak*
J.A. Garrison**

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Sargent & Lundy Engineers

Chicago, Illinois

Fluid Dynamics and Diffusion Laboratory
Department of Civil Engineering
College of Engineering
Colorado State University
Fort Collins, Colorado

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* Co-principal Investigators
**Research Engineer

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EXECUTIVE SUMMARY

Tests were conducted in the Colorado State University Environmental Wind Tunnel facility, to study the gaseous plumes released from stacks associated with the Welsh Power Station of the Southwestern Electric Power Company. The tests were conducted over a model power plant to scale 1/200 including all significant structures, topography, and roughness elements in the vicinity. Effects of wind orientation, stack height, plant operation load, and wind velocity were established. Data obtained included photographs and color motion pictures of smoke plume trajectories and contaminant concentration downwind of the power plant at ground level sampling positions. On the basis of the experimental measurements reported herein, the following comments may be made:

Single Unit:

1) Plumes from a single unit do not entrain directly into the building complex cavity for any wind angle, velocity, load, or stack height studied.

2) For a 241 ft stack on a single unit there is no significant visual evidence of ground contact within a mile of the plant until the wind speed exceeds 30 mph.

3) The plume-building wake influence for all plumes is a maximum for the east wind approach direction and a minimum for the south orientation.

4) The addition of a nozzle to the 300 ft stack to increase exit velocity for the 30 percent load case to that normally found for 100 percent load did loft the plume; however, the result was only to increase plume intercept at 30 mph, 30 percent load, from 1250 ft to 2500 ft.

5) Concentration measurements show that maximum SO_2 ground-level concentrations of .179 ppm will result from a 241 ft stack at 30 percent load for a 30 mph wind approaching from the SE. Increasing the stack height to 300 or 350 ft decreases this maximum to .091 ppm and .045 ppm, respectively.

All Three Units:

6) The presence of three units definitely increases the probability of plume entrainment into the building cavity and early intersection with the ground. Although a 300 ft stack on a single unit resulted in plume intercept with the ground beyond 5000 ft except for the highest wind speed situations, the presence of three units resulted in ground contact between 750-4000 ft for almost all situations studied.

7) For three units the eastern wind approach angle consistently resulted in the largest concentrations and earliest plume touchdown.

8) Concentration measurements show that maximum SO_2 ground-level concentrations of .467 ppm will result for a 300 ft stack at 60 percent load for a 30 mph wind approaching from the E.

Since specific maximum source levels may vary depending on the source of coal or the load, dimensional prediction tables have been prepared in the manner of Pasquill for the Welsh Power Station configuration. If percent frequency of winds and stability conditions at various wind approach angles are known for the Welsh site, average annual concentrations or 24 hour averages including the effects of wind angle frequency distribution may be calculated in the manner of Turner (1969) or Sherlock and Stalker (1940). If one desires the

meteorological significant situations such as looping, fanning, fumigation, or trapping one may combine the experimental results developed herein with the expressions suggested by Bierly and Hewson (1962) or Slade (1968, Chapter 3, Section 3.5).

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LIST OF SYMBOLS

Symbol	Definition	
A	Area of the projection of the power station building on a plane transverse to the upstream flow direction	(L^2)
C	Entrainment parameter	(-)
C_p	Specific heat capacity	$(L^2T^{-2}\theta^{-1})$
D	Stack diameter	(L)
Fr	Froude number $\frac{V^2}{g\frac{\Delta\rho}{\rho}D}$	(-)
g	Gravitational constant	(L/T^2)
H	Stack height	(L)
ΔH	Plume rise	(L)
H	Power station effective building height	(L)
k	von Karman constant	(-)
K	Concentration isopleth	(-)
M	Molecular weight	(-)
Q	Source strength	(Curies/T)
Re	Reynolds number $\frac{VL}{\nu}$	(-)
U_*	Friction velocity	(L/T)
V	Mean velocity	(L/T)
x,y,z	General coordinates--downwind, lateral, upwind	(L)
z_o	Surface roughness parameter	(L)

Greek symbols

χ	Local concentration	$(Curies/L^3)$
τ	Sampling time	(T)
θ	Azimuth angle of upwind direction measured from plant north	(-)

Symbol	Definition	
σ	Standard deviation of either plume dispersion or wind angle fluctuations	(L) (-)
ν	Kinematic viscosity	(L^2/T)
δ	Boundary layer thickness	(L)
γ	Specific weight	$m/(T^2L^2)$
ρ	Density	(M/L^3)
Ω	Angular velocity	(1/T)
μ	Dynamic viscosity	M/(TL)

Subscripts

a	Free stream
s	Stack
m	Model
p	Prototype
max	Maximum

CONVERSION TABLE (English to Metric Units)

Multiply units	by	to obtain
inches	2.540	centimeters
square inches	6.452	square centimeters
cubic inches	16.39	cubic centimeters
feet	0.3048	meters
square feet	0.0929	square meters
cubic feet	0.02832	cubic meters
feet/second	0.3048	meters/second
miles/hour	0.4470	meters/second
cubic feet/minute	0.02832	cubic meters/minute
cubic feet/minute	0.00047	cubic meter/second

1.0 INTRODUCTION

A wind tunnel study of the Welsh Power Station, Southwestern Electric Power Company, near Cason, Texas was intended to determine the optimum stack height which would eliminate plume downwash and reduce the concentration of sulfur dioxide at ground level such that the plant can meet state and federal ambient air quality standards. The power plant is located in Titus County, Texas, approximately twelve miles southeast of the city of Mt. Pleasant on Swauano Creek.

Commercial fossil fuel steam electric generating stations generally require an analysis of the potential behavior of gaseous effluents emitted to the atmosphere as a result of combustion processes. The proposed new design incorporates processes to reduce particulate emissions and ground-level concentrations of gaseous chemical effluents to a minimum. Used wisely the atmospheric reservoir permits disposal without damage or nuisance; used without due consideration for its widely varying dispersion capacity, pollutants may at times remain at sufficiently high concentrations near the ground to cause annoyance.

A primary factor in determining whether these gaseous products are to be a nuisance is the stack design. Under certain conditions it may be necessary to make a release in meteorologically unfavorable situations. Hence, it is necessary to design gas exhaust systems such that adequate dispersal of gaseous materials will occur under any realistic meteorological condition.

It has been a traditional design technique to release the various gases through the top of a tall stack located near the power station,

where the stack is at least two and one-half times taller than nearby buildings. Calculation of peak and mean ground concentrations of these gases are then based on some semiempirical model which relates the release rate from an elevated point source to the concentration at some point downwind. Mathematical models have been suggested by Sutton (1947), Hay and Pasquill (1962), Roberts and Cramer (1957). These mathematical models require the assumptions of plane homogeneous atmospheric turbulence and constant mean lateral and mean vertical velocities. These assumptions are satisfied for a point release over a flat undisturbed terrain.

In addition, considerable effort has been made to determine the effects of vertical stack velocity and gas buoyancy on the effective stack release height. Recently Carson and Moses (1967) have reviewed over 15 plume rise formulas constructed to calculate effective stack heights for conditions where there are no effects from local terrain or buildings. They concluded that no available plume rise equation can be expected to accurately predict short-term plume rise. More recent results produced by Briggs (1969) are more optimistic concerning isolated plumes suggesting error bounds for plume rise of ±20 percent.

Often, it is necessary, due to aesthetics cost, and public relation reasons, to utilize a short to medium height stack. In these cases plume dispersion is sufficiently modified by the presence of the local building structure or ground topography that the only approach available is one of wind tunnel model tests (Moses, et al. (1964), Halitsky, et al. (1963)).

A number of wind tunnel studies have considered the effects of variations in a single building geometry on plume entrainment and

dispersion (Halitsky (1963), Strom et al. (1957), Dickson et al. (1967), Jensen and Frank (1963)). These studies have permitted the specification of pertinent scaling criteria for model studies of plume excursions near buildings. Model laws will be discussed in greater detail in Section 2.

Since each arrangement of the power plant and auxiliary buildings or terrain may have separate effects on the generation of mechanical turbulence and mean flow movement, any specific gas dispersion problem will require individual tests. Hence, there exist in the literature descriptions of a variety of different model studies on reactor and industrial plants (Halitsky et al. (1963), Kalinske (1945), Davies et al. (1964), Sherlock and Stalker (1940), Hohenleiten and Wolf (1942), Martin (1965), Meroney et al. (1967), Meroney et al. (1968), Cermak and Nayak (1973), etc.) These studies are significant in that their results have been essentially confirmed by either direct prototype measurements or the absence of the gases or dusts the study was directed to remove. Kalinske (1945), Davies and Moore (1964), Hohenleiten and Wolf (1942), and Martin (1965), incorporate such comparisons within their text. Halitsky et al. (1963) has recently been compared with prototype measurements at the National Reactor Testing Station in southeast Idaho (Dickson et al. (1967)). Agreement of the diffusion concentration results were very satisfactory. Martin (1965) favorably compared his wind tunnel study measurements about a model of the Ford Nuclear Reactor at the University of Michigan with prototype measurements. Finally, Munn and Cole (1967) have taken diffusion measurements on a power station complex at the National Research Council, Ottawa, Canada, to confirm the general entrainment criteria suggested by the model studies of Davies and Moore (1964).

The purpose of this study is to determine the behavior of plumes created by gases discharged from proposed new stacks for up to three units of the Southwestern Electric Power Company Welsh Power Station (Figs. 1 and 2). Using a 1:200 scale model of the plant in a wind tunnel capable of simulating the appropriate meteorological conditions downwind ground-level stack-gas concentrations were determined by sampling concentrations of tracer gas (Krypton 85) released from the model stacks and overall plume geometry was obtained by photographing smoke plumes created by releasing smoke (titanium oxide) from the model stacks.

The general scope includes determination of how plume behavior is affected by stack height by loading level, wind direction, and wind speed of the atmosphere. A wide range of meteorological conditions can be simulated in the environmental wind tunnel of the Fluid Dynamics and Diffusion Laboratory (FDDL) at Colorado State University. The conditions simulated for this study are limited to the adiabatic lapse rate (thermally neutral flow) case.

The modeling criteria necessary to simulate atmospheric motions over such a site are presented in Section 2. Details of the model construction and the experimental equipment are described in Section 3. Finally, Sections 4 and 5 discuss the results obtained and their significance.

This report is supplemented by a motion picture (in color) and color TV tapes which show the plume behavior for all stacks for all operating levels, wind directions and meteorological conditions investigated during the course of this study (see Table 7 for TV picture sequences). A set of black-and-white photographs of each plume realization further supplements the material presented in this report.

2.0 SIMULATION OF ATMOSPHERIC MOTION

The use of a wind tunnel for model tests of gas diffusion by the atmosphere is based upon the concept that nondimensional concentration coefficients will be the same at contiguous points in the model and the prototype and will not be a function of the length scale ratio. Concentration coefficients will only be independent of scale if the wind tunnel boundary layer is made similar to the atmospheric boundary layer by satisfying certain similarity criteria. These criteria are obtained by inspectional analysis of physical statements for conservation of mass, momentum and energy. Detailed discussions have been given by Halitsky (1963), Martin (1965), and Cermak et al. (1966). Basically the model laws may be divided into requirements for geometric, dynamic, thermic and kinematic similarity. In addition, similarity of upwind flow characteristics and ground boundary conditions must be achieved.

For the Welsh Power Station study, geometric similarity is satisfied by an undistorted model of length ratio 1:200. This scale was chosen to facilitate ease of measurements, provide a boundary layer equivalent to 600-800 ft for the atmosphere and minimize wind tunnel blockage. (The ratio of projected area to the area of the wind tunnel cross section should not exceed five percent. The model of the Welsh Power Station at a scale of 1:200 produced a blockage of 3.0 percent in the EWT.)

When interest is focused on the vertical motion of plumes of heated gases emitted from stacks into a thermally neutral atmosphere the following variables are of primary significance:

ρ_a = density of ambient air

$\Delta\gamma$ = $(\rho_a-\rho_s)g$--difference in specific weight of ambient air and stack gas

Ω = local angular velocity component of earth

μ_a = dynamic viscosity of ambient air

V_a = speed of ambient wind at stack height

V_s = speed of stack gas emission

H = stack height

D = stack diameter

δ_a = thickness of planetary boundary layer

z_o = roughness heights for upward surface

Grouping the independent variables into dimensionless parameters with ρ_a, V_a and H as reference variables yields the following parameters upon which the dependent quantities of interest must depend:

$$\frac{V_a}{H\Omega}, \frac{\delta_a}{H}, \frac{z_o}{H}, \frac{D}{H}, \frac{V_a \rho_a H}{\mu_a}, \frac{\rho_s V_s^2}{\rho_a V_a^2}, \frac{\rho_a V_a^2}{\Delta\gamma D}, \frac{\Delta\gamma}{g\rho}$$

The laboratory boundary-layer-thickness parameter δ_a/H was made approximately equal to that for the atmosphere. A value for this ratio of at least 1.5 was established for the highest stacks. Equality of the surface parameter z_o/H for model and prototype was achieved through geometrical scaling of the stacks and upwind roughness. Likewise the stack parameter D/H was equal for model and prototype.

Dynamic similarity is achieved in a strict sense if a Reynolds number $\frac{\rho_a V_a H}{\mu_a}$ and a Rossby number $\frac{V_a}{H\Omega}$ for the model is equal to its counterpart for the atmosphere. The model Rossby number cannot be made equal to the atmospheric value. However, over the short distances considered (up to 15,000 ft), the Coriolis acceleration has little influence upon the flow. Accordingly, the standard practice is to relax the requirement of equal Rossby numbers.

Kinematic similarity requires the scaled equivalence of streamline movement of the air over prototype and model. It has been shown in Halitsky et al. (1963) that flow around geometrically similar sharp-edged buildings at ambient temperatures in a neutrally stratified atmosphere should be dynamically and kinematically similar when the approaching flow is kinematically similar. This approach depends upon producing flows in which the flow characteristics become independent of Reynolds number if a lower limit of the Reynolds number is exceeded. For example, the resistance coefficient for flow in a sufficiently rough pipe as shown in Schlicting (1960, p. 521) is constant for a Reynolds number larger than 2×10^4. This implies that surface or drag forces are directly proportional to the mean flow speed squared. In turn, this condition is the necessary condition for mean turbulence statistics such as root-mean square value and correlation coefficient of the turbulence velocity components to be equal for the model and the prototype flow.

Golden, as cited by Halitsky et al. (1963), found that for flow about a cube for Reynolds numbers above 11,000, there was no change in concentration measurements. The minimum Reynolds number encountered in the present study was 11,000 based on the model scale of 1.0 ft and a minimum velocity of 15 fps. Correlation tests of flow about the Rock of Gibraltar flow over Pt. Arguello, California, and flow over San Nicolas Island, California, may be cited as examples of large Reynolds number flows which have been modeled successfully in a wind tunnel (Field and Warden (1933), Cermak and Peterka (1966), Meroney and Cermak (1965)).

Buildings and building complexes produce nonuniform fields of flow which perturb the regular upstream atmospheric wind profiles. Around each building a boundary layer exists, where the velocity is zero at the surface but increases rapidly to a relatively constant value a short distance from the building wall. Outside of the boundary layer and downstream there exists a region of low velocities and pressures called the cavity. In this region circulations are such that flow may actually reverse with respect to the upstream winds. Surrounding the cavity but extending further downstream is a parabolic region called the wake in which the presence of the building is still evident in terms of deviations of velocity, turbulence, and pressure from conditions found in the upstream atmospheric boundary layer.

The formation of the wake and cavity regions are associated with a phenomena called boundary-layer separation. Under certain conditions the boundary layer actually detaches and enters the flow streaming about the building. This may occur at the corner of a sharp-edged building or on a curved surface if the pressure increases due to a decelerating flow field. The separated boundary layer forms a sheet which completely surrounds the cavity region which contains relatively stagnant fluid. The extent of the cavity region for the Welsh Power Station building may be approximated by $5H \cong 1000$ ft. Based on the measurements of Evans (1957) the effect of alternate wind approach angles to an elongated rectangular complex may extend this to $6H \cong 1200$ ft.

The need for scaling of the atmospheric mean wind profile was demonstrated by Jensen (1963). Substitutions of a uniform velocity profile for a logarithmic profile results in threefold variation in

the dimensionless pressure coefficient downstream of a model building. Such variance in the pressure fields indicates a strong effect of the upstream wind profile on the kinematic behavior of the fluid near the building complex. One of the few tunnels currently capable of generating a turbulent boundary layer thick enough for a 1:200 model scale is the Environmental Wind Tunnel at Colorado State University. Other investigators have attempted to generate logarithmic profiles in short tunnels by inserting special grids upstream of the test section; however, this technique normally creates a nontypical turbulence field which decays rapidly downstream.

The length of scale used for scaling the velocity profile is the roughness height z_o. For the Welsh Power Station site a typical roughness length is assumed to be less than 0.33 ft. This means the critical wind velocities could be modeled in the wind tunnel by a roughness length of less than 1/400 in., or essentially a smooth upstream surface. A turbulent boundary layer approximately 2.5 ft thick was produced by an upstream fetch of 15 ft and a tailored vortex grid in the Environmental Wind Tunnel. Considering the flat to rolling terrain with intermittent covering of trees and shrubs it was decided to simulate the upstream wind profile by a power law exponent of approximately 0.22. This shape profile is characteristic of flow over flat or rolling terrain partially covered by trees and obstructions.

Equality of the parameter $\rho_a V_a^2/(\Delta\gamma D)$ for model and prototype in essence determines the relationship between the atmospheric wind speed and the model wind speed once the geometric scale has been selected (1:200 in the case). Often this criteria results in $(V_a)_m$ being too small to satisfy the minimum Reynolds number requirement.

When this happens to the specific weight difference for the model $(\Delta\gamma)_m$ can be made larger than $(\Delta\gamma)_p$ to compensate for the effect of small geometric scale. However, equality of the density difference ratio for model and prototype will be maintained in this study. This equality ensures that the initial plume behavior where acceleration of the stack gases is maximum will be modeled correctly. This is particularly important if downwash behavior is to be correctly indicated by a small scale model.

Using the lowest wind speed of 10 mph or 17.4 ft/sec and a scale of 1:200, the Froude number equality gives

$$\frac{(V_a)_m^2}{(V_a)_p^2} = \left(\frac{1}{200}\right)$$

or

$$(V_a)_m = 14.7 \left(\frac{1}{200}\right)^{\frac{1}{2}}$$

$$(V_a)_m = 1.00 \text{ ft/sec.}$$

The corresponding model Reynolds number then becomes approximately

$$\left(\frac{V_a \rho_a H}{\mu_a}\right)_m = \frac{1.0 \times 1}{1.5 \times 10^{-4}}$$

$$= 6700 < 11{,}000 .$$

Since minimum Reynolds number for the 20 and 30 mph cases seems sufficiently high thus no corrections are recommended. Inaccuracies in near field behavior resulting from adjustment in density ratios do not appear to justify any improvements expected at long distance downwind.

Rather than heat the model stack gases to obtain the same specific-weight-difference ratio as for the prototype, helium may be used to

attain the proper density differences $(\Delta\gamma)_m$. This approach will be used since the helium-air mixture can be accurately metered to provide better monitoring and adjustment of the stack gas.

To summarize the following scaling criteria were applied for the neutral boundary layer situation:

1/ $Re = \frac{\rho_a V_a H}{\mu_a} > 11{,}000$

2/ $Fr = \frac{\rho_a V_a^2}{\Delta\gamma D}$; $(Fr)_m = (Fr)_p$

3/ $R = \frac{V_s}{V_a}$; $R_m = R_p$

4/ $(z_o)_m = (z_o)_p$

5/ Similar velocity and turbulence profiles upwind.

Operating conditions for the Welsh Power Station have been supplied by Sargent & Lundy Engineers for the various units. (See Table 1.) Meteorological data converted to the form of wind rose patterns (Fig. 3) suggest tests at four primary wind orientations. Modeled wind velocities, stack velocities, and plume densities based upon the selected scaling criteria are tabulated together in Table 2.

3.0 TEST APPARATUS

3.1 Wind-Tunnels

The environmental wind tunnel (EWT) shown in Fig. 4 was used for this neutral flow study. This wind tunnel, specially designed to study atmospheric flow phenomena, incorporates special features such as adjustable ceiling, rotating turntables, transparent boundary walls, and a long test section to permit adequate reproduction of micrometeorological behavior. Mean wind speeds of 0.2 to 50 ft/sec (0.14 to 40 mi/hr) in the EWT can be obtained. In the EWT boundary layers three feet thick over the downstream 20 ft can be obtained with the use of the vortex generators at the test section entrance. The flexible test section roof on the EWT is adjustable in height to permit the longitudinal pressure gradient to be set at zero.

3.1.1 Test Configuration in the EWT

Vortex generators were installed at the tunnel entrance together with an initial roughness to accelerate the preliminary growth of the modeled boundary layer.

The Welsh Power Station model (see Section 3.2) was constructed to represent a swath 1200 ft to the right and left of the wind orientation chosen. The floor of the tunnel was pierced by 58 taps arranged in sampling arrays to measure ground level concentrations.

3.2 Model

The model consisted of the power station, the stacks, and the auxiliary buildings constructed from lucite and sheet metal to a linear scale of 1:200 (see Figs. 2 and 6).

The model was built at a 1:200 scale to dimensions taken from drawings supplied by Sargent & Lundy Engineers. These were

topographical maps N3300-W9445/7.5 Cason Quadrangle, and drawings. Three stacks were constructed for each unit, one 241 ft, one 300 ft, and one 350 ft in height. All connections to the stacks were made by the addition of fittings at the base of each stack.

Metered quantities of gas were allowed to flow from each stack to simulate the exit velocity and also account for buoyancy effects due to the temperature difference between the stack gas and the ambient atmosphere. Helium and compressed air were mixed in metered amounts to adjust the specific weight as proposed in Section 2. Fischer-Porter flow rator settings were adjusted for pressure, temperature, and molecular weight effects as necessary. When a visible plume was required the gas was bubbled through titanium tetrachloride before emission. When a traceable plume was required a high pressure mixture of Krypton-85 and air was used in place of the compressed air.

3.3 Flow Visualization Techniques

Smoke was used to define plume behavior over the power plant complex. The smoke was produced by passing the air mixture through a container of titanium tetrachloride located outside the wind tunnel and transported through the tunnel wall by means of a tygon tube terminating at the stack inlet within the model complex. The plume was illuminated with arc-lamp beams. A visible record was obtained by means of pictures taken with a Speed Graphic camera utilizing Polaroid film for immediate examination. Additional still pictures were obtained with a Hasselblad camera. Stills were taken with camera speeds of both 1/30 and 30 seconds--the first to capture characteristic plume excursions on the short time scale, the second to identify mean plume boundaries. A partial series of color motion pictures were also taken with a Bolex

motion picture camera mounted on a movable dolly which was traversed the length of the tunnel parallel to the plume trajectory at the average wind speed.

A complete series of color TV sequences were obtained on 3/4" TV cassettes utilizing a Hatachi-Shibaden FP-1500 color camera with a 5:1 auto iris lens as recorded on a JVC Model 6000U TV cassette tape recorder. Complete sets of these still pictures and motion picture sequences were provided to Sargent & Lundy Engineers, as a separate part of this final report.

3.4 Wind Profiles and Temperature Measurements

A standard pitot-static tube was utilized to measure the up and downstream velocity profiles in the EWT for neutral flow fields.

3.5 Gas Tracer Technique

After the flow in a tunnel was stabilized, a mixture of Kr-85 of predetermined concentration was released from model stacks at a required rate (Table 2). Samples of air were withdrawn from the sample points on the wind tunnel floor and analyzed. The flow rate of Kr-85 mixture was controlled by a pressure regulator at the supply cylinder outlet and monitored by Fischer and Porter precision flow meters. Source concentration was from .23 to .48 μc_i/cc of Kr-85, a beta emitter (half lifetime = 10.3 years). The sampling and detection systems are shown in Fig. 7 and described in Cermak and Nayak (1923). A sampling grid of sample points was spaced on the wind tunnel floor (Fig. 8) at suitable locations to establish the plume axis and locate the points of maximum ground-level concentrations.

3.5.1 Analysis of Data

Krypton-85 is a radioactive noble gas with a half life of 10.6 years. The gas decays by emission of beta particles with small amounts of gamma rays. The gas has many advantages over the other tracers used in wind tunnel dispersion studies. It is diluted with air about a million times before use, and as such, has properties very similar to those of air. Its detection procedure is fairly simple and direct.

The procedure for analyzing the concentration data was as follows:

1) Counts of the pulses generated in the G.M. tubes and displayed by the ultra scaler counter were recorded for each sample location

2) These counts were transformed into concentration values by the following steps:[□]

$$Cpm^* = Cpm - \text{Background (Cpm)}$$

$$\chi(\mu\mu \text{ Curie/cc}) = Cpm^* \times \text{Counting Yield (p Curie/cc/Cpm)}$$

3) For counts over 1,000 a dead time correction[△] had to be applied to the readings, and in this case the correction is,

$$Cpm^* = Cpm - \text{Background}$$

$$Cpm^* = \frac{Cpm^*}{1 - 2.00 \times 10^{-6} \times Cpm^*}$$

$$\chi(\text{p Curie/cc}) = Cpm^* \times \text{Counting Yield.}$$

4) Average concentration values were determined for the known probe position and then displayed at the proper locations.

□ p Curie: pico curie (10^{-12} curie)

△ The time taken for the positive space charge to move sufficiently far from the anode for further pulses to occur.

5) The concentration parameter $\chi \bar{V}/Q$ was then computed at all locations. A sample computation is shown below:

$$q = 600 \text{ cc/min} = 10 \text{ cc/sec}$$

$$Q_{total} = 1.8 \ \mu \text{ Curie/cc} \times 10 \text{ cc/sec}$$

$$= 18.0 \ \mu \text{ Curie/sec}$$

Let $V = 2$ fps $= 60.96$ cm/sec, and $\chi = 80$ p Curie/cc. Then

$$\frac{\chi V}{Q} = \frac{80 \times 10^{-6} \times 60.96}{18} \times 10^{4} = 2.71 \text{ m}^{-2}$$

$$(= .25 \text{ ft}^{-2})$$

6) So far the values of the concentration parameter apply to the model and it is desirable to express these values in terms of the field. At the present time there is no set procedure for accomplishing this transformation. The simplest and most straightforward procedure is to make this transformation using the scaling factor of the model. Since

$$1 \text{ ft}|_m = 200 \text{ ft}|_p \ (= 61^m|_p),$$

one can write

$$\frac{\chi V}{Q}|_p \ (\text{ft}^{-2}) = \frac{1}{200^2} \times \frac{\chi V}{Q}|_m \ (\text{ft}^{-2})$$

or

$$\frac{\chi V}{Q}|_p \ (\text{m}^{-2}) = \frac{1}{200^{-2}} \times \frac{\chi V}{Q}|_m \ (\text{m}^{-2})$$

or in terms of the above example,

$$\frac{\chi V}{Q}|_p \ (\text{ft}^{-2}) = \frac{1}{200^2} \times .25 = 6.25 \times 10^{-6} (\text{ft}^{-2})$$

or

$$(\frac{\chi V}{Q}|_p \ (\text{m}^{-2}) = \frac{1}{200^2} \times 2.71 = 6.775 \times 10^{-5} \ (\text{m}^{-2}))$$

This sample scaling of the concentration parameter from model to field appears to give reasonable results.

7) To convert these results to concentration in ppm of SO_2 requires specific information concerning the prototype SO_2 source strength. If the source strength of Unit 4 is say 944.6 gm/sec-SO_2 and the mean wind speed is 22 ft/sec then

$$\chi_p = \frac{\chi V}{Q}\Big|_p \times \frac{Q}{V}\Big|_p = 6.25 \times 10^{-6} \times \left(\frac{944.61/454}{22}\right)$$

$$= 5.91 \times 10^{-7} \text{ lb/ft}^3 - SO_2$$

$$\left(\text{or } \chi_p = 6.775 \times 10^{-5} \times \left(\frac{944.6}{22 \times 0.30}\right) = 9.70 \times 10^{-3} \text{ g/m}^3\right.$$

$$= 9.70 \times 10^{-3} \times 0.375 \times 10^{-3}$$

$$= 3.64 \text{ ppm} - SO_2$$

3.5.2 Errors in Concentration Measurements

Where data is obtained with a scaler counter, the apparent activity of a radioactive source is found by subtracting the background rate from the observed sample-plus-background rate. The background rate is measured separately and has an uncertainty of its own due to random radioactive sources.

If the background is present, the standard deviation in the net counting rate σ_{R_s} for a sample is

$$\sigma_{R_s} = \left(\frac{R_{s+b}}{t_s} + \frac{R_b}{t_b}\right)^{1/2}$$

where R_{s+b} is the observed sample-plus-background rate, R_b is the background rate, t_s and t_b are the measurement time for the sample and background, respectively. The standard deviation in the sample rate depends, then, upon both the time for sample measurement and that

for background-rate measurement. When R_{s+b} is large in comparison with R_b, a long background measurement is not needed to make the error contribution from the background rate negligible. On the other hand, when R_{s+b} is comparable to R_b, both t_s and t_b must be very long for small values of σ_{R_s}. In the present experiments, an effort was made to keep the probable errors in concentration measurements within 10 percent. For this reason the sample counting time and background counting time were manipulated with this end in view. More detailed information on errors in radioactivity measurements can be found in Yang and Meroney (1970).

3.5.3 Test Results: Concentration Measurements

Since the conventional point-source diffusion equations cannot be used for predicting diffusion near objects which cause the wind to be nonuniform and nonhomogeneous in velocity and turbulence, it is necessary to calculate gaseous concentrations on the basis of experimental data. It is convenient to report dilution results in terms of a nondimensional factor independent of model to prototype scale.

In Cermak et al. (1966) and Halitsky (1963) the problem of similarity for diffusion plumes is discussed in detail. It is suggested that concentration measurements be transformed to K-isopleths by the formula

$$K = \frac{\chi}{Q/AV_a}$$

where

χ = sample volume concentration

A = frontally projected area of power plant complex

V_a = mean wind velocity at some references height

Q = gas source release rate

This expression is specifically suitable for measurements within the near-wake and cavity region. Data reported herein, however, represent measurements made at equivalent distances of 5000 ft from the power plant.

Concentration measurements were made at various downwind distances in the vertical and horizontal planes. Count rates were corrected to concentration in picocuries and compensation was made for Geiger Mueller tube dead time. Since measurements were made at a variety of wind approach angles, wind velocities, and stack heights, the ground-level concentration data has been reported in terms of the ratio $V_a\chi/Q$ which has units of length squared. For dispersion in a homogeneous flow this should produce similarity for various V_a and Q values. The significance of all results is discussed in the following section.

When interpreting model diffusion measurements it is important to remember that there can be considerable difference between the instantaneous concentration in a plume and the average concentration due to horizontal meandering. The average dilution factors near a building complex will correlate well with wind tunnel dilution factors since the mechanical turbulence of the wake and cavity region dominate the dispersion. In the wind tunnel a plume does not generally meander due to the absence of large scale eddies. Thus, it is found that field measurements of peak concentrations which effectively eliminate horizontal meandering, should correlate with the wind tunnel data (Hino (1968)). In order to compare downwind measurements of dispersion to predict average field concentrations it is necessary to use data on peak-to-mean concentration ratio as gathered by Singer, et al.(1953, 1963). Their data is correlated in terms of the gustiness categories suggested by Pasquill for a variety of terrain conditions. It is

possible to determine the frequency of different gustiness categories for a specific site. Direct use of wind tunnel data at points removed from the building cavity region may underestimate the dilution capacity of a site by a factor of four unless these adjustments are considered (Martin (1965)).

An alternate technique has also been suggested by Hino (1968) who argues the relationship between the maximum of time-mean ground concentration χ_{max} and the sampling time is $\chi_{max} \sim \tau^{-1/2}$. Field experiments may be compared with wind tunnel data by the formula:

$$(\chi_a)_p = \frac{(\chi_a)_m Q_p V_p^{-1} h_p^{-2}}{Q_m V_m^{-1} h_m^{-2}} \left(\frac{\tau_p}{\tau_m}\right)^{-1/2}$$

where χ_a is the maximum axial concentration, Q discharge rate of gases from a stack, V wind speed, h effective height of stack, τ sampling time, and subscripts p and m represent values for a prototype and model respectively. One may assume that τ_m corresponds to three to five minutes in the atmosphere for the wind tunnel experiment. Pasquill's suggested values for the standard deviations σ_z and σ_y correspond to 10 minute averages (Turner (1969)). Hence tunnel concentrations could be high by a factor of 1.7 if a 10 minute average is desired, or by a factor of 21.9 if a 24 hour average is desired.

An examination of Singer's results for peak-to-mean concentration ratios suggests the ratio is a function of both stability and boundary surface roughness. Hence for a variation of stratification from unstable to moderately stable the peak/mean concentration ratio may be nearly equal though the sampling time might vary from 30 minutes to three minutes respectively and the power law coefficient in Hino's equation above would vary from -0.6 to -0.3. It is not likely that a

decisive interpretation of the effects of plume meandering will be available in the near future; hence, the conservative assumption is recommended that the wind tunnel measurements correspond to a 30 minute averaging time and, when correcting results to alter sampling periods, a power law coefficient of -1/2 be utilized. (A five minute wind tunnel equivalent sampling time results in 24 hour equivalent concentrations 50 percent smaller.)

4.0 TEST PROGRAM AND RESULTS

4.1 Test Program

The test program consisted of (1) a qualitative study of the flow field around the power plant by visual observation of the smoke plume trajectory released from the stacks; and (2) a quantitative study of gas concentrations produced by the release of Kr-85 from the stacks. The test conditions are summarized in Table 2. The test program was accomplished in two parts: Phase A involved a single unit and Phase B involved the presence of all three units.

Angular locations of the approach winds are referred to in terms of angles from a nominal north. Downwind distances refer to lengths as measured from the center stack as marked in Fig. 2. Unless otherwise noted, the term wind velocity refers to the velocity in the undisturbed free stream at an equivalent height of 241 feet; however, a velocity at any reference height is available by referring to the velocity profiles (Fig. 9).

4.2 Phase A: Unit 1 Alone

4.2.1 Test Results: Characteristics of Flow

All the experiments were carried out in the EWT over the range of conditions shown in Table 2. The atmospheric boundary layer was modeled to produce a velocity profile equivalent to flow typical of irregular terrain. Figure 9 shows the development of the velocity profile over the model for a neutral situation. No comparison of model velocity data with that in the prototype is possible because the latter is not available over a range of height. However, as the model velocity profiles were carefully produced over roughness tailored to reflect the characteristics of the site, it is expected that the

prototype flow is adequately represented in the model. The power law exponent for the upstream velocity profile was 0.22.

4.2.2 Test Results: Visualization

The test results consist of photographs and sketches showing the general nature of air flow and diffusion in the vicinity of the power station, (Figs. 10-15). A general understanding of wake and cavity flows is necessary for an interpretation of the plume behavior (see Halitsky, 1963).

The sequences of photographs shown in Fig. 10 show side views of the behavior of a smoke plume released from Unit 1 at wind angle SE for full load at 20 mph for various stack heights. At low wind speeds the plume lofts high above the separation cavity and aerodynamic wake generated by the power plant complex. The gas behaves as a plume released at an elevated point and is convected well downstream. As the wind speed increases the stack effluent plume is bent over and behaves as though it were released at increasingly lower effective heights. At a sufficiently large free stream velocity the plume intermittently entrains behind the stack itself and the plume may intersect the building wake. For the shortest stack at high wind speeds the plume may become entrained in the building complex cavity. Entrainment, as utilized herein, will be understood as the presence of any of the gas released from the stack in the power station cavity. A small amount of entrainment usually first occurs under conditions where the gas plume follows the cavity separation streamline to the downstream cavity stagnation point from which it diffuses upstream into the cavity proper. Downwash will be understood as severe entrainment where the plume does not penetrate the separation streamline but rather ventilates directly into the cavity region. A decrease in load from full to

one-half has the same effect on the plume behavior as an increase in wind speed. In general lower load aggravates plume behavior; however one must consider the reduced pollutant burden in any assessment of the net significance. Figure 12 displays the effect of change in load for all Units, wind angle W, when the mean effective wind speed is 10 mph.

It is instructive to examine the plume behavior for both instantaneous effluent boundary location and when averaged over a larger time period. Figure 15 depicts the plume outlines when the camera is released after 1/32 and 20 seconds respectively. In an instantaneous sense a plume may contact the ground yet result in rather low ground average concentrations. The longer averaging time tends to emphasize locations beyond which extensive ground contact will occur.

The observed "touchdown" distances evaluated from the flow visualization tests are summarized in Table 3. Touchdown is defined during observation as that point where the plume encounters the ground more than 10 percent of the time. Such an interpretation is necessarily qualitative but different observers do not vary by more than 500 ft. Smoke photographs tend to confirm the initial opinion. Complete sets of instantaneous (speed 1/32 sec) and average (shutter speed 20 sec) still photographs supplement this report. Color motion and TV pictures have been arranged into titled sequences and the sets available are summarized in Table 7.

4.2.3 Test Results: Concentration Measurements

Turbulent diffusion of gaseous effluent released for three different stack heights was studied. Krypton-85 concentrations at ground level and in the vertical were measured at distances equivalent to 500 ft to 5000 ft downwind.

Twenty-five samples were taken over the model distributed at ground level over the topography in the matrix shown in Fig. 8. Since the stack for Unit 1 was sometimes displaced to the right or left of the concentration grid centerline, coordinates x and y of this stack are recorded for each set of data. All concentration data have been converted to the prototype scale levels as explained in Section 3.5.1. The data is recorded herein in dimensional form as $\frac{\chi V}{Q}$ where χ is the concentration over the assumed equivalent averaging time for laboratory measurements, Q is the source strength, and V is the mean wind velocity at stack height (240 ft). The source flow rate and thermal condition assumed for each stack and load condition are summarized in Table 2. Data in Table 1 were provided by Sargent & Lundy Engineers.

The results for various sources, loads, wind directions, and wind velocities are presented in Table 8 and 9. The coordinates x and y shown in the tables are explained in the definition sketch in Fig. 8. The maximum concentration measured and its respective downwind location for each situation has been gathered together in Tables 5 and 6.

A series of figures have been prepared from the bulk data to enable some general conclusions to be made concerning the influence of wind approach angle, stack height, load, and wind velocity on the plume behavior over the Welsh Power Station model. The influence of wind approach angle for a single unit is displayed in Fig. 16. Plume downwash is apparently enhanced for winds approaching the plant from the E, SE, and S wind directions. Once entrained into the wake however, the plume dispersion rate seems very similar. Wind speed or load variation appears to effect the plume trajectory in a similar manner. Figure 17 displays the degrading influence of increased

wind speed or decreased load on plume rise and subsequent ground level concentrations.

Increase in stack height definitely provides site protection. Figure 18 depicts the advantages of increased stack height with respect to ground level concentration profiles. Increase of the units stacks from 241 to 300 ft decreases maximum observed concentration by about 50 percent. A further increase in stack height to 350 ft reduces the ground concentrations to less then 10 percent of the maximums observed for a 241 ft stack.

Figures 20 and 21 display the influence of wind speed and load on the vertical profiles of plume concentration at a site 4000 ft downwind of the plant. Since the maximum probe height utilized was at a model height of 800 ft it is evident many plume situations will develop maximum concentrations at a greater distance above the ground. As wind speed increases or load decreases the initial plume rise decreases until a maximum concentration occurs below 800 ft. Note that ground level concentrations are a small fraction of the elevated values. Plume looping in unstable conditions may well cause high ground level concentrations for short periods of time.

An appendix is included which gives a short discourse on plume calculation techniques pertinent to the cases examined herein. The example case supplied for a 300 ft stack when compared with laboratory results emphasizes the importance of considering topography, exhaust velocity ratio, and stack/building height ratio.

4.3 Phase B: All Units

4.3.1 Test Results: Visualization

The additional aerodynamic blockage and turbulence developed by a set of three adjacent plant units tends to increase the rate of entrainment and mixing of the elevated plumes to ground level. Figure 12 displays for the E wind approach direction the influence of additional units on plumes emitted from a 300 ft stack at 60 percent load into a 20 mph wind. The lower edge of the plume disperses downwind under the influence of the wide building wake. Although not clearly apparent in the photographs plumes now intermittently descend to the surface within 2000 ft of the stacks.

For high winds and low loads the plume may be completely entrained into the near building cavity. Wisps of tracer smoke are visible to an observer near the ground returning to the plant base (see Fig. 13). Plant orientation has a strong influence on plume behavior. When the plant structures are perpendicular to the approach flow (E or W) plumes are quickly entrained by the wake. When the plume structures are aligned with the wind (S) the wake is smaller. In addition the plumes from the three stacks appear to intersect and the additive effect of their buoyancy is to increase plume rise (see Fig. 14).

4.3.2 Test Results: Concentration Measurements

The results for various sources, loads, wind directions and wind velocities are also presented in Tables 8, 5 and 6. Figures 19, 20 and 21 dramatically display the increase measured in ground level concentrations as a result of downwind mixing in the building wake region. Figure 21, in particular, suggests the extent of vertical mixing which results from the fence-like presence of the three aligned units.

5.0 CONCLUSIONS

The investigation was undertaken to determine the dispersion of exhaust gases released from stacks of the Welsh Power Station operated by the Southwestern Electric Power Company, Louisiana. The primary aim of the study was to determine the optimum height of stack to utilize a new boiler unit (Unit 1) and effect of building-complex wake on ground-level concentrations of sulfur dioxide.

On the basis of the experimental measurements reported herein, the following comments may be made:

5.1 Phase A: Unit 1 Alone

1) Plumes from a single unit do not entrain directly into the building complex cavity for any wind angle, velocity, load, or stack height studied.

2) For a 241 ft stack on a single unit there is not significant visual evidence of ground contact within a mile of the plant until the wind speed exceeds 30 mph.

3) The plume-building wake influence for all plumes is a maximum for the east wind approach direction and a minimum for the south orientation.

4) The addition of a nozzle to the 300 ft stack to increase exit velocity for the 30 percent load case to that normally found for 100 percent load did loft the plume; however, the result was only to increase plume intercept at 30 mph, 30 percent load, from 1250 ft to 2500 ft.

5) Concentration measurements show that maximum SO_2 ground-level concentrations of .179 ppm will result from a 241 ft stack at 30 percent load for a 30 mph and approaching from the SE. Increasing

the stack height to 300 or 350 ft decreases this maximum to .091 ppm and .045 ppm, respectively.

5.2 Phase B: All Units

6) The presence of three units definitely increases the probability of plume entrainment into the building cavity and early intersection with the ground. Although a 300 ft stack on a single unit resulted in plume intercept with the ground beyond 5000 ft except for the highest wind speed situations, the presence of three units resulted in ground contact between 750-4000 ft for almost all situations studied.

7) For three units the eastern wind approach angle consistently resulted in the largest concentrations and earliest plume touchdown.

8) Concentration measurements show that maximum SO_2 ground-level concentrations of .467 ppm will result fot a 300 ft stack at 607 load for a 30 mph wind approaching from the E.

Since specific maximum source levels may vary depending on the source of coal or the load, dimensional prediction tables have been prepared in the manner of Pasquill for the Welsh Power Station configuration. If percent frequency of winds and stability conditions at various wind approach angles are known for the Welsh site, average annual concentrations or 24 hour averages including the effects of wind angle frequency distribution may be calculated in the manner of Turner (1969) or Sherlock and Stalker (1940). If one desires the meteorological significant situations such as looping, fanning, fumigation, or trapping one may combine the experimental results developed herein with the expressions suggested by Bierly and Hewson (1962) or Slade (1968, Chapter 3, Section 315).

REFERENCES

Barrett. R. V., "Use of the Wind Tunnel to Investigate the Influence of Topographical Features on Pollution from a Tall Stack," Chimney Design Symposium, April 9-11, 1973. Edinburgh, Scotland, 16 p.

Barry, P. J., "Estimation of Downwind Concentration of Airborne Effluents Discharged in the Neighborhood of Buildings," Canada, AECL-2043, July 1964.

Bierly, E. W. and E. W. Hewson, "Some Restrictive Meteorological Conditions to be Considered in the Design of Stacks," Journal of Applied Meteorology, Vol. 1, 1962, pp. 383-390.

Carson, J. E. and H. Moses, "Validity of Currently Popular Plume Rise Formulas," USAEC Meteorological Information Meeting, September 11-14, 1967, Chalk River, Canada, AECL-2787, pp. 1-15.

Cermak, J. E. and J. Peterka, "Simulation of Wind Fields over Point Arguello, California, by Wind-Tunnel Flow over a Topographical Model," Final Report, U.S. Navy Contract N126(61756)34361 A(PMR), Colorado State University, CER65JEC-JAP64, December 1965.

Cermak, J. E., "Laboratory Simulation of the Atmospheric Boundary Layer," AIAA J1., Vol. 9, No. 9, pp. 1746-1754, September 1971.

Cermak, J. E. and S. K. Nayak, "Wind-Tunnel Model Study of Downwash from Stacks at Maui Electric Company Power Plant, Kahului, Hawaii," Fluid Dynamics and Diffusion Laboratory Report CER72-73JEC-SKN8, Colorado State University, March 1973.

Cermak, J. E., V. A. Sandborn, E. J. Plate, G. J. Binder, H. Chuang, R. N. Meroney and S. Ito, "Simulation of Atmospheric Motion by Wind-Tunnel Flows," Colorado State University, CER66JEC-VAS-EJP-HC-RNM-SI17.

Cramer, H. E., "A Practical Method for Estimating the Dispersal of Atmospheric Contaminants," Proceedings, First National Conference of Applied Meteorology, Amer. Meteor. Soc., C., pp. 33-35, Hartford, Connecticut, October 1957.

Davies, P. O. A. L. and P. L. Moore, "Experiments on the Behavior of Effluent Emitted from Stacks at or near the Roof Level of Tall Reactor Buildings," Int. Jour. Air Water Pollution, Vol. 8, pp. 515-533, 1964.

Dickson, C. R., G. E. Start and E. H. Markee, Jr., "Aerodynamic Effects of the EBR-II Containment Vessel Complex on Effluent Concentrations," USAEC Meteorological Information Meeting, Chalk River, Canada, AECL-2787, pp. 87-104, September 11-14, 1967.

Evans, B. H., "Natural Air Flow Around Buildings," Research Report 59, Texas Engineering Experiment Station, 1957.

Field, J. H. and R. Warden, "A Survey of the Air Currents in the Bay of Gibraltar, 1929-1930," Air Ministry, Geophys, Mem. No. 50, London, 1933.

Halitsky, J., J. Golden, P. Halpern and P. Wu, "Wind Tunnel Tests of Gas Diffusion from a Leak in the Shell of a Nuclear Power Reactor and from a Nearby Stack," Geophysical Sciences Laboratory Report No. 63-2, New York University, April 1963.

Halitsky, J., "Gas Diffusion near Buildings," Geophysical Science Laboratory Report No. 63-3, New York University, February 1963.

Hewson, E. W., "Stack Heights Required to Minimize Ground Concentrations," ASME Transaction, Vol. 77, pp. 1163-1172, 1955.

Ilino, M., "Maximum Ground-Level Concentration and Sampling Time," Atmospheric Environment, Vol. 2, pp. 149-165, 1968.

Hoot, T. G., R. N. Meroney and J. A. Peterka, "Wind Tunnel Tests of Negatively Buoyant Plumes," FDDC Report CER73-74TGH-RNM-JAP13, Colorado State University, October 1973.

Hoult, D. P., et al., "A Theory of Plume Rise Compared with Field Observations," MIT Fluid Lab. Pub. 68-2, (PB 179 536), March 1968.

Integrated Army Meteorological Wind-Tunnel Research Program, Eleventh Quarterly Progress Report, 22 p., 1 November 1967 - 31 January 1968.

Jensen, M. and N. Frank, "Model-Scale Test in Turbulent Wind, Part I," The Danish Technical Press, Copenhagen, 1963.

Kalinske, A. A., "Wind Tunnel Studies of Gas Diffusion in a Typical Japenese Urban District," National Defense Res. Council OSCRD Informal Report No. 10. 3A-48 and 48a, 1945.

Martin, J. E., "The Correlation of Wind Tunnel and Field Measurements of Gas Diffusion using Kr-85 as a Tracer," Ph.D. Thesis, MMPP 272, University of Michigan, June 1965.

Meroney, R. N., J. E. Cermak and F. H. Chaudhry, "Wind Tunnel Model Study of Shoreham Nuclear Power Station Unit 1, Long Island Lighting Company," Progress Report 1, FDDL Report CER68-69RNM-JEC-FHC1, Colorado State University, July 1968.

Meroney, R. N. and J. E. Cermak, "Wind Tunnel Modeling of Flow and Diffusion over San Nicolas Island, California," U.S. Navy Contract No. N123(61756)50192 A(PMR), Colorado State University, CER66-67RNM-JEC44, September 1967.

Meroney, R. N., J. E. Cermak and F. H. Chaudhry, "Wind Tunnel Model Study of Shoreham Nuclear Power Station Unit 1, Long Island Lighting Company," Progress Report 2, CER68-69RNM-JEC-FHC14, October 1968.

Moses, H., G. H. Strom and J. E. Carson, "Effects of Meteorological and Engineering Factors on Stack Plume Rise," Nuclear Safety, Vol. 6, No. 1, pp. 1-19, Fall 1964.

Montgomery, T. L. and M. Cain, "Adherence of Sulfur Dioxide Concentrations in the Vicinity of a Steam Plant to Plume Dispersion Models," Journal of APCA, Vol. 17, No. 8, pp. 512-517, 1967.

Munn, R. E. and A. F. W. Cole, "Turbulence and Diffusion in the Wake of the Building," Atmospheric Environment, Vol. 1, pp. 34-43, 1967.

Pasquill, F., Atmospheric Diffusion, D. Van Nostrand Co., London, 1962.

Roberts, O. F. T., "The Theoretical Scaling of Smoke in a Turbulent Atmosphere," Proc. Roy. Soc., A. 104, p. 640, 1957.

Roshko, A., "On the Development of Turbulent Wakes from Vortex Steel," NACA Report 1191, 1954.

Schlichting, H., Boundary Layer Theory, McGraw Hill, New York, 1960.

Sherlock, R. H. and E. A. Stalker, "The Control of Gases in the Wake of Smokestacks," Mechanical Engineering, Vol. 62, No. 6, pp. 455-458, June 1940.

Singer, I. A., I. Kazukiko and G. D. Roman, "Peak to Mean Pollutant Concentration Ratios for Various Terrain and Vegetative Cover," Journal APCA, Vol. 13, No. 1, p. 40, 1963.

Singer, I. A. and M. E. Smith, "The Relation of Gustiness to Other Meteorological Parameters," Journ. Meteor. Vol. 10, No. 2, 1953.

Slade, D. H., editor, "Meteorology and Atomic Energy-1968," U.S. Atomic Energy Commission, TID-24190, July 1968.

Smith, M., editor, "Recommended Guide for the Prediction of the Dispersion of Airborne Effluents," ASME, 1968.

Strom, G. H., M. Hackman and E. J. Kaplin, "Atmospheric Dispersal of industrial Stack Gases Determined by Concentration Measurements in the Scale Model Wind Tunnel Experiments," J. of APCA, Vol. 7, No. 3, pp. 198-204, November 1957.

Sutton, O. G., "The Theoretical Distribution of Airbonrne Pollution from Factory Chimneys," Quar. J. R. Meteor. Soc. 73, p. 426, 1947.

Sutton, O. G., Micrometeorology, McGraw-Hill, 1953.

Turner, P. B., "Workbook of Atmospheric Dispersion Estimates," U.S. Department of Health, Education and Welfare, Public Health Service, Cincinnati, Ohio, 1969.

Yang, B. T. and R. N. Meroney, "Gasious Dispersion into Stratified Building Wakes," Atomic Energy Commission Report COO-2053-3, Colorado State University CER70-71BTY-RNM8, August 1970.

APPENDIX: DISPERSION CALCULATIONS

Industrial designers must rely upon generalized dispersion formulae to predict concentrations in the vicinity of pollutant released from tall stacks. Unfortunately one cannot depend upon the accuracy of such relations when nearby buildings are tall enough to cause aerodynamic perturbations upon the theoretical plume behavior. Hence, it is considered good practice to utilize wind tunnel model studies to determine the range of validity of particular formulae and the necessity for correction coefficients for a particular application. It is with these thoughts in mind that the measurements over the Lansing Power Station complex are interpreted. Corrections applied to plume rise near the source may provide a more reliable prediction of contamination at extended distances downstream by means of analytical expressions.

The latest publications summarizing the "state-of-the-art" for atmospheric diffusion estimates are very similar in detail. There are some reasons however, to prefer some calculation methods over others; thus some of the relations will be discussed in detail below.

Effective Plume Height

While a smoke plume quickly attains the wind speed in the horizontal direction, its rise is determined by its vertical momentum and buoyancy. Numerous formulae have been published to correlate field measurements of plume rise; none is universally accepted, partially due to observational difficulties, and partially due to the fact that some plumes never really appear to level off.

Although Turner (1969) recommends the use of Holland's plume rise formula it may be judged unnecessarily conservative. Stümke

recommended the Holland formula be multiplied by a correction factor of 3.0. In addition more recent dimensional analysis formulae for buoyant sources give consistently good results for all source sizes and distances downwind and take into account atmospheric stability. The formulae below are conservative but not so severely conservative as other formulas. The AEC-1968 Monograph by Slade suggests the following expressions: (Eqs. (5.19) and 5.20)):

$$\text{Neutral:} \quad \frac{\Delta H}{D_s} = 100 \frac{R}{Fr} + 1.5R \tag{A}$$

$$\text{Stable with wind:} \quad \frac{\Delta H}{D_s} = 1.63 \left[\frac{RL^2}{Fr\ Ri}\right]^{1/3} \tag{B}$$

where $R = \dfrac{V_s}{V_a}$

$L = \dfrac{H_s}{D_s}$

$Fr \cong \dfrac{V_a^2}{g \frac{\Delta T}{T_s} D_s}$

$Ri = \dfrac{g(d\theta/dz)}{T_s(V_a^2/H_s^2)}$

Maximum Ground Concentration

Often the limiting criteria for a particular stack release system is the maximum allowed ground concentration. Since the plume rise formulae recommended above incorporate the effect of atmospheric stability on plume rise it is possible to include their results in expressions which calculate the maximum probable concentration conditions directly. Again the AEC Monograph suggests: for plume rise in a neutral or slightly unstable atmosphere (Eq. 5.28):

$$\frac{\chi_{max} V_a D_s^2}{Q} = 0.01 \left(\frac{Fr}{R}\right)^{1/3} \frac{1}{\left(L + \frac{\Delta H}{D_s}\right)^{5/3}} \quad (C)$$

at an actual velocity associated with

$$\frac{Fr}{R} = \frac{500}{\left(L + \frac{\Delta H}{D_s}\right)} \quad (D)$$

or

$$V_a = 7.94 \left(\frac{\frac{\Delta T}{T_s} g V_s D_s^2}{H_s + \Delta H} \right)^{1/3} \quad (E)$$

for a buoyant source in a neutral atmosphere.

Ground Level Concentration Distributions

Correct calculation of ground level dilution profiles depends, of course, on an accurate estimate of the effective stack height. Assuming such information is available the most popular expression is the Gaussian plume formulae:

$$\frac{\chi}{Q} = \frac{1}{\pi \sigma_y \sigma_z V} \exp\left[-\left(\frac{y^2}{2\sigma_y^2} + \frac{h^2}{2\sigma_z^2}\right)\right] \text{ where } h = h_s + \Delta h \text{ and}$$

where the variance terms σ_y or σ_z are evaluated in terms of downwind distance and the stability condition. Authors such as Sutton (1953), Pasquill (1962), Smith (1968) and many others have suggested variance coefficient evaluation techniques.

Probably the most convenient method currently is that developed by Pasquill where σ_y and σ_z figures have been prepared for simply defined stability categories. See Figs. A.2 and A.3 and Table A.1 from the AEC Monograph. Figures 3-2 through 3-9 in Turner's (1969)

workbook also provide a convenient summary of ground level dilution for various height releases and atmospheric stability conditions.

Typical Concentration Results

Montgomery and Cain (1967) have compared the adherence of sulfur dioxide concentrations in the vicinity of a steam plant to plume dispersion models. They concluded that general dispersion models cannot accurately predict specific pollutant concentrations that can be expected to occur at a particular station at a specific time, but they can predict the range of concentrations likely to occur. Dispersion models generally incorporate a conservative bias, hence they also were found to successfully estimate maximum concentrations 93 to 99 percent of the time. Finally, the same mathematical model using different diffusion coefficients may yield very different results, hence the diffusion coefficients should be developed for the model at the particular site of application (if possible).

The influence of building wake and topographical features may be demonstrated by examining a typical calculation for the station considered herein.

Consider, Unit 1, Stack height 300 ft: Neutral flow field;

	D(ft)	V_s(ft/sec)	$\Delta T°F$	R	Fr_s	$\frac{\chi_{max} V_a}{Q} 10^6 (m^{-2})$
Maximum Predicted by Equation C-E Full Load	14.4	129	192	2.00	133.9	4.92
Maximum Predicted for V_a = 30 mph Full Load	14.4	129	192	2.93	133.9	1.65
Maximum Predicted for V_a = 30 mph 30% Load	14.4	66	153	1.50	41.6	3.88

The maximum ground level concentration $\chi V_a/Q \times 10^6 (m^{-2})$ measured for full load was 7.36 and for 30 percent load was 28.5.

Turner has suggested that estimates based on a Pasquill-Gifford type approach are probably accurate to within a fraction of three assuming the plume rise is correctly estimated. This accuracy is limited to three cases:

(1) for all stabilities for distances of travel out to a few hundred meters;

(2) for neutral to moderately unstable conditions for distances out to a few kilometers; and

(3) unstable conditions in the lower 1000 meters of the atmosphere with a marked inversion above for distances out to 10 kilometers or more.

Based on the work of Briggs (see Slade (1968)) one expects plume rise results to be accurate within ±19 percent. However, experience is very varied and some calculators have been conservative by a factor of five or optimistic by a factor of nearly two.

For a source which emits at constant rate from hour to hour one may estimate a 24 hour probability of dispersion based on stability wind "rose" data. A stability wind "rose" gives the frequency of occurrence for each wind direction (usually 16 points) of each wind speed class and stability category.

If the effluent is assumed uniformly distributed in each angular sector an appropriate equation for average concentration is then:

$$\frac{\chi(x,\theta)}{Q} = \sum_S \sum_N \left\{ \frac{2\, f\,(\theta,S,N)}{\sqrt{2\pi}\ \sigma_{zs}\ V_N\ (\frac{2\pi x}{16})} \exp\left[\frac{1}{2}\left(\frac{h_V}{\sigma_{zs}}\right)^2\right] \right\}$$

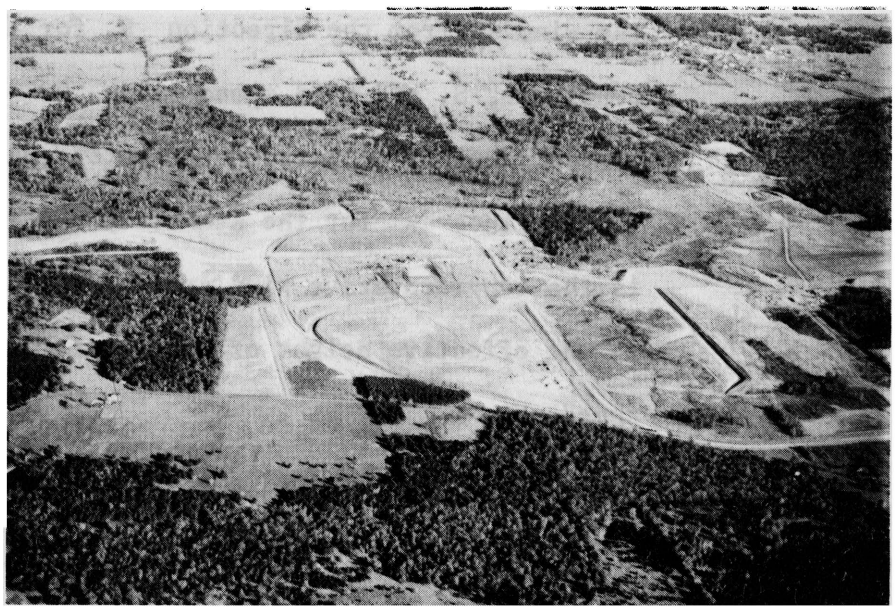
where $f(\theta,S,N)$ is the frequency during the period of interest that the wind is from the direction θ, for the stability condition, S, and wind speed class N.

$(\sigma_z)_S$ is the vertical dispersion parameter evaluated at the distance x for the stability condition S.

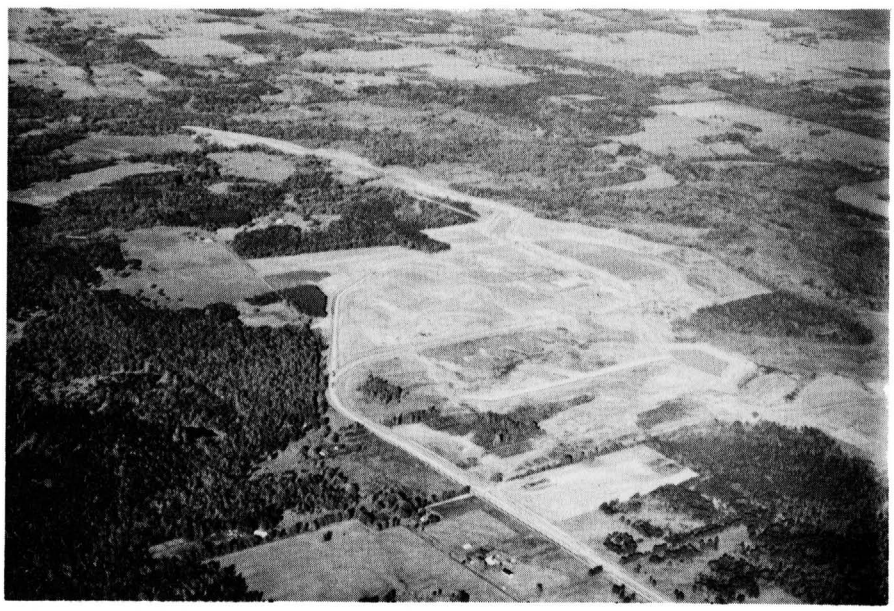
V_N is the representative wind speed for class N.

h_V is the effective height of release for the wind speed V_N.

When stability wind rose information is unavailable a first-order approximation may be made of diurnal concentrations by using the appropriate 24 hour wind rose and assuming all releases occur in neutral stability class, Pasquill D.

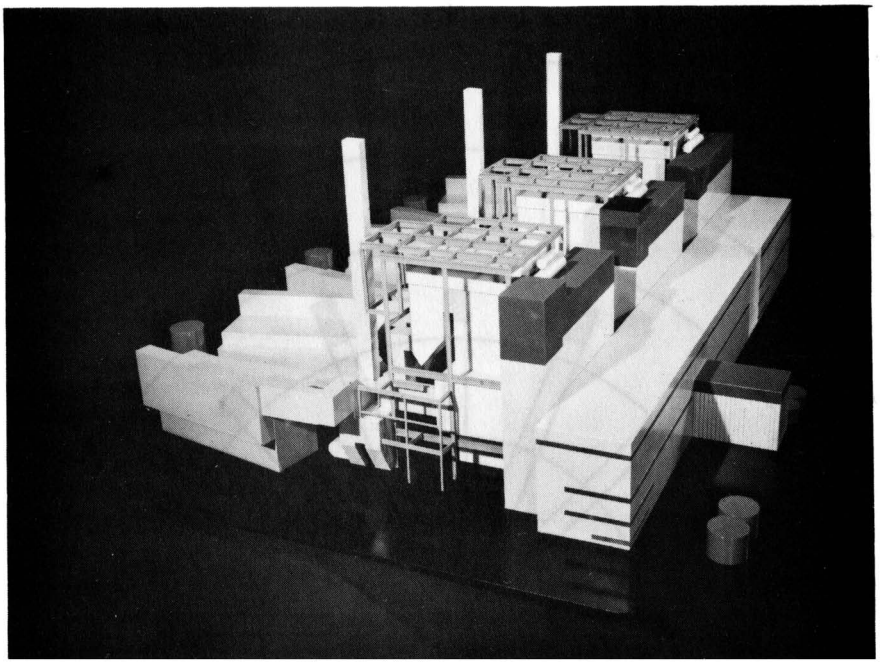


Looking East

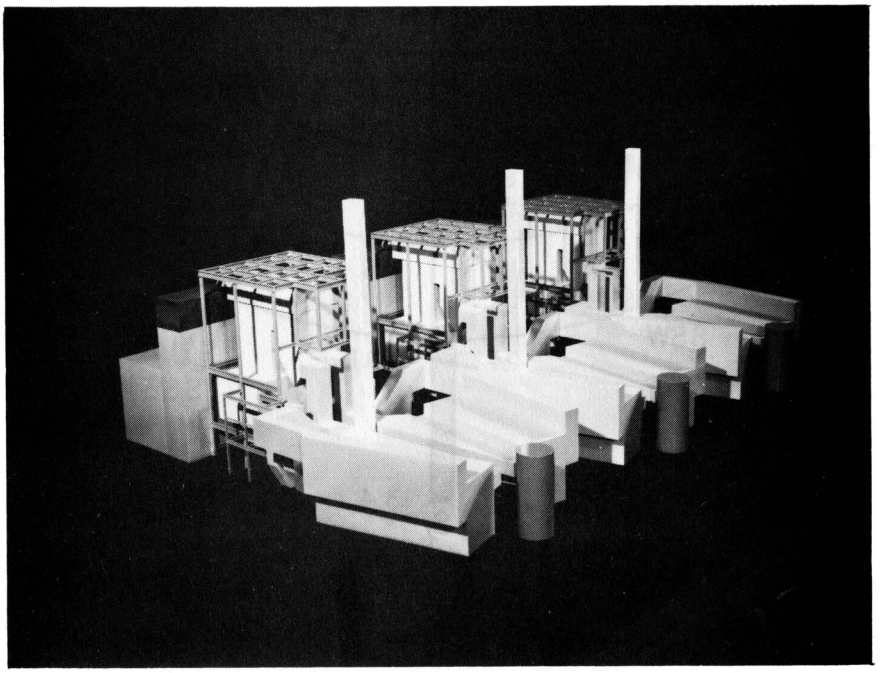


Looking Southeast

Figure 1: Views of Welsh Power Station Site.



View from South-Southeast



View from Northwest

Figure 2: Welsh Power Station, Model Scale 1:200.

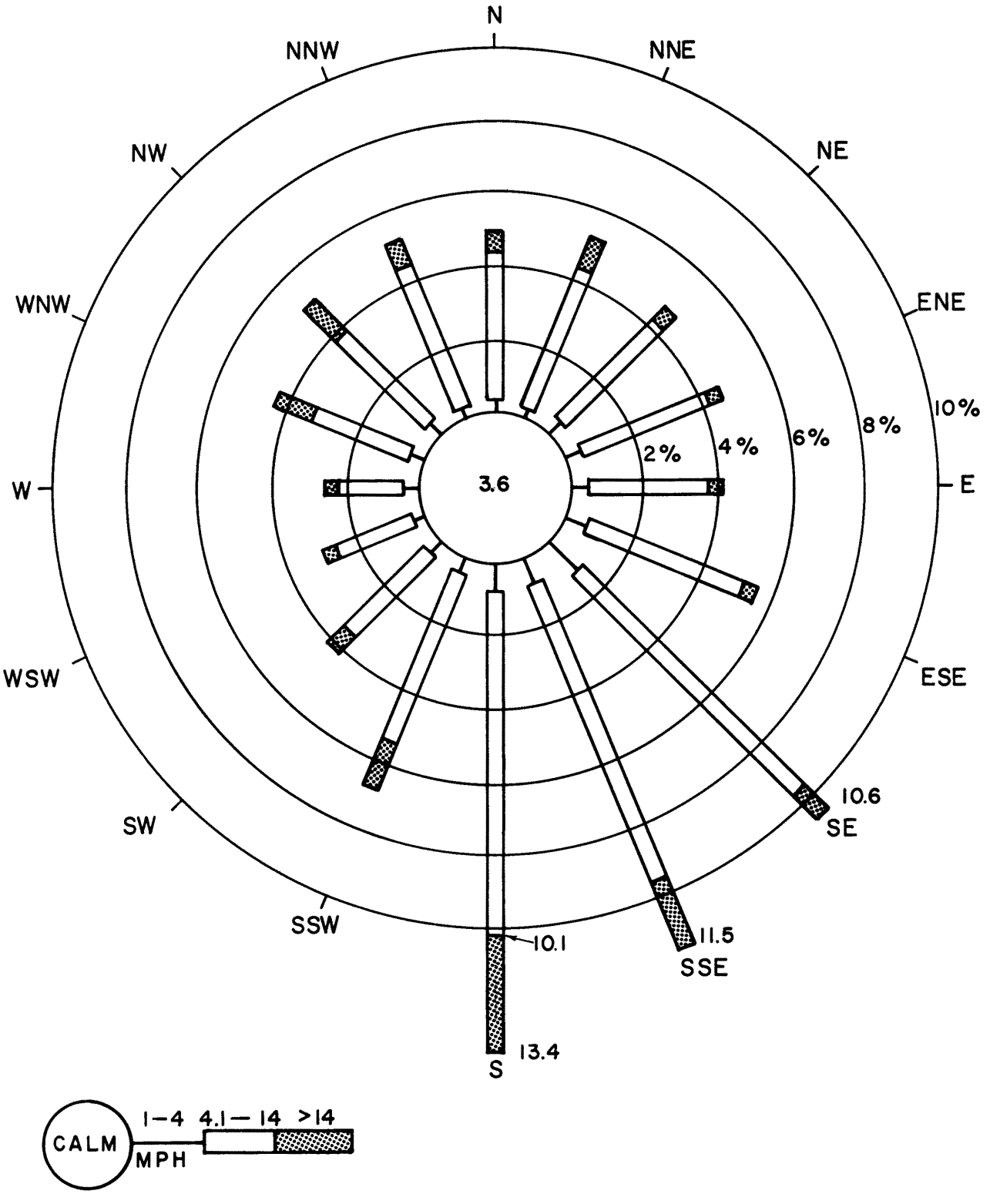


Figure 3. Wind Rose for Welsh Power Station:
Shreveport, Louisiana, Annual Wind Rose 1951-1970.

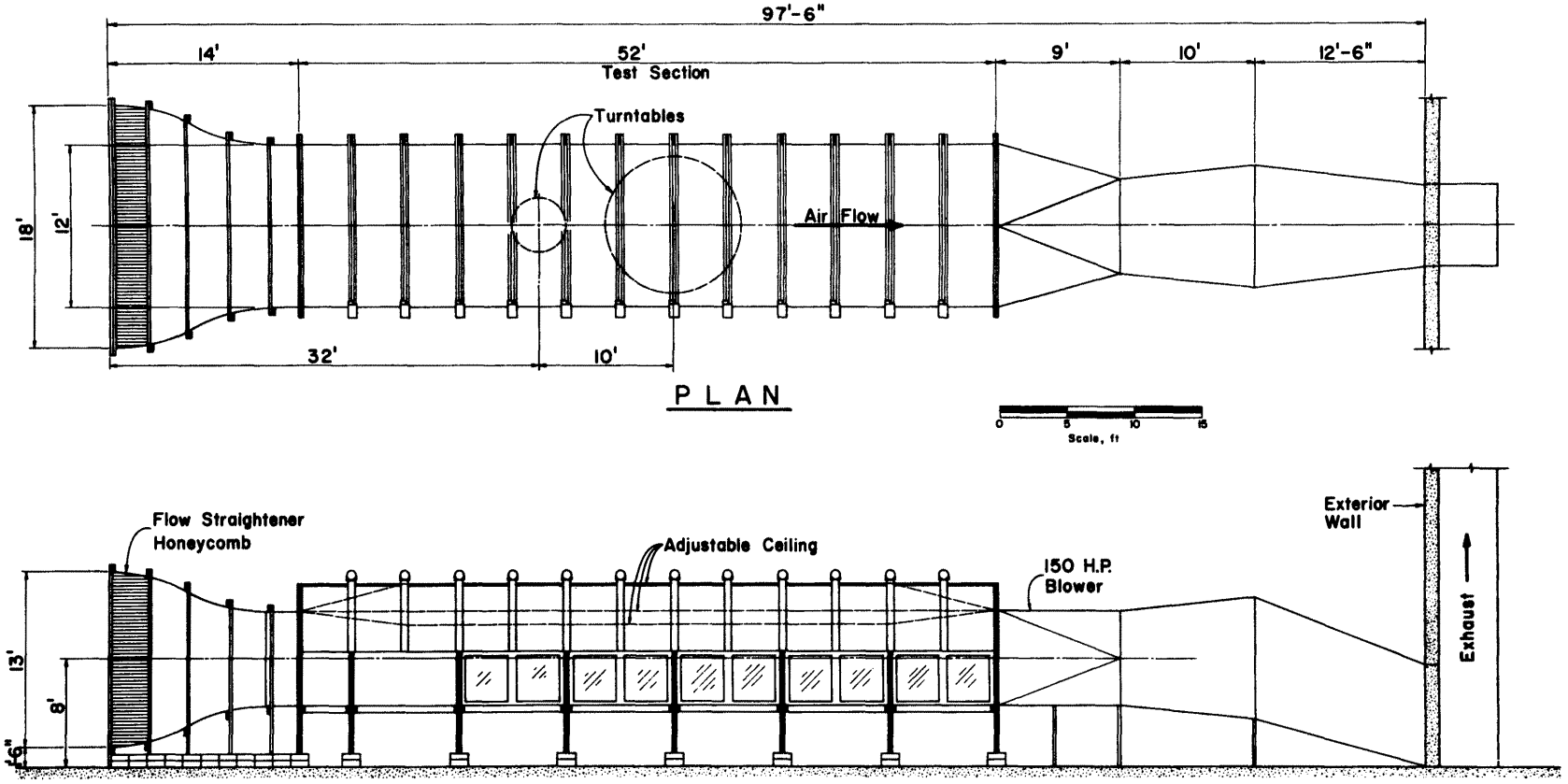


FIGURE 4. ENVIRONMENTAL WIND TUNNEL
FLUID DYNAMICS AND DIFFUSION LABORATORY,
COLORADO STATE UNIVERSITY.

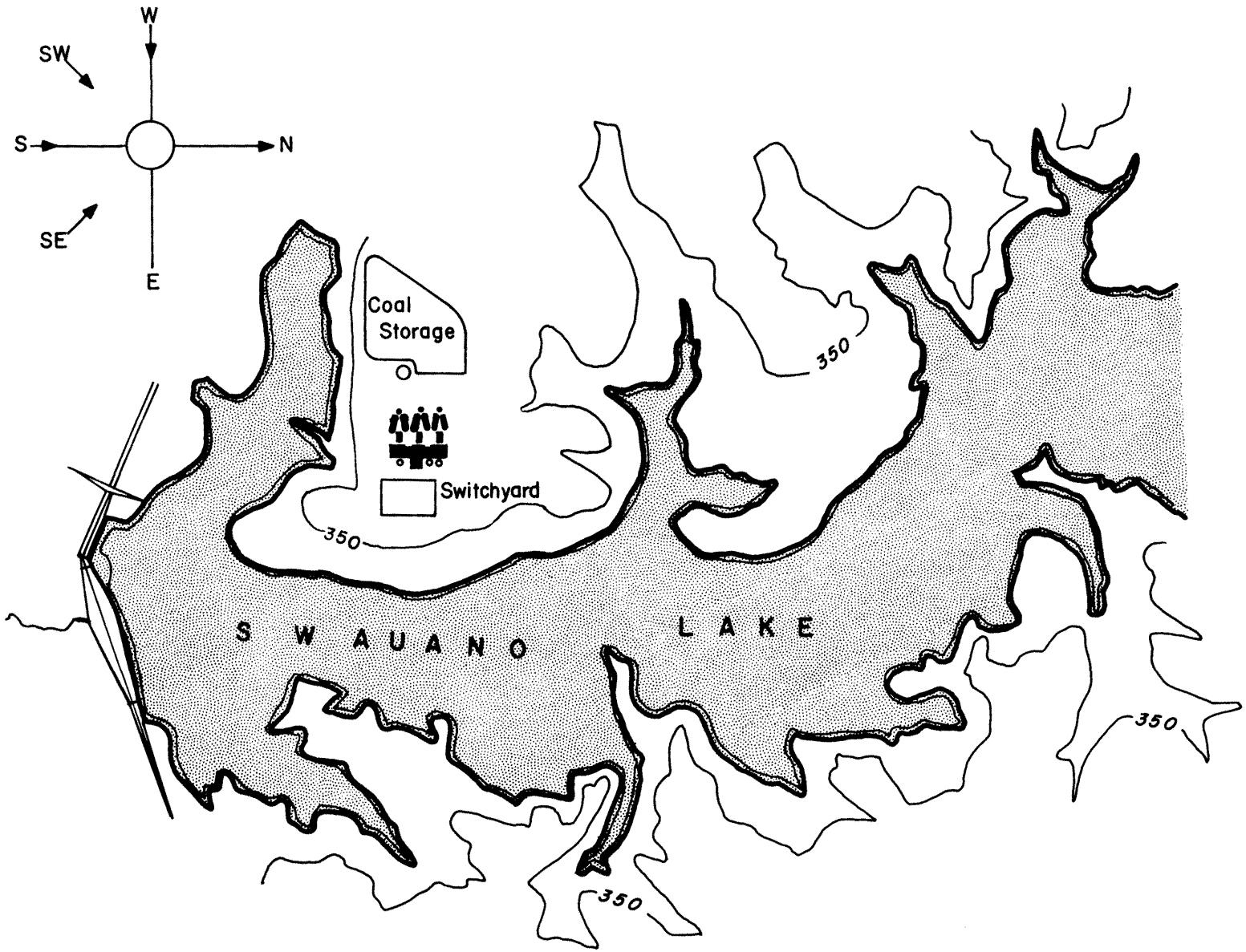


Figure 5. Topographical Map of Area Modeled: Location of Welsh Power Station Building Complex.

Figure 6: Model being Installed in Environmental Wind Tunnel.

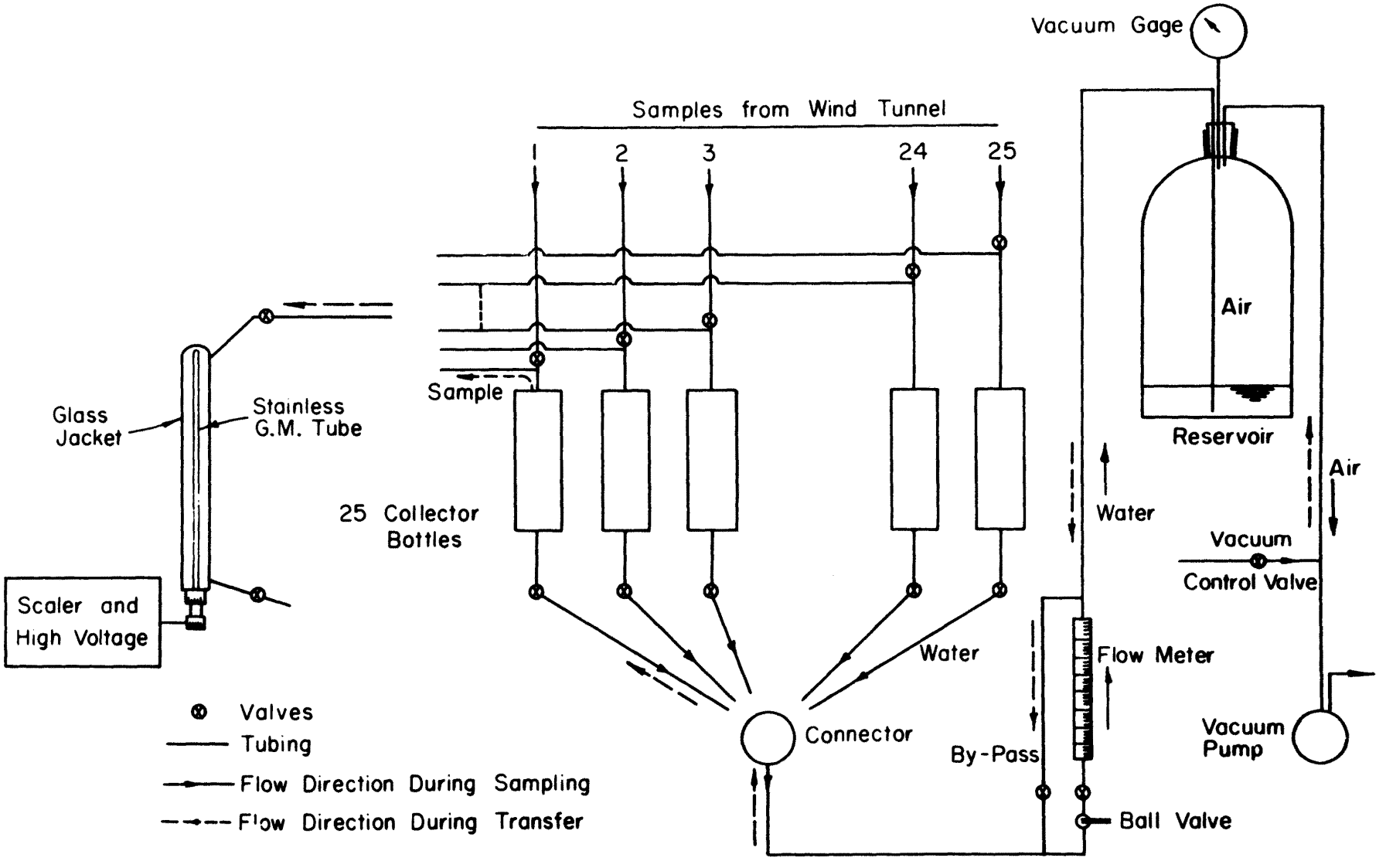


Figure 7: Tracer-Gas Sampling and Analysis System - Schematic.

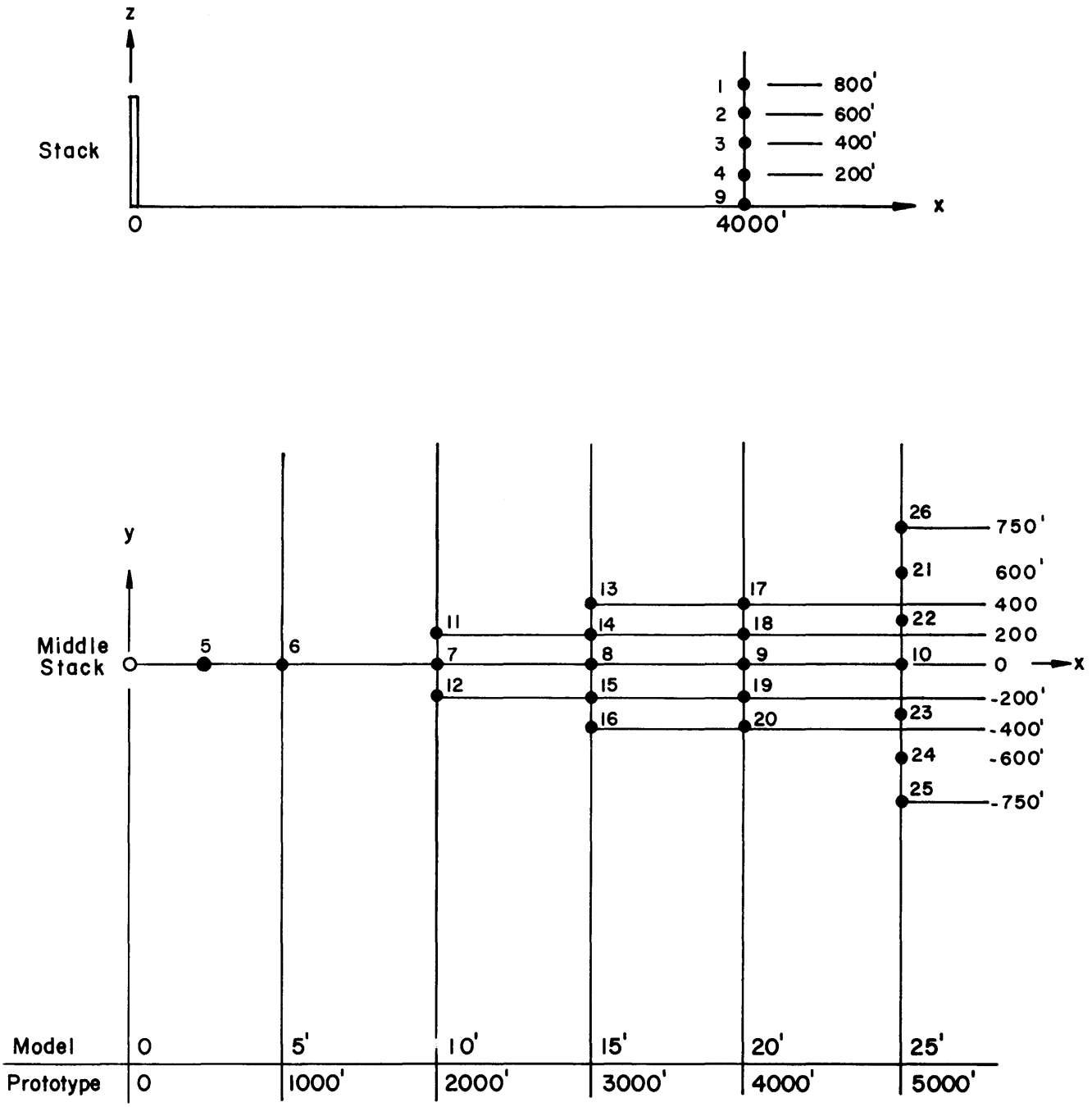


Figure 8. Coordinates for Concentration Measuring Locations in Environmental Wind Tunnel.

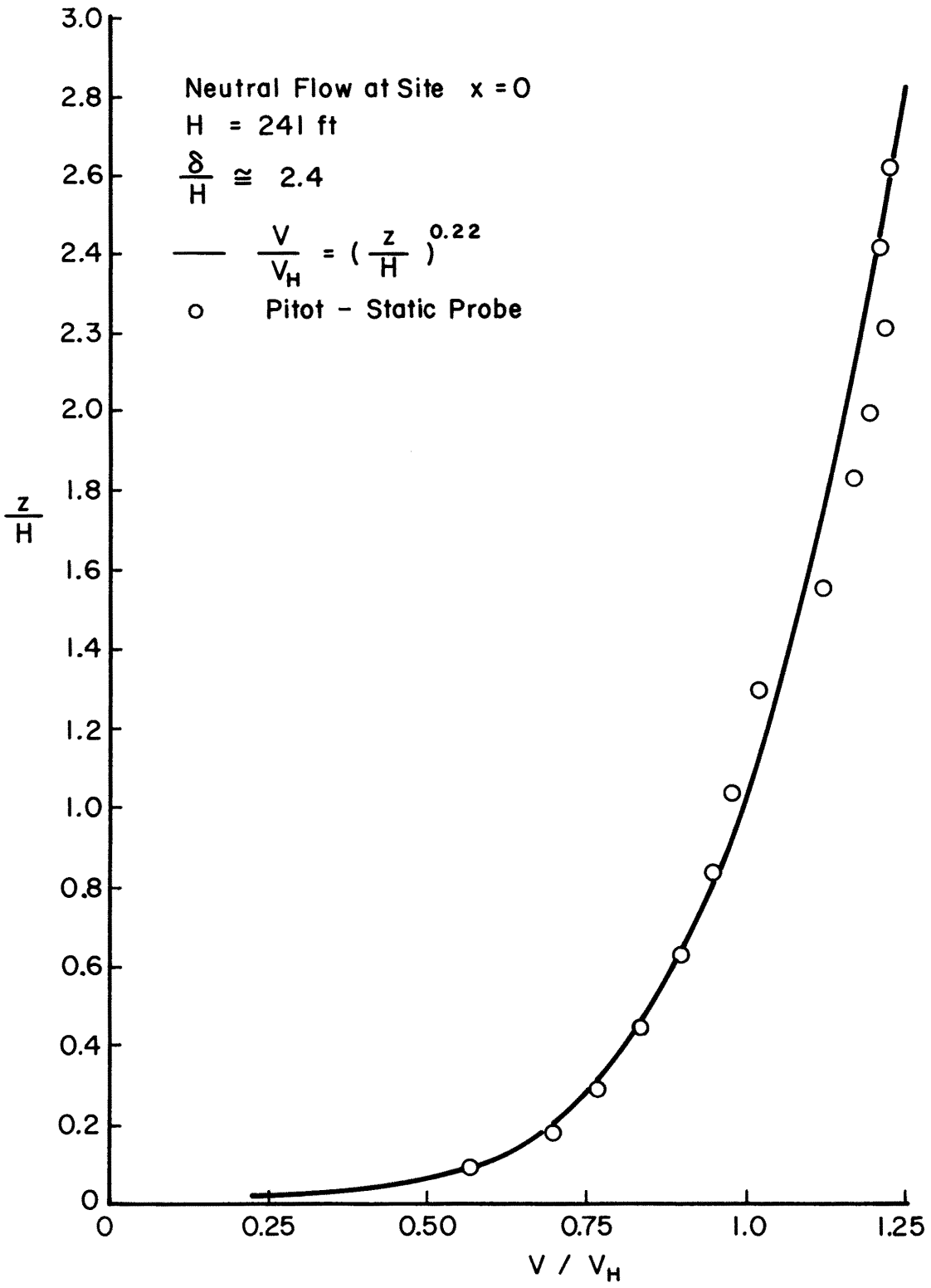


Figure 9. Velocity Profile, Neutral Flow Environmental Wind Tunnel.

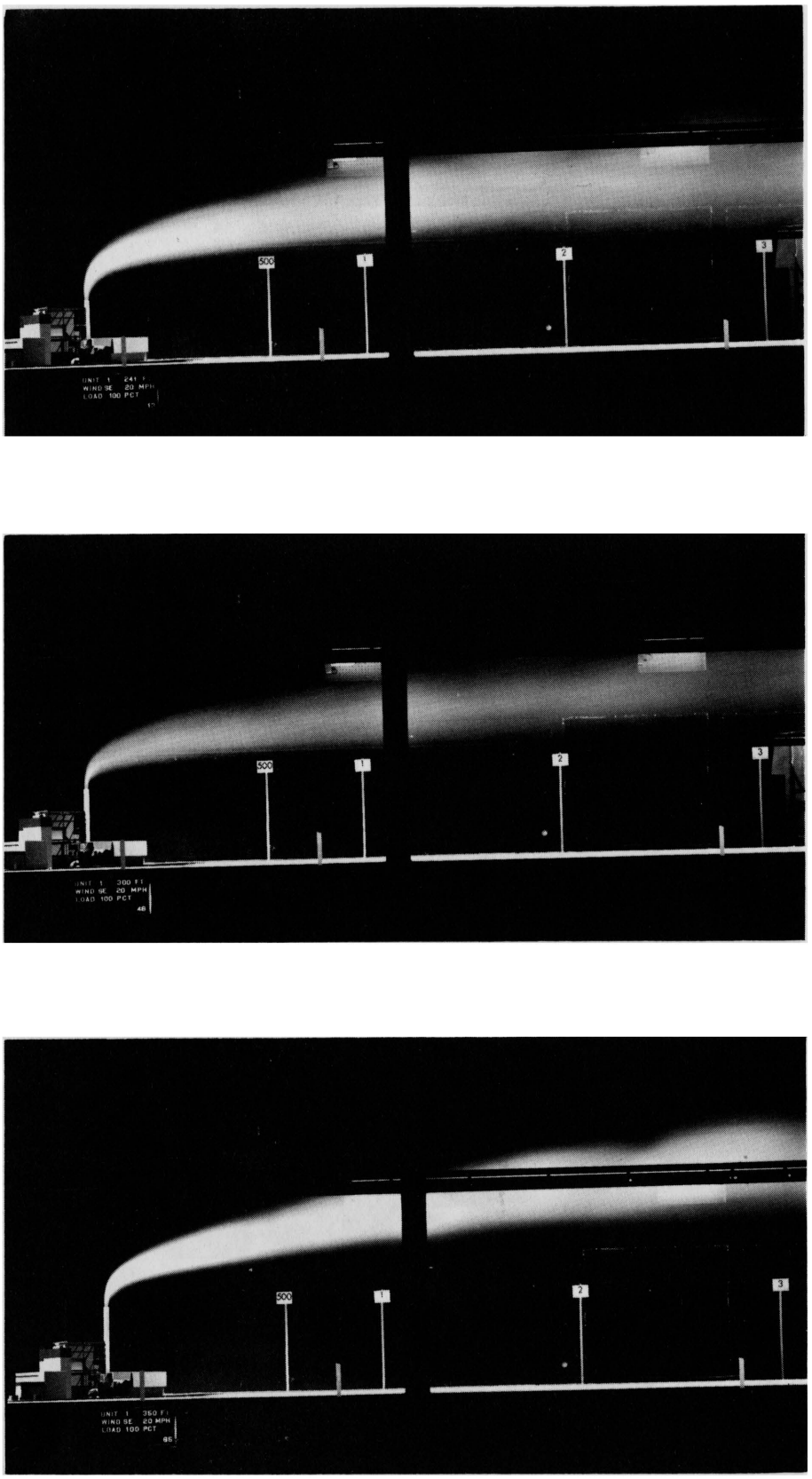


Figure 10: Flow Visualization: SE Wind Direction at 20 mph for 100% Load, Various Stack Heights.

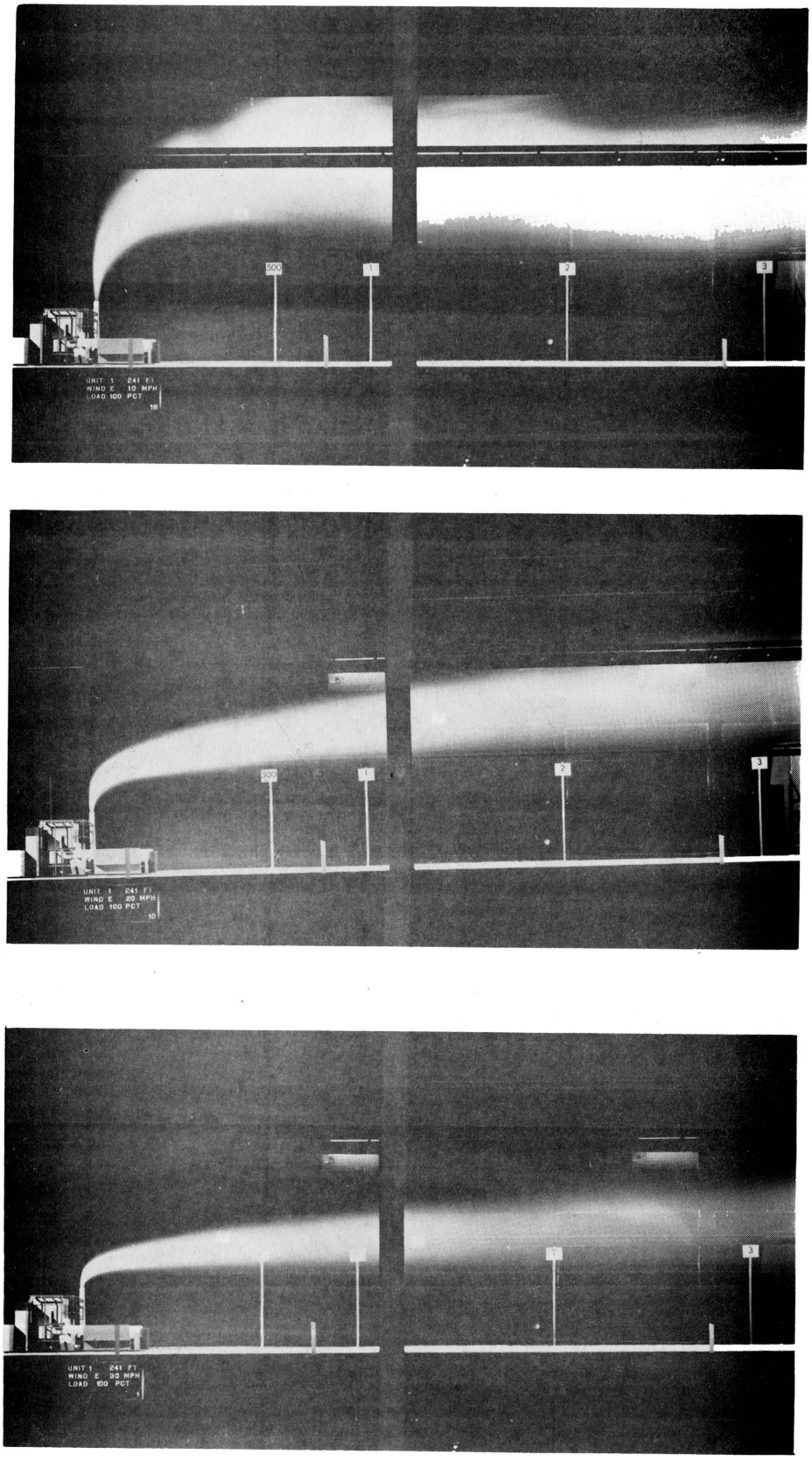


Figure 11: Flow Visualization: E Wind Direction, Stack Height 241 ft at 100% Load, Various Wind Speeds.

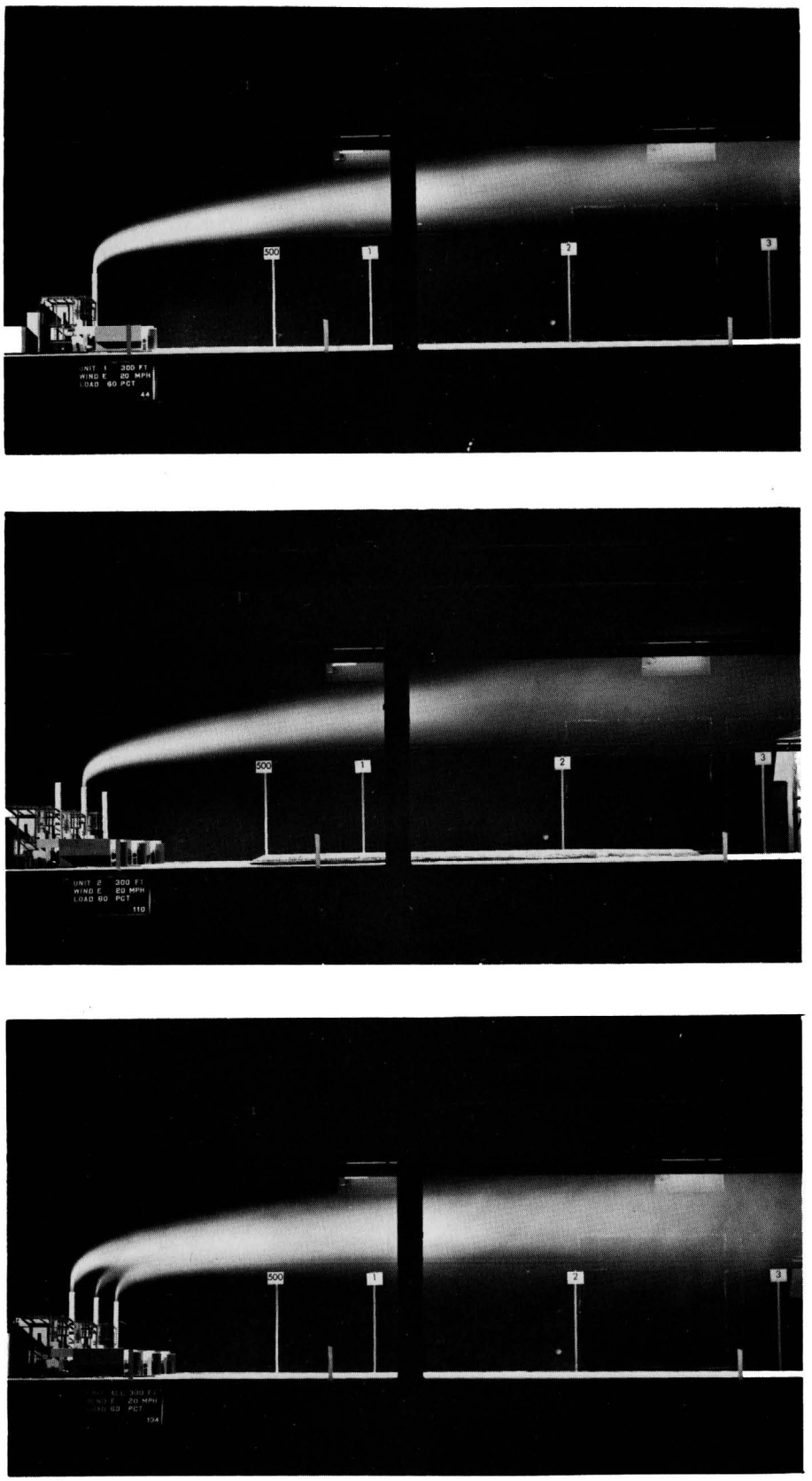


Figure 12: Flow Visualization: E Wind Direction at 20 mph, 300 ft Stack at 60% Load, Various Units Operating.

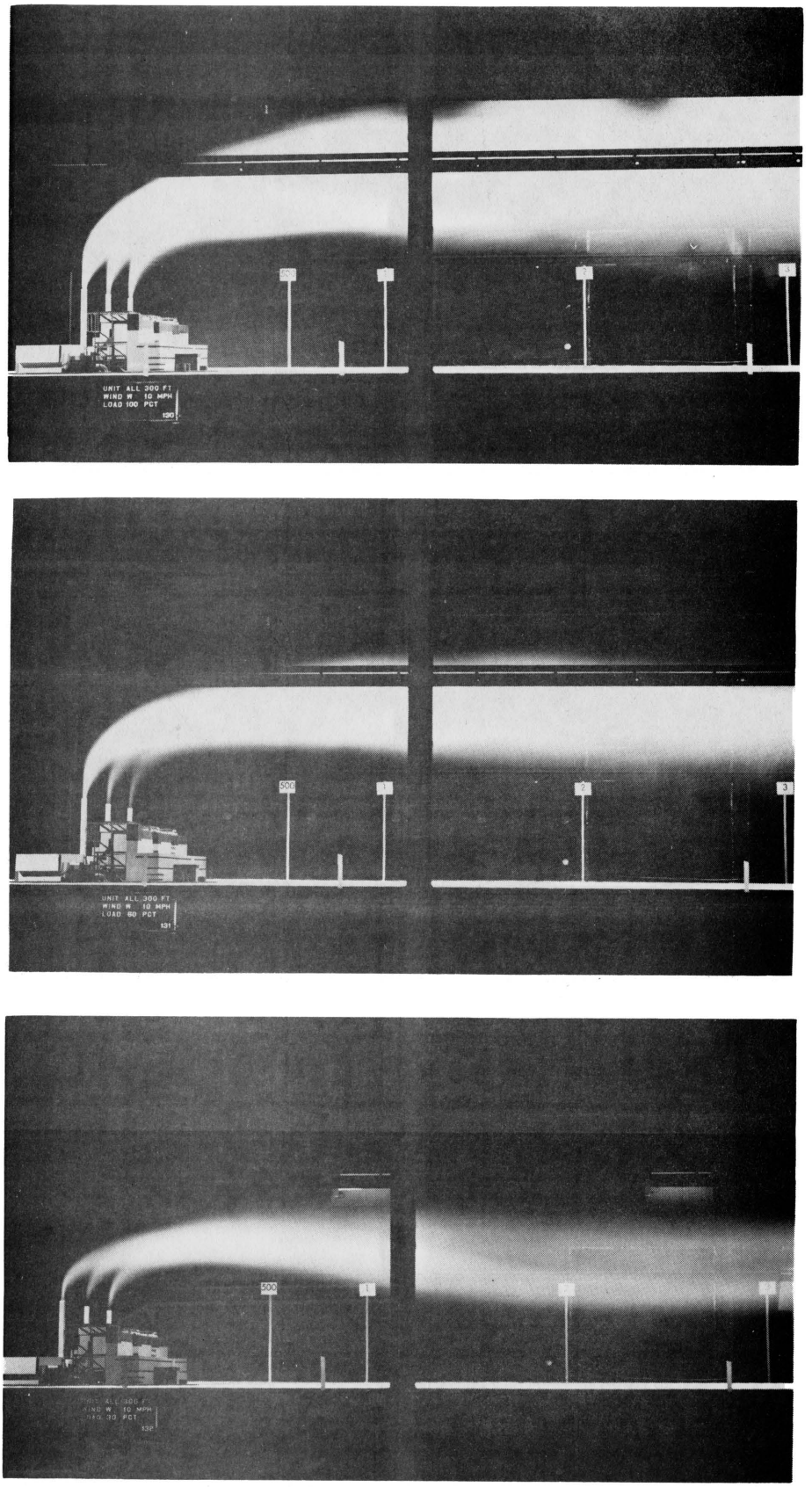


Figure 13: Flow Visualization: W Wind Direction at 10 mph, All Units with 300 ft Stack; Various Loads.

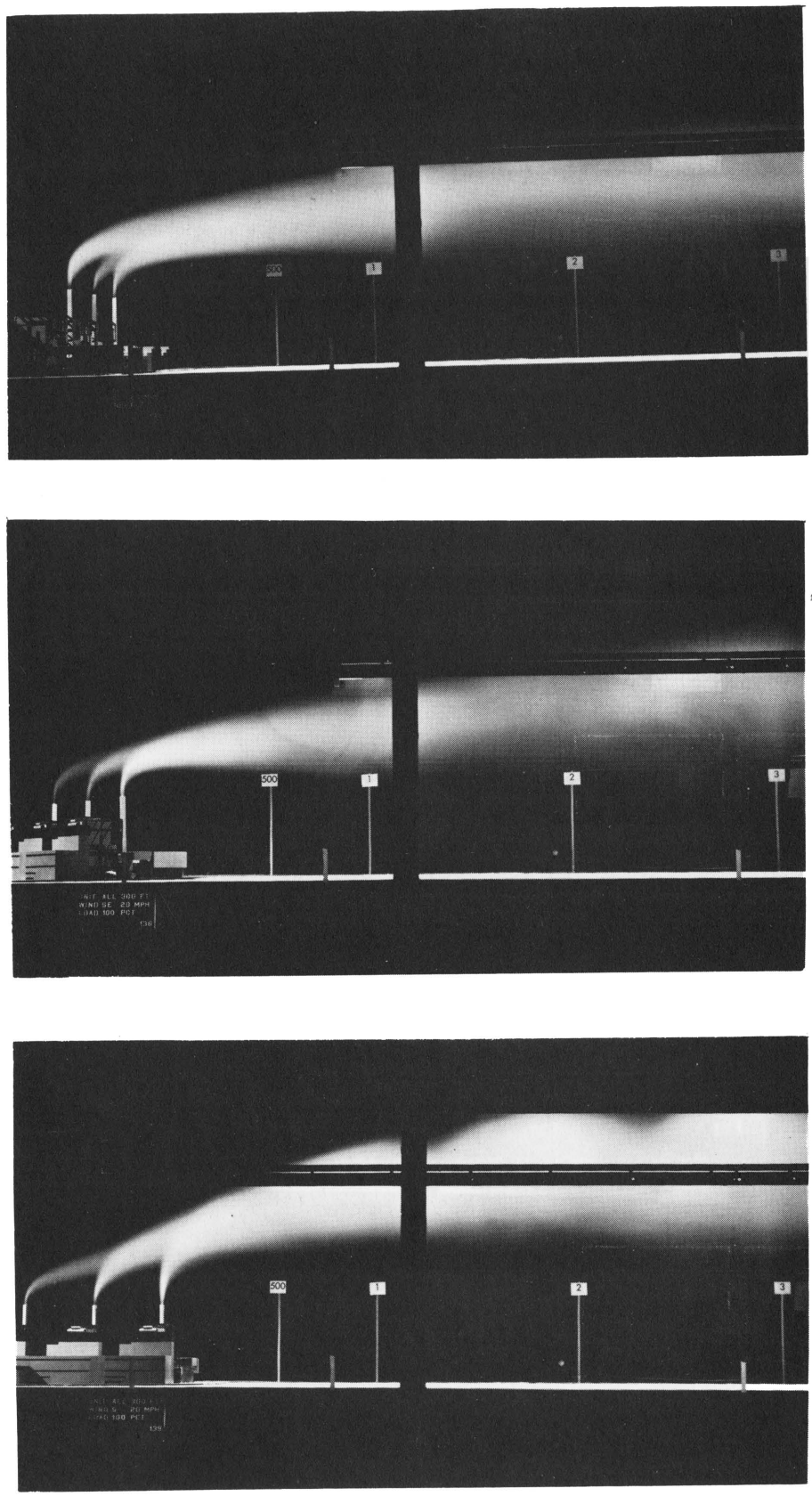


Figure 14: Flow Visualization: All Units, 300 ft Stack, 20 mph, 100% Load, Wind Directions E, SE, S, SW, W.

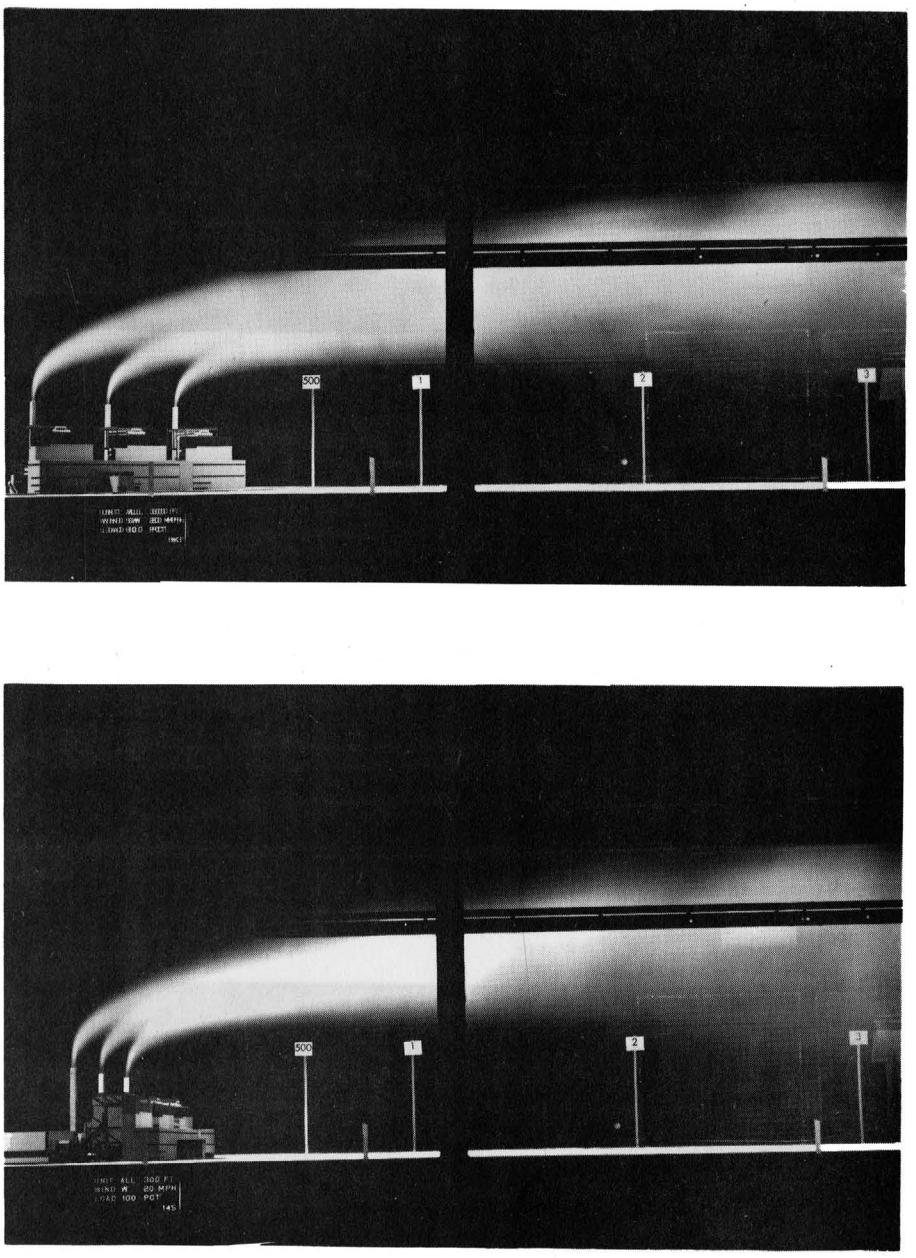


Figure 14 (continued).

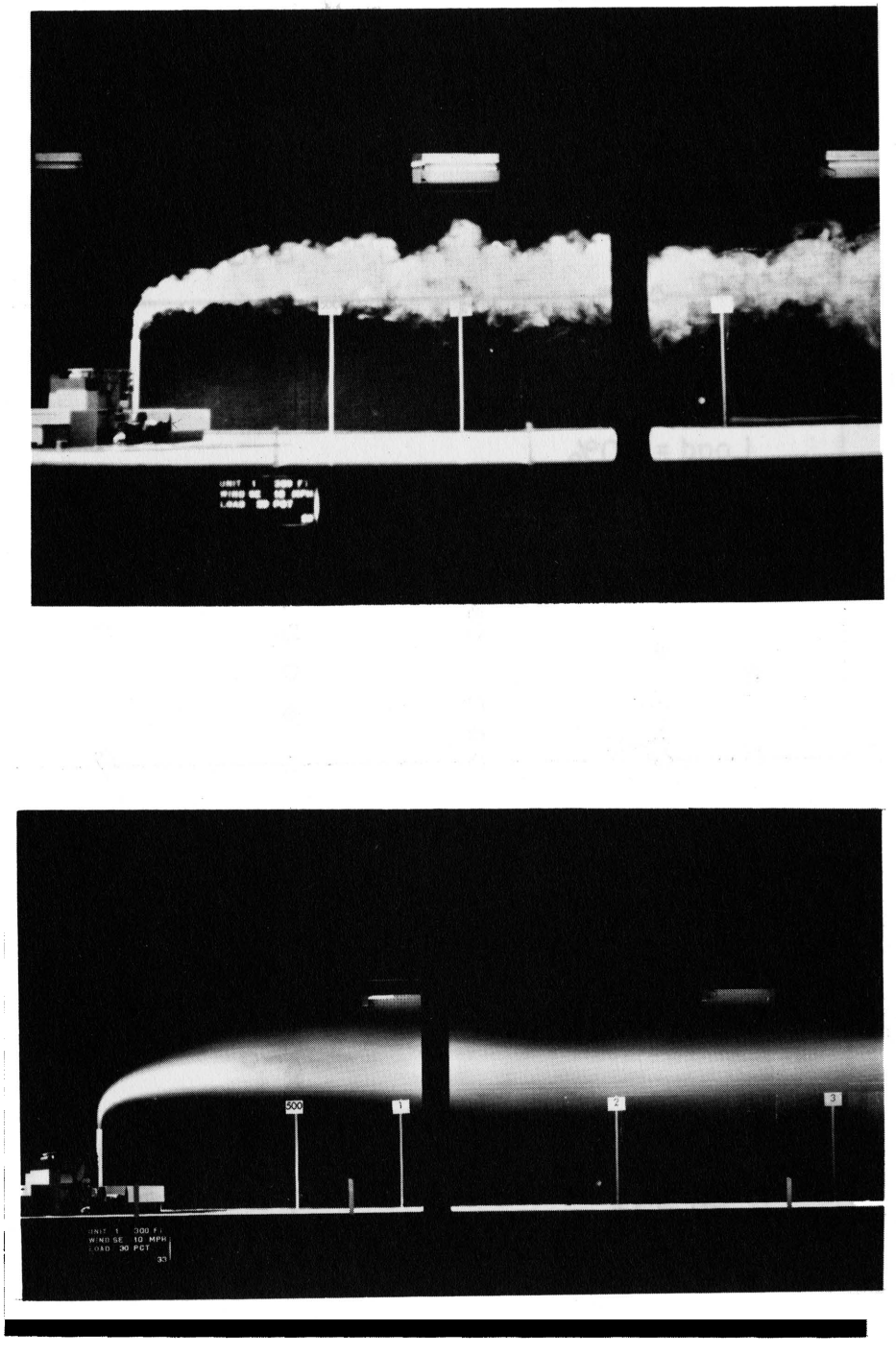


Figure 15: Flow Visualization: Plume Outlines when Camera is Set for 1/32 and 20 sec Exposures Respectively, Unit I, 300 ft Stack, Wind SE, 10 mph, 30% Load.

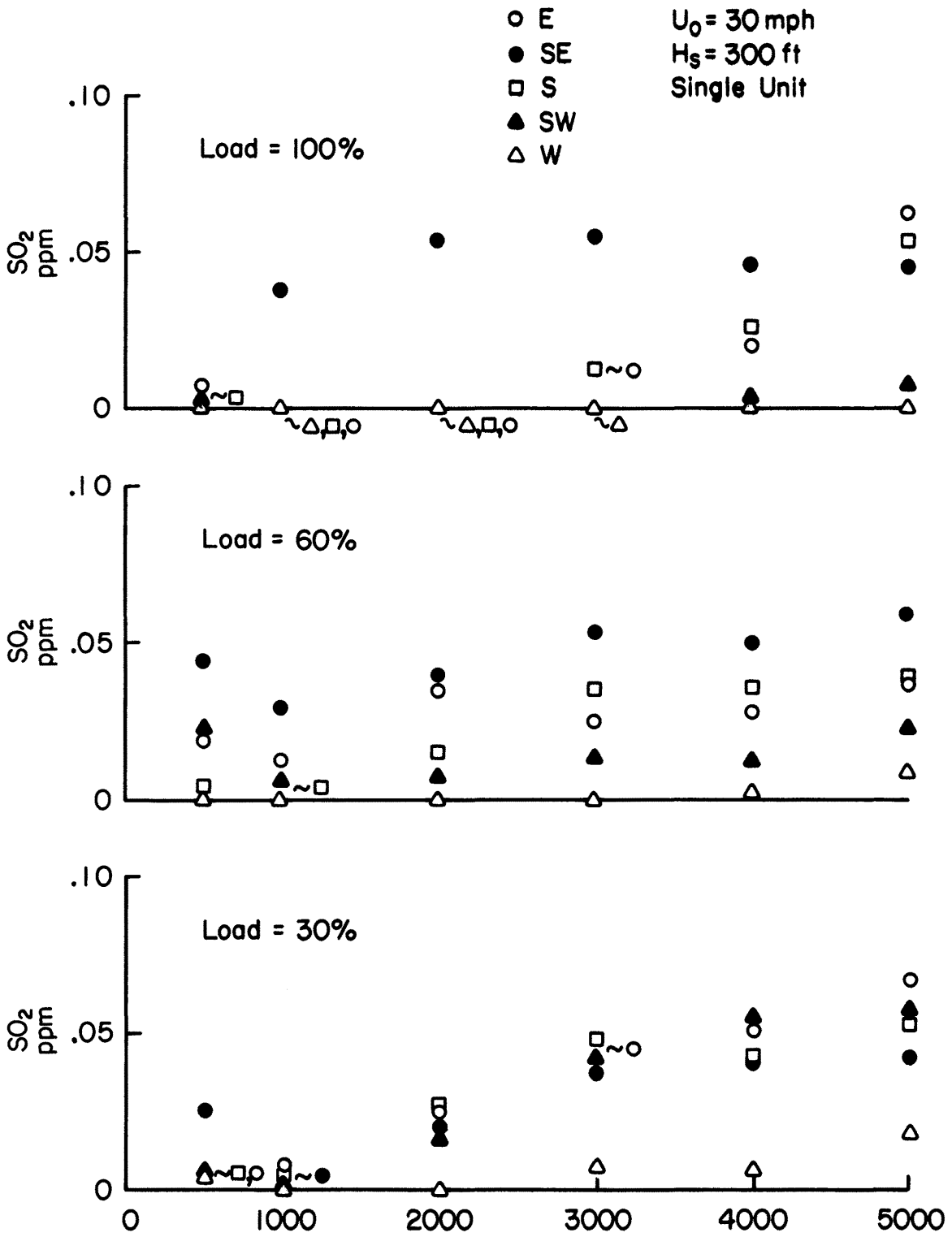


Figure 16. Maximum Ground Concentration Profiles for Various Wind Approach Angles and Loads for a 30 mph Wind over a Single Unit with a 300 ft Stack.

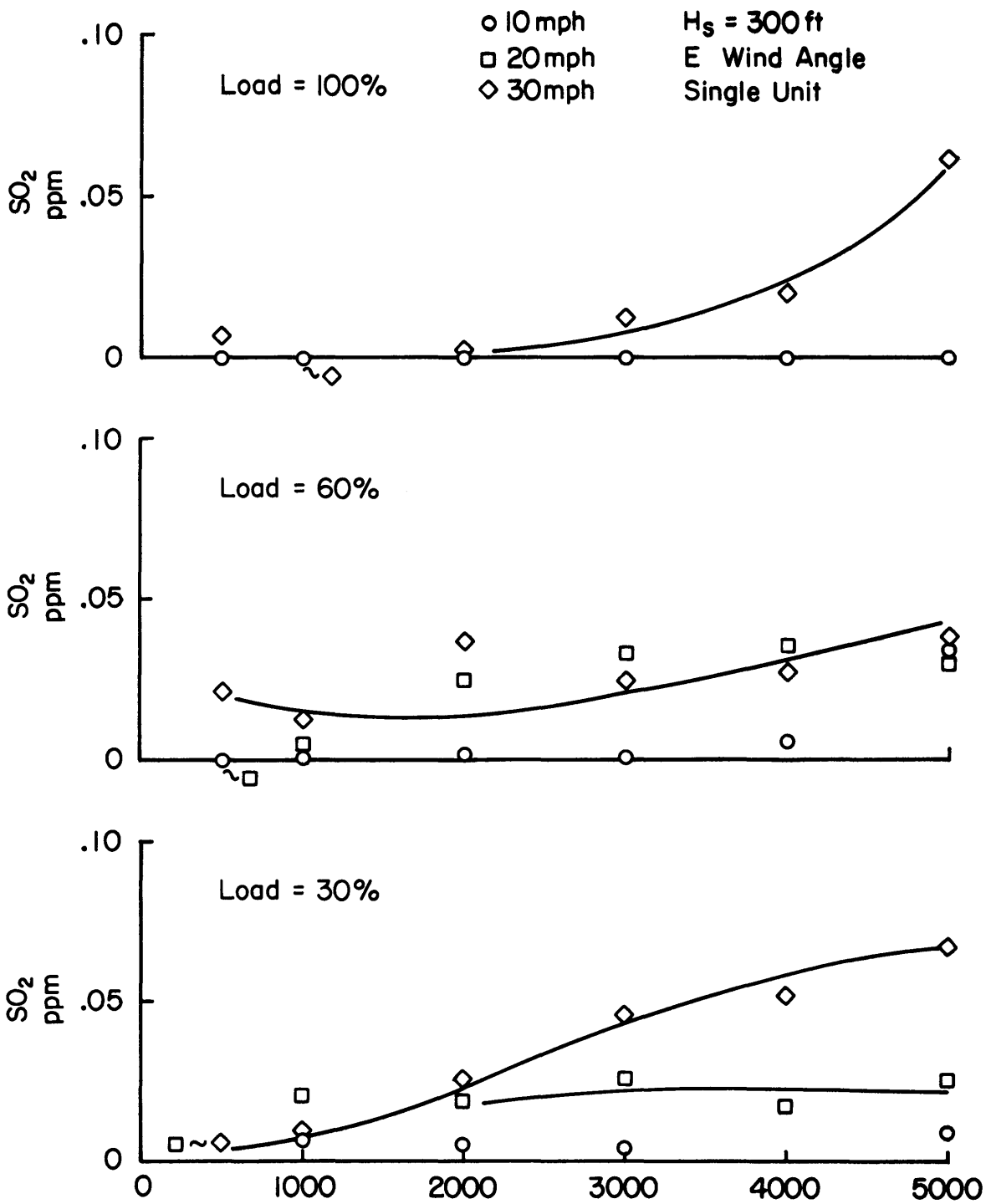


Figure 17. Maximum Ground Concentration Profiles for Various Wind Speeds and Loads for a Wind from the E over a Single Unit with a 300 ft Stack.

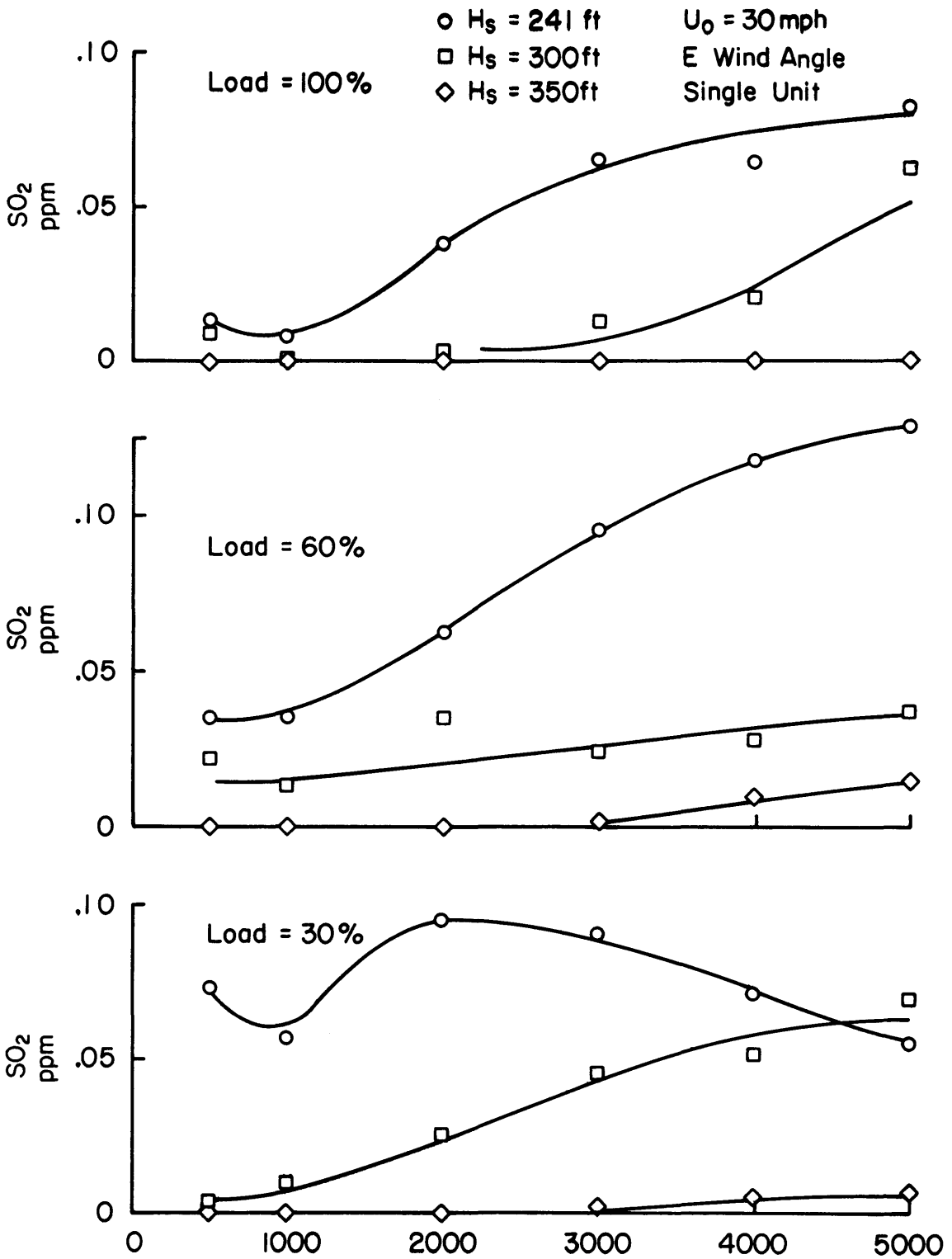


Figure 18. Maximum Ground Concentration Profiles for Various Stack Heights and Loads for a Single Unit for a Wind from the E at 30 mph.

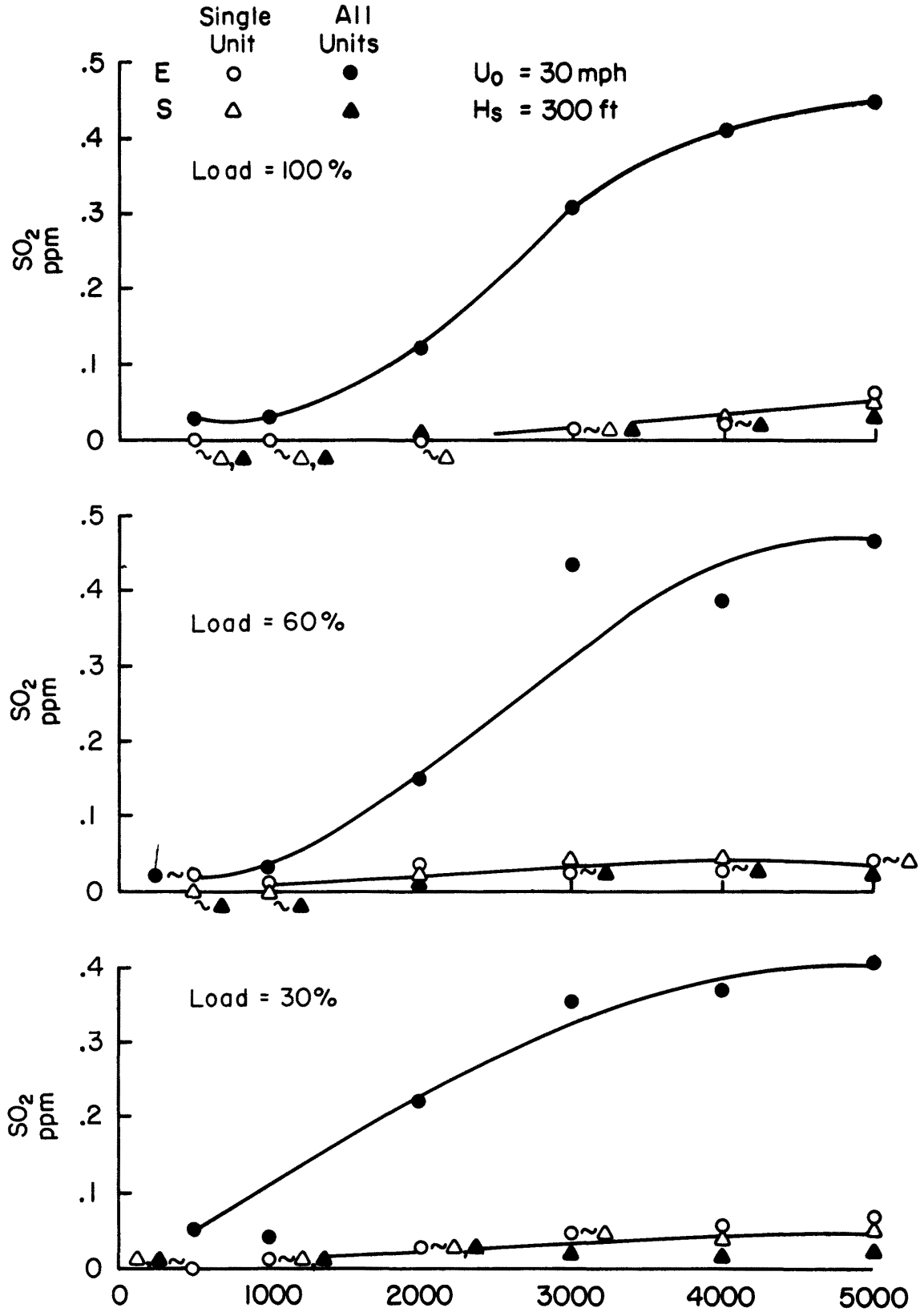


Figure 19. Maximum Ground Concentration Profiles for a Single versus All Units at Various Loads with Winds from the E and S at 30 mph for a 300 ft Stack.

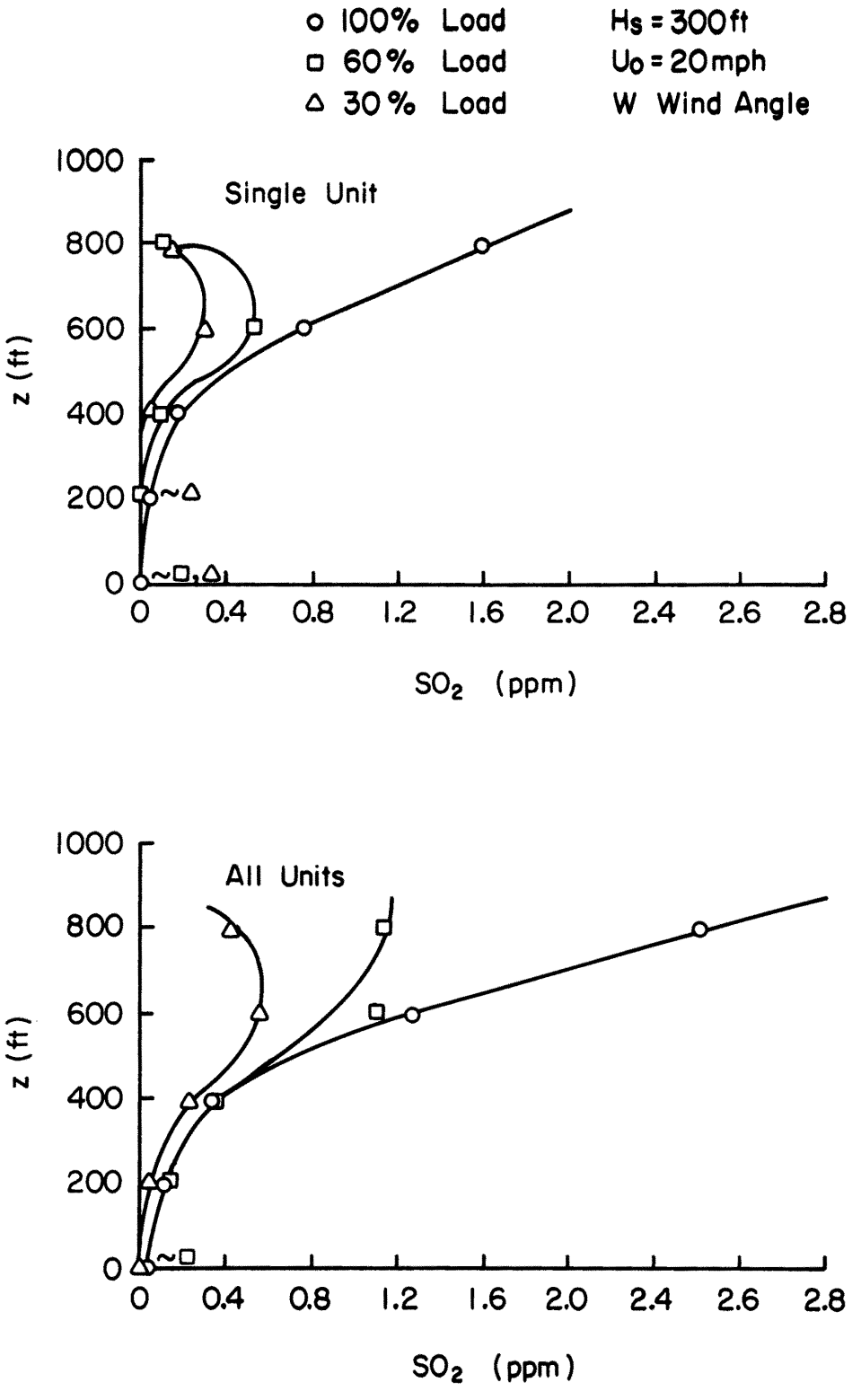


Figure 20. Vertical Concentration Profiles at x = 4000 ft, W Wind at 20 mph.

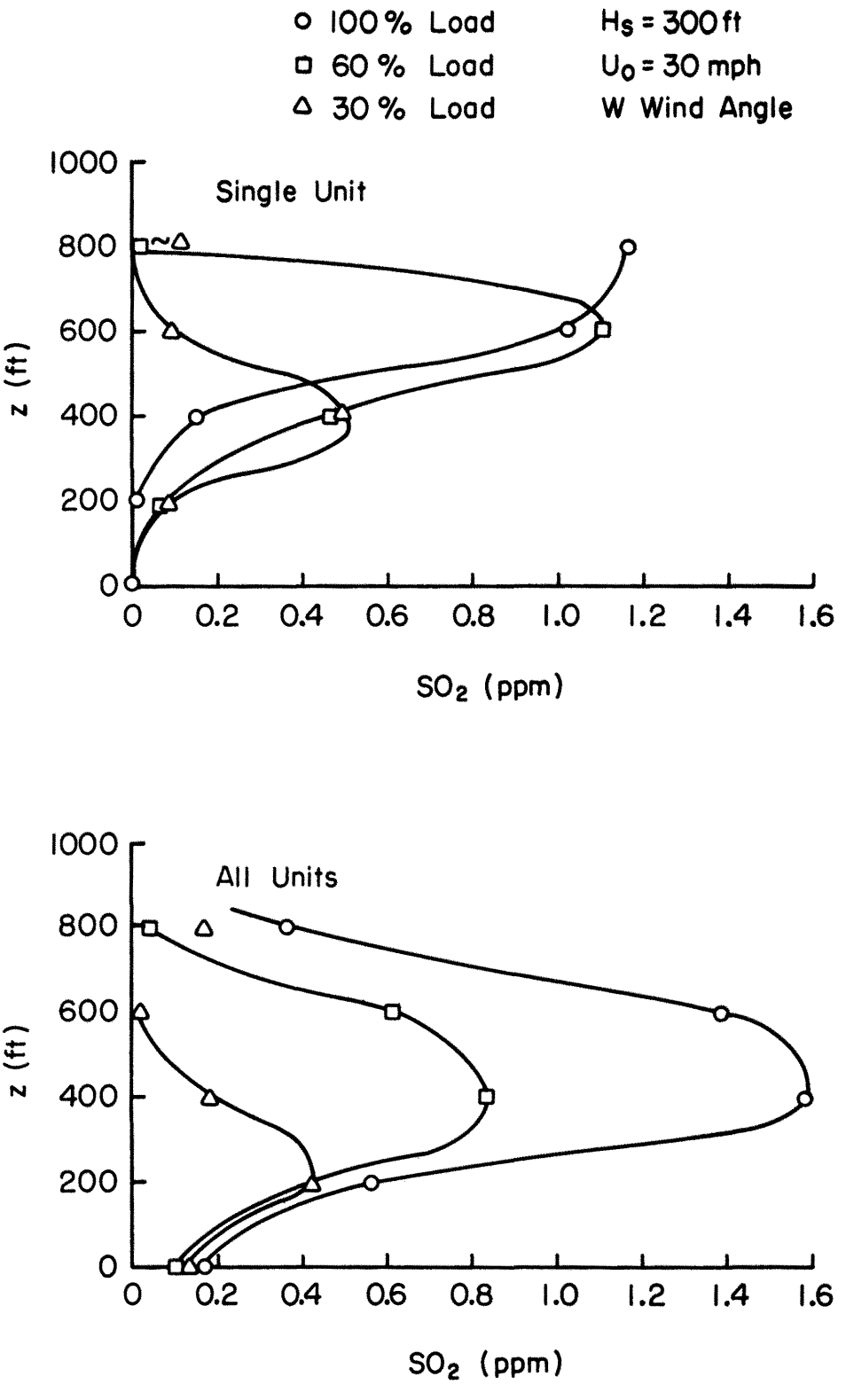


Figure 21. Vertical Concentration Profiles at x = 4000 ft, W Wind at 30 mph.

Table 1. Prototype Emission Parameters: Welsh Power Station

Load	100%	60%	30%
Stack Size (ft)	12' x 18'	12' x 18'	12' x 18'
Stack Area (ft^2)	216	216	216
Stack Height (ft)	241, 300	241, 300	241, 300
Gas Temperature (°F)	264	242	225
Gas Velocity (ft/sec)	129	94	66
Source Strength (SO_2) Q_s (gm/sec)	749.1	446.4	224.5
Free Stream Velocity (ft/sec) (10, 20, 30 mph)	14.67, 29.33, 44.0	14.67, 29.33, 44.0	14.67, 29.33, 44.0
R	8.79, 4.40, 2.93	6.41, 3.20, 2.14	4.50, 2.25, 1.50
$\frac{\Delta\rho}{\rho a}$	0.268	0.245	0.226
$Fr_s = \frac{V_s^2}{g \frac{\Delta\rho}{\rho a} D_H}$	133.9	77.8	41.6

D equiv = $\frac{4(216)}{(24+36)}$ = 14.4 ft

Table 2. Model Emission Parameters: Welsh Power Station.

Load	100%	60%	30%
Stack Size (in)	0.72 x 1.08	0.72 x 1.08	0.72 x 1.08
Area (in^2)	.778	.778	.778
Stack Height (in)	1.21, 1.5	1.21, 1.5	1.21, 1.5
R	8.79, 4.40, 2.93	6.41, 3.20, 2.14	4.50, 2.25, 1.50
V_{am} (ft/sec)	1.04, 2.07, 3.11	1.04, 2.07, 3.11	1.04, 2.07, 3.11
V_{sm} (ft/sec)	9.14	6.67	4.68
Q_s (cfm)	2.96	2.16	1.51
Fr_s	133.9	77.8	41.6
$\frac{\Delta\rho}{\rho_a}\|_m$	0.268	0.245	0.226
χ_{He}	0.311	0.284	0.262
Q_{He} (cfm)	0.92	0.61	0.40
Q_{psi} (cfm)	2.04	1.55	1.11

Table 3 Instrumentation and Materials Employed

Camera	movie:	Bolex 16 mm camera lens
	still:	Speed Graphic Camera 4" x 5" & Hasselblad 2" x 3"
Film	movie:	Extachrome - 7242, ASA 125 - Forced developed ASA 500
	still:	Tri-X-Pan-4164 Kodak film, Polaroid
Exposure	movie:	f-1.9, 18 frames per second
	still:	f = 8-11, t = 1/30 sec or 20 sec
Flow meters	1)	Fischer & Porter Co. Precision flow rator No. B4-21-10 float B SVT-45
	2)	Fischer & Porter Co. Precision flow rator No. FP1/4-09-G-G3/4 / 4 / 61
	3)	Fischer & Porter Co. Precision flow rator No. 2F-1/4-20-5/70
Counters	1)	Ultra scaler - model 192A by Nuclear Chicago
	2)	Ortec timer model 482, Sclaer model - 484 power supply model 446, amplifier model 485, ratemeter model 441
Hot-Wire Anemometer		Disa 55D0 constant temperature anemometer shielded hot curve
Hot-Wire Anemometer		Disa 55D0 constant temperature anemometer shielded hot curve
Hot Wire		Pt (80%) IR (20%) wire, diameter - 0.1 mm
Traversing Mechanism		Made at CSU, with remote control, range 17"
Recorder		Hewlett and Packard X-Y Recorder Model 7035B
Meter		HP Integrating digital voltmeter model 2401C
Sampling Panels	1)	Made at CSU, 25 sample point capacity as shown in Fig. 7.
	2)	Radioactive gas samplers a) N00014-68-A-0493-0001-65234 b) N00014-68-A-0493-0001-65227
Television System		

A. Single Tube Color TV Camera Shibaden model FP-1500 U (E,K)

Features -

1. Frequency separation system using a 1-inch filter integrated color vidicon;
2. Luminance required - 500Lux
3. Automatic sensitivity control

4. Automatic iris adjustment
5. Camera cable extension to 200 m

B. Color Video Cassette Recorder
JVC model CR-6000 U

Features -

1. AGC and double-stabilizing ACC circuits
2. Instant video output
3. Auto search
4. Auto repeat
5. Double audio channel recording system
6. Remote control

Table 4 Observed Touchdown Distances from Flow Visualization Tests (ft).

Unit	Stack Height (ft)	Wind Angle	10 mph			20 mph			30 mph		
			100%	60%	30%	100%	60%	30%	100%	60%	30%
1	241	E	NT	NT	2000	NT	4500	3500	3000	2000	1250
		SE	NT	NT	2000	NT	NT	3000	3000	2000	1600
		S	NT	NT	2000	NT	4500	4000	1500	1300	1000
1	300	E	NT	NT	NT	NT	NT	NT	4000	3000	2500
		SE	NT	NT	NT	NT	NT	NT	3500	3000	3500
		S	NT	NT	NT	NT	NT	NT	4000	3000	1700
		SW	NT	NT	4000	NT	NT	NT	NT	4000	3000
		W	NT	NT	NT	NT	NT	NT	NT	4500	4000
1	350	E	NT	NT	NT	NT	NT	NT	NT	NT	3800
		SE	NT	NT	NT	NT	NT	NT	NT	NT	3800
		S	NT	NT	3700	NT	NT	NT	NT	NT	NT
ALL middle stack emitting	241	E	3200	2800	2800	2500	2000	2500	1500	500	0
	300	E	NT	3500	3200	4000	3000	2000	1200	1000	750
ALL	300	E	2500	2000	1750	2000	2000	1500	1000	1200	600
		SE	2000	3000	2000	2500	2000	1500	1500	1500	1000
		S	NT	NT	NT	NT	4000	3000	NT	NT	800
		SW	3000	2500	2200	2000	1500	2000	1800	1500	1200
		W	2500	2000	1500	2000	1500	1500	2200	2000	1750
1 nozzle added	300	E	--	--	--	--	--	--	--	--	2500
ALL nozzle added middle stack only	300	E	--	--	--	--	--	--	--	--	1400

Table 5 Maximum Ground Concentration (ppm) & Distance to Maximum (ft, x direction).

Unit	Stack Height (ft)	Wind Angle	10 mph			20 mph			30 mph		
			100%	60%	30%	100%	60%	30%	100%	60%	30%
1	241	E				0.00 (--)	.004 (5000)	.022 (5000)	.083 (5000)	.130 (5000)	.097 (2000)
		SE				.030 (5000)	.055 (5000)	.047 (5000)	.154 (4000)	.135 (3000)	.179 (3000)
		S				.051 (5000)	.042 (5000)	.072 (5000)	.150 (5000)	.068 (5000)	.083 (5000)
	300	E	0.00 (--)	.036 (5000)	.009 (5000)	.089 (3000)	.037 (3000)	.026 (3000)	.062 (5000)	.038 (5000)	.068 (5000)
		SE				.019 (5000)	.018 (5000)	.029 (5000)	.091 (5000)	.059 (5000)	.043 (5000)
		S				.019 (5000)	.042 (5000)	.043 (5000)	.054 (5000)	.037 (5000)	.054 (5000)
		SW				.026 (5000)	.008 (5000)	.015 (5000)	.009 (5000)	.024 (5000)	.059 (5000)
		W				0.00 (--)	.012 (5000)	0.00 (--)	0.00 (--)	.007 (5000)	.018 (5000)
	350	E				0.009 (4000)	0.00 (--)	0.00 (--)	0.009 (4000)	.017 (5000)	.006 (5000)
		SE				0.00 (--)	0.00 (--)	.003 (5000)	.002 (5000)	.017 (5000)	.041 (5000)
		S				0.00 (--)	.008 (5000)	0.00 (--)	.013 (4000)	.030 (5000)	.045 (5000)
All	300	E				.235 (5000)	.162 (4000)	.189 (5000)	.449 (5000)	.467 (5000)	.402 (5000)
		SE				.086 (4000)	.220 (5000)	.123 (5000)	.331 (4000)	.193 (5000)	.239 (4000)
		S				0.00 (--)	.004 (2000)	.009 (5000)	.023 (5000)	.031 (4000)	.020 (2000)
		SW				.078 (5000)	.096 (5000)	.068 (5000)	.336 (4000)	.342 (5000)	.308 (4000)
		W				.147 (5000)	.077 (5000)	.068 (5000)	.266 (5000)	.246 (5000)	.292 (5000)

Table 6 Maximum Concentration on Vertical Rake (ppm) at χ = 4000 feet and Height (ft, z direction).

Unit	Stack Height (ft)	Wind Angle	10 mph			20 mph			30 mph		
			100%	60%	30%	100%	60%	30%	100%	60%	30%
1	241	E				1.000 (800)	.856 (800)	.425 (600)	1.113 (600)	.527 (400)	.255 (400)
		SE				1.300 (800)	.790 (600)	.307 (600)	.490 (400)	.636 (400)	.246 (400)
		S				1.610 (800)	.670 (600)	.213 (600)	.399 (400)	.165 (400)	.105 (400)
	300	E	.564 (800)	.245 (600)	.685 (600)	.845 (800)	(--) (--)	.660 (800)	1.120 (600)	.440 (400)	.247 (400)
		SE				.853 (600)	.896 (800)	.527 (800)	1.440 (600)	1.060 (600)	.302 (600)
		S				1.000 (600)	.666 (600)	.121 (400)	.286 (400)	.664 (600)	.321 (400)
		SW				.949 (800)	.754 (800)	.339 (800)	1.290 (600)	.741 (600)	.426 (400)
		W				1.59 (800)	.528 (600)	.306 (600)	1.160 (800)	1.10 (600)	.480 (400)
	350	E				.594 (800)	.954 (800)	.791 (800)	1.580 (600)	.742 (600)	.237 (600)
		SE				1.470 (800)	.898 (800)	.119 (800)	1.290 (800)	.729 (600)	.210 (400)
		S				.864 (800)	.428 (800)	.142 (600)	1.440 (600)	.665 (600)	.353 (400)
All	300	E				2.130 (600)	.948 (600)	.496 (600)	.917 (600)	.884 (400)	.432 (400)
		SE				2.530 (800)	1.940 (600)	.560 (400)	1.850 (400)	.364 (400)	.472 (200)
		S				2.010 (600)	2.430 (800)	.950 (800)	1.790 (800)	.660 (600)	.473 (600)
		SW				.932 (600)	.952 (600)	.556 (800)	1.510 (400)	.817 (400)	.523 (400)
		W				2.590 (800)	1.160 (800)	.542 (600)	1.590 (400)	.828 (400)	.423 (200)

Table 7 TV Tape Sequence for Flow Visualization

Welsh Power Plant
TV Tape Log

Run	Unit	Stack Ht. ft	Wind Dir	Wind Vel m/h	Load %
1	1	241	E	30	100
2	1	241	E	30	60
3	1	241	E	30	30
4	1	241	SE	30	100
5	1	241	SE	30	60
6	1	241	SE	30	30
7	1	241	S	30	100
8	1	241	S	30	60
9	1	241	S	30	30
10	1	241	E	20	100
11	1	241	E	20	60
12	1	241	E	20	30
13	1	241	SE	20	100
14	1	241	SE	20	60
15	1	241	SE	20	30
16	1	241	S	20	100
17	1	241	S	20	60
18	1	241	S	20	30
19	1	241	E	10	100
20	1	241	E	10	60
21	1	241	E	10	30
22	1	241	SE	10	100
23	1	241	SE	10	60
24	1	241	SE	10	30
25	1	241	S	10	100
26	1	241	S	10	60
27	1	241	S	10	30
28	1	300	E	10	100
29	1	300	E	10	60
30	1	300	E	10	30
31	1	300	SE	10	100
32	1	300	SE	10	60
33	1	300	SE	10	30
34	1	300	S	10	100
35	1	300	S	10	60
36	1	300	S	10	30
37	1	300	SW	10	100
38	1	300	SW	10	60
39	1	300	SW	10	30
40	1	300	W	10	100
41	1	300	W	10	60
42	1	300	W	10	30
43	1	300	E	20	100
44	1	300	E	20	60
45	1	300	E	20	30
46	1	300	SE	20	100
47	1	300	SE	20	60

Welsh Power Plant
TV Tape Log (continued)

Run	Unit	Stack Ht. ft	Wind Dir	Vel m/h	Load %
48	1	300	SE	20	30
49	1	300	S	20	100
50	1	300	S	20	60
51	1	300	S	20	30
52	1	300	SW	20	100
53	1	300	SW	20	60
54	1	300	SW	20	30
55	1	300	W	20	100
56	1	300	W	20	60
57	1	300	W	20	30
58	1	300	E	30	100
59	1	300	E	30	60
60	1	300	E	30	30
61	1	300	SE	30	100
62	1	300	SE	30	60
63	1	300	SE	30	30
64	1	300	S	30	100
65	1	300	S	30	60
66	1	300	S	30	30
67	1	300	SW	30	100
68	1	300	SW	30	60
69	1	300	SW	30	30
70	1	300	W	30	100
71	1	300	W	30	60
72	1	300	W	30	30
73	1	350	E	10	100
74	1	350	E	10	60
75	1	350	E	10	30
76	1	350	SE	10	100
77	1	350	SE	10	60
78	1	350	SE	10	30
79	1	350	S	10	100
80	1	350	S	10	60
81	1	350	S	10	30
82	1	350	E	20	100
83	1	350	E	20	60
84	1	350	E	20	30
85	1	350	SE	20	100
86	1	350	SE	20	60
87	1	350	SE	20	30
88	1	350	S	20	100
89	1	350	S	20	60
90	1	350	S	20	30
91	1	350	E	30	100
92	1	350	E	30	60
93	1	350	E	30	30

Welsh Power Plant
TV Tape Log (continued)

Run	Unit	Stack Ht. ft	Wind Dir	Vel m/h	Load %
94	1	350	SE	30	100
95	1	350	SE	30	60
96	1	350	SE	30	30
97	1	350	E	30	100
98	1	350	E	30	60
99	1	350	E	30	30
100	2	241	E	10	100
101	2	241	E	10	60
102	2	241	E	10	30
103	2	300	E	10	100
104	2	300	E	10	60
105	2	300	E	10	30
106	2	241	E	20	100
107	2	241	E	20	60
108	2	241	E	20	30
109	2	300	E	20	100
110	2	300	E	20	60
111	2	300	E	20	30
112	2	241	E	30	100
113	2	241	E	30	60
114	2	241	E	30	30
115	2	300	E	30	100
116	2	300	E	30	60
117	2	300	E	30	30
118	All	300	E	10	100
119	All	300	E	10	60
120	All	300	E	10	30
121	All	300	SE	10	100
122	All	300	SE	10	60
123	All	300	SE	10	30
124	All	300	S	10	100
125	All	300	S	10	60
126	All	300	S	10	30
127	All	300	SW	10	100
128	All	300	SW	10	60
129	All	300	SW	10	30
130	All	300	W	10	100
131	All	300	W	10	60
132	All	300	W	10	30
133	All	300	E	20	100
134	All	300	E	20	60
135	All	300	E	20	30
136	All	300	SE	20	100
137	All	300	SE	20	60
138	All	300	SE	20	30
139	All	300	S	20	100

Welsh Power Plant
TV Tape Log (continued)

Run	Unit	Stack Ht. ft	Wind Dir	Vel m/h	Load %	
140	All	300	S	20	60	
141	All	300	S	20	30	
142	All	300	SW	20	100	
143	All	300	SW	20	60	
144	All	300	SW	20	30	
145	All	300	W	20	100	
146	All	300	W	20	60	
147	All	300	W	20	30	
148	All	300	E	30	100	
149	All	300	E	30	60	
150	All	300	E	30	30	
151	All	300	SE	30	100	
152	All	300	SE	30	60	
153	All	300	SE	30	30	
154	All	300	S	30	100	
155	All	300	S	30	60	
156	All	300	S	30	30	
157	All	300	SW	30	100	
158	----------	----------	missing	----------	----------	
159	All	300	SW	30	30	
160	All	300	W	30	100	
161	All	300	W	30	60	
162	All	300	W	30	30	
163	2	300	E	30	30	Nozzle
164	1	300	E	30	30	Nozzle
End						

Table 8 Ground Level Concentration Results for Neutral Flow Conditions (concentrations in ppm SO_2)

Table 8 Locator Table Ground-Level Concentration Results

Unit	Stack Height (ft)	Wind Angle	10 mph			20 mph			30 mph		
			100%	60%	30%	100%	60%	30%	100%	60%	30%
1	241	E				1	2	3	4	5	6
		SE				7	8	9	10	11	12
		S				13	14	15	16	17	18
	300	E	19	20	21	22	23	24	25	26	27
		SE				28	29	30	31	32	33
		S				34	35	36	37	38	39
		SW				40	41	42	43	44	45
		W				46	47	48	49	50	51
	350	E				52	53	54	55	56	57
		SE				58	59	60	61	62	63
		S				64	65	66	67	68	69
A11	300	E				70	71	72	73	74	75
		SE				76	77	78	79	80	81
		S				82	83	84	85	86	87
		SW				88	89	90	91	92	93
		W				94	95	96	97	98	99

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	.242E-03	0.	0.	0.
-100						
-200			0.	0.	0.	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .242E-03
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.110E+01
600	.333E+00
400	.245E-01
200	.304E-03
0	0.

TABLE 8-1

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.589E-02
500						
400				0.	0.	
300						.215E-02
200			0.	0.	0.	
100						
0	0.	0.	.247E-02	0.	0.	0.
-100						
-200			0.	0.	0.	
-300						.247E-02
-400				0.	.715E-03	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .589E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.858E+00
600	.842E+00
400	.126E+00
200	.260E-01
0	0.

TABLE 8-2

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						0.
500						
400				0.	.267E-03	
300						0.
200			0.	0.	0.	
100						
0	.160E-02	.368E-02	.133E-03	.134E-02	.133E-02	.201E-02
-100						
-200			.569E-02	.116E-01	.136E-01	
-300						.230E-01
-400				.636E-02	.104E-01	
-500						
-600						.871E-02
-900						.320E-02
-1200						

MAXIMUM CONCENTRATION = .230E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.100E+00
600	.427E+00
400	.220E+00
200	.421E-01
0	.133E-02

TABLE 8-3

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						.170E-02
500						
400				.121E-02	.291E-02	
300						.608E-03
200			.242E-03	.608E-02	.182E-02	
100						
0	.167E-01	.128E-01	.121E-02	.146E-01	.177E-01	.109E-01
-100						
-200			.411E-01	.700E-01	.577E-01	
-300						.858E-01
-400				.566E-01	.690E-01	
-500						
-600						.560E-01
-900						.211E-01
-1200						

MAXIMUM CONCENTRATION = .858E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.184E+00
600	.113E+01
400	.104E+01
200	.194E+00
0	.177E-01

TABLE 8-4

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.570E-03
500						
400				.950E-03	0.	
300						.978E-02
200			.123E-01	.131E-01	.715E-02	
100						
0	.367E-01	.379E-01	.213E-01	.785E-01	.715E-01	.706E-01
-100						
-200			.649E-01	.968E-01	.118E+00	
-300						.132E+00
-400				.472E-01	.592E-01	
-500						
-600						.336E-01
-900						.190E-02
-1200						

MAXIMUM CONCENTRATION = .132E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.256E-01
600	.362E+00
400	.529E+00
200	.246E+00
0	.715E-01

TABLE 8-5

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 241
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.267E-03	
300						.921E-02
200			0.	0.	0.	
100						
0	.752E-01	.602E-01	.176E-01	.189E-01	.172E-01	.320E-01
-100						
-200			.991E-01	.920E-01	.298E-01	
-300						.566E-01
-400				.798E-01	.717E-01	
-500						
-600						.566E-01
-900						.140E-01
-1200						

MAXIMUM CONCENTRATION = .991E-01
STACK LOCATION, X = -100.00 Y = -33.

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.280E-02
600	.627E-01
400	.256E+00
200	.151E+00
0	.172E-01

TABLE 8-6

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.121E-02
500						
400				0.	.484E-03	
300						0.
200			0.	0.	.152E-02	
100						
0	0.	0.	.242E-03	.152E-02	.266E-02	.578E-02
-100						
-200			.912E-03	.162E-01	.172E-01	
-300						.322E-01
-400				.517E-02	.119E-01	
-500						
-600						.249E-01
-900						.726E-03
-1200						

MAXIMUM CONCENTRATION = .322E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.130E+01
600	.559E+00
400	.824E-01
200	.116E-01
0	.266E-02

TABLE 8-7

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.380E-03
500						
400				0.	0.	
300						.715E-03
200			.532E-02	.238E-03	0.	
100						
0	.361E-02	.691E-02	.475E-02	.811E-02	.150E-01	.234E-01
-100						
-200			.105E-01	.355E-01	.346E-01	
-300						.566E-01
-400				.210E-01	.327E-01	
-500						
-600						.131E-01
-900						0.
-1200						

MAXIMUM CONCENTRATION = .566E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.374E+00
600	.793E+00
400	.161E+00
200	.184E-01
0	.150E-01

TABLE 8-8

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 241
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.133E-02	0.	0.	0.	0.	0.
-100						
-200			.121E-01	.179E-01	.934E-02	
-300						.252E-01
-400				.484E-01	.394E-01	
-500						
-600						.488E-01
-900						.354E-01
-1200						

MAXIMUM CONCENTRATION = .488E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.308E+00
400	.237E+00
200	.459E-01
0	0.

TABLE 8-9

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = 500 / Y	1000	2000	3000	4000	5000
1200					
900					0.
600					.283E-01
500					
400			.872E-02	.214E-01	
300					.809E-01
200		.214E-01	.354E-01	.646E-01	
100					
0	.109E-01 .126E-01	.191E-01	.122E+00	.155E+00	.129E+00
-100					
-200		.382E-01	.129E+00	.131E+00	
-300					.139E+00
-400			.252E-01	.474E-01	
-500					
-600					.362E-01
-900					.811E-02
-1200					

MAXIMUM CONCENTRATION = .155E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.166E-01
600	.150E+00
400	.491E+00
200	.268E+00
0	.155E+00

TABLE 8-10

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						.266E-02
500						
400				.285E-02	.190E-03	
300						.477E-03
200			.541E-02	.384E-01	.286E-02	
100						
0	.246E-01	.432E-01	.125E-01	.453E-01	.289E-01	.246E-01
-100						
-200			.923E-01	.136E+00	.650E-01	
-300						.806E-01
-400				.895E-01	.875E-01	
-500						
-600						.607E-01
-900						.251E-01
-1200						

MAXIMUM CONCENTRATION = .136E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.104E-02
600	.243E+00
400	.637E+00
200	.265E+00
0	.289E-01

TABLE 8-11

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.454E-02
500						
400				.494E-02	.144E-01	
300						.374E-01
200			.351E-01	.377E-01	.404E-01	
100						
0	.287E-01	.543E-01	.339E-01	.102E+00	.105E+00	.113E+00
-100						
-200			.126E+00	.180E+00	.177E+00	
-300						.165E+00
-400				.717E-01	.109E+00	
-500						
-600						.327E-01
-900						.507E-02
-1200						

MAXIMUM CONCENTRATION = .180E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.109E-01
400	.248E+00
200	.196E+00
0	.105E+00

TABLE 8-12

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = 500 1000 2000 3000 4000 5000 Y					
1200					
900					0.
600					.266E-02
500					
400			0.	.969E-02	
300					.185E-01
200		0.	.122E-02	.106E-01	
100					
0	.969E-03 0.	.121E-02	.125E-01	.337E-01	.544E-01
-100					
-200		.912E-03	.208E-01	.351E-01	
-300					.523E-01
-400			.882E-02	.116E-01	
-500					
-600					.179E-01
-900					0.
-1200					

MAXIMUM CONCENTRATION = .544E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.161E+01
600	.111E+01
400	.219E+00
200	.605E-01
0	.337E-01

TABLE 8-13

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 60 STRAT = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5
1200						
900						0.
600						.190E-03
500						
400				0.	0.	
300						.143E-01
200			.190E-03	.143E-02	.501E-02	
100						
0	.152E-02	.572E-02	.589E-02	.405E-02	.142E-01	.446E-01
-100						
-200			.858E-02	.194E-01	.253E-01	
-300						.313E-01
-400				.253E-01	.169E-01	
-500						
-600						.186E-01
-900						.266E-02
-1200						

MAXIMUM CONCENTRATION = .446E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.659E+00
600	.673E+00
400	.334E+00
200	.549E-01
0	.142E-01

TABLE 8-14

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.133E-03	
300						0.
200			.427E-02	.469E-02	.402E-02	
100						
0	0.	.636E-02	.867E-02	.338E-01	.247E-01	.179E-01
-100						
-200			.261E-01	.586E-01	.350E-01	
-300						.730E-01
-400				.253E-01	.333E-01	
-500						
-600						.261E-01
-900						.160E-02
-1200						

MAXIMUM CONCENTRATION = .730E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.120E-01
600	.214E+00
400	.190E+00
200	.340E-01
0	.247E-01

TABLE 8-15

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = 500 / Y	1000	2000	3000	4000	5000
1200					
900					0.
600					.365E-01
500					
400			.823E-02	.418E-01	
300					.152E+00
200		.605E-02	.353E-01	.721E-01	
100					
0	.134E-01 .102E-01	.375E-02	.551E-01	.113E+00	.137E+00
-100					
-200		.117E-01	.462E-01	.662E-01	
-300					.650E-01
-400			.122E-01	.239E-01	
-500					
-600					.204E-01
-900					.690E-02
-1200					

MAXIMUM CONCENTRATION = .152E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.605E-03
600	.111E+00
400	.400E+00
200	.268E+00
0	.113E+00

TABLE 8-16

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 241
SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.386E-01
500						
400				.133E-01	.398E-01	
300						.693E-01
200			.156E-01	.291E-01	.561E-01	
100						
0	.220E-01	.108E-01	.157E-01	.437E-01	.538E-01	.690E-01
-100						
-200			.128E-01	.264E-01	.232E-01	
-300						.332E-01
-400				.620E-02	.110E-01	
-500						
-600						.193E-01
-900						.665E-03
-1200						

MAXIMUM CONCENTRATION = .693E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.541E-02
600	.411E-01
400	.165E+00
200	.116E+00
0	.538E-01

TABLE 8-17

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 241

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.361E-01
500						
400				.974E-02	.409E-01	
300						.842E-01
200			.164E-01	.363E-01	.569E-01	
100						
0	.146E-01	.123E-01	.560E-02	.438E-01	.732E-01	.764E-01
-100						
-200			.184E-01	.371E-01	.499E-01	
-300						.495E-01
-400				.171E-01	.203E-01	
-500						
-600						.216E-01
-900						.854E-02
-1200						

MAXIMUM CONCENTRATION = .842E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.166E-01
400	.106E+00
200	.105E+00
0	.732E-01

TABLE 8-18

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 10 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			.969E-03	0.	0.	
100						
0	0.	0.	0.	0.	0.	0.
-100						
-200			0.	0.	0.	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						.121E-02
-1200						

MAXIMUM CONCENTRATION = .121E-02

STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.567E+00
600	.108E+00
400	.138E-01
200	0.
0	0.

TABLE 8-19

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 10 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	0.	0.
-100						
-200			0.	0.	.665E-02	
-300						.167E-01
-400				0.	.787E-02	
-500						
-600						.331E-01
-900						.378E-01
-1200						

MAXIMUM CONCENTRATION = .378E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.152E-01
600	.248E+00
400	.631E-01
200	.134E-01
0	0.

TABLE 8-20

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 10 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.800E-03
500						
400				.454E-02	.240E-02	
300						.285E-02
200			.534E-02	.352E-02	.218E-02	
100						
0	.427E-02	.111E-01	.654E-02	.134E-02	.293E-02	.268E-02
-100						
-200			.670E-02	.360E-02	.387E-02	
-300						.227E-02
-400				.452E-02	.385E-02	
-500						
-600						.586E-02
-900						.881E-02
-1200						

MAXIMUM CONCENTRATION = .111E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.687E+00
400	.820E-01
200	.137E-01
0	.293E-02

TABLE 8-21

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.170E-01	.170E-02	
300						0.
200			.293E-01	.128E-01	0.	
100						
0	.567E-01	.505E-01	0.	.140E-01	.172E-01	.882E-02
-100						
-200			.760E-01	.906E-01	.480E-01	
-300						.565E-01
-400				.623E-01	.368E-01	
-500						
-600						.225E-01
-900						.150E-01
-1200						

MAXIMUM CONCENTRATION = .906E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.848E+00
600	.225E-01
400	.167E-01
200	.699E-02
0	.172E-01

TABLE 8-22

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.191E-02
200			0.	0.	0.	
100						
0	0.	.262E-02	0.	.453E-02	.192E-01	.110E-01
-100						
-200			.255E-01	.353E-01	.255E-01	
-300						.321E-01
-400				.377E-01	.360E-01	
-500						
-600						.260E-01
-900						.112E-01
-1200						

MAXIMUM CONCENTRATION = .377E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.613E-01
400	.114E-01
200	.954E-03
0	.192E-01

TABLE 8-23

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.402E-02
200			0.	.268E-02	.435E-02	
100						
0	.587E-02	.214E-01	0.	.938E-02	.188E-01	.147E-01
-100						
-200			.196E-01	.272E-01	.208E-01	
-300						.271E-01
-400				.186E-01	.201E-01	
-500						
-600						.904E-02
-900						.520E-02
-1200						

MAXIMUM CONCENTRATION = .272E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.664E+00
600	.302E+00
400	.387E-01
200	.938E-02
0	.188E-01

TABLE 8-24

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.152E-02
200			0.	0.	.274E-02	
100						
0	.969E-02	0.	.726E-03	.122E-02	.111E-01	.176E-01
-100						
-200			.486E-02	.109E-01	.216E-01	
-300						.453E-01
-400				.146E-01	.231E-01	
-500						
-600						.651E-01
-900						.453E-01
-1200						

MAXIMUM CONCENTRATION = .651E-01

STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.452E+00
600	.112E+01
400	.695E+00
200	.103E+00
0	.111E-01

TABLE 8-25

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.950E-03
500						
400				0.	0.	
300						0.
200			.190E-03	.262E-02	.238E-02	
100						
0	.230E-01	.143E-01	.304E-02	.145E-01	.148E-01	.303E-01
-100						
-200			.384E-01	.256E-01	.279E-01	
-300						.397E-01
-400				.262E-01	.298E-01	
-500						
-600						.382E-01
-900						.256E-01
-1200						

MAXIMUM CONCENTRATION = .397E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.338E-01
600	0.
400	.442E+00
200	.110E+00
0	.148E-01

TABLE 8-26

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 / Y	1000	2000	3000	4000	5000
1200					
900					0.
600					0.
500					
400			0.	.133E-03	
300					.653E-02
200		0.	0.	.837E-03	
100					
0	.560E-02 .112E-01	.267E-03	.134E-01	.255E-01	.302E-01
-100					
-200		.283E-01	.467E-01	.526E-01	
-300					.694E-01
-400			.389E-01	.499E-01	
-500					
-600					.416E-01
-900					.143E-01
-1200					

MAXIMUM CONCENTRATION = .694E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.720E-02
600	.701E-01
400	.248E+00
200	.984E-01
0	.255E-01

TABLE 8-27

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.969E-03	
300						0.
200			.726E-03	0.	0.	
100						
0	.484E-03	0.	0.	0.	.242E-03	0.
-100						
-200			.152E-02	.460E-02	.630E-02	
-300						.216E-01
-400				.547E-02	.195E-01	
-500						
-600						.207E-01
-900						.143E-01
-1200						

MAXIMUM CONCENTRATION = .216E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.340E+00
600	.856E+00
400	.216E+00
200	.322E-01
0	.242E-03

TABLE 8-28

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.209E-02	.405E-02	0.	0.	.532E-02	.596E-02
-100						
-200			.501E-02	.456E-02	.108E-01	
-300						.196E-01
-400				.620E-02	.126E-01	
-500						
-600						.162E-01
-900						.142E-01
-1200						

MAXIMUM CONCENTRATION = .196E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.898E+00
600	.537E+00
400	.985E-01
200	.200E-01
0	.532E-02

TABLE 8-29

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						.267E-03
500						
400				.107E-02	.934E-03	
300						.385E-02
200			.520E-02	.636E-02	.553E-02	
100						
0	.107E-01	.126E-01	.680E-02	.136E-01	.160E-01	.154E-01
-100						
-200			.255E-01	.286E-01	.210E-01	
-300						.219E-01
-400				.250E-01	.157E-01	
-500						
-600						.203E-01
-900						.306E-01
-1200						

MAXIMUM CONCENTRATION = .306E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.528E+00
600	.371E+00
400	.100E+00
200	.229E-01
0	.160E-01

TABLE 8-30

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.121E-02	0.	
300						0.
200			.160E-01	.395E-02	.304E-03	
100						
0	.933E-01	.404E-01	.751E-02	.198E-01	.145E-01	.109E-01
-100						
-200			.581E-01	.577E-01	.422E-01	
-300						.489E-01
-400				.496E-01	.487E-01	
-500						
-600						.450E-01
-900						.266E-01
-1200						

MAXIMUM CONCENTRATION = .933E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.363E-01
600	.144E+01
400	.410E+00
200	.636E-01
0	.145E-01

TABLE 8-31

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = 500 / Y	1000	2000	3000	4000	5000
1200					
900					0.
600					.646E-02
500					
400			.817E-02	.247E-02	
300					.691E-02
200		.329E-01	.188E-01	.153E-01	
100					
0	.466E-01 .324E-01	.125E-01	.410E-01	.519E-01	.439E-01
-100					
-200		.420E-01	.542E-01	.456E-01	
-300					.610E-01
-400			.396E-01	.362E-01	
-500					
-600					.222E-01
-900					.101E-01
-1200					

MAXIMUM CONCENTRATION = .610E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.112E+00
600	.107E+01
400	.345E+00
200	.997E-01
0	.519E-01

TABLE 8-32

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.133E-03	
300						0.
200			.400E-03	0.	.301E-02	
100						
0	.284E-01	.703E-02	.240E-02	.109E-01	.168E-01	.124E-01
-100						
-200			.231E-01	.399E-01	.426E-01	
-300						.439E-01
-400				.250E-01	.335E-01	
-500						
-600						.258E-01
-900						.179E-01
-1200						

MAXIMUM CONCENTRATION = .439E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.991E-01
600	.304E+00
400	.120E+00
200	.390E-01
0	.168E-01

TABLE 8-33

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 30

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.545E-03
500						
400				.242E-03	.303E-03	
300						.334E-02
200			0.	0.	.456E-03	
100						
0	.666E-03	0.	.908E-03	.122E-02	.557E-02	.195E-01
-100						
-200			0.	.890E-02	.113E-01	
-300						.173E-01
-400				.137E-02	.448E-02	
-500						
-600						.608E-02
-900						.291E-02
-1200						

MAXIMUM CONCENTRATION = .195E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.476E+00
600	.100E+01
400	.314E+00
200	.716E-01
0	.557E-02

TABLE 8-34

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.214E-02
500						
400				.237E-03	.218E-02	
300						.924E-02
200			.475E-03	.185E-02	.584E-02	
100						
0	.280E-02	.143E-02	.180E-02	.972E-02	.191E-01	.271E-01
-100						
-200			.841E-02	.234E-01	.253E-01	
-300						.422E-01
-400				.176E-01	.223E-01	
-500						
-600						.212E-01
-900						.803E-02
-1200						

MAXIMUM CONCENTRATION = .422E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.263E-01
600	.592E+00
400	.667E+00
200	.914E-01
0	.191E-01

TABLE 8-35

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 1000 2000 3000 4000 5000 / Y						
1200						
900						0.
600						.967E-03
500						
400				.667E-04	.193E-02	
300						.854E-02
200			0.	.795E-03	.239E-02	
100						
0	.967E-03	.293E-03	.333E-04	.205E-02	.754E-02	.288E-01
-100						
-200			.448E-02	.964E-02	.129E-01	
-300						.436E-01
-400				.124E-01	.172E-01	
-500						
-600						.293E-01
-900						.164E-01
-1200						

MAXIMUM CONCENTRATION = .436E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.407E-02
600	.175E-01
400	.121E+00
200	.114E+00
0	.754E-02

TABLE 8-36

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.278E-02
500						
400				.157E-02	.545E-02	
300						.316E-01
200			.194E-02	.654E-02	.234E-01	
100						
0	.436E-02	0.	.109E-02	.836E-02	.254E-01	.554E-01
-100						
-200			.228E-02	.140E-01	.279E-01	
-300						.344E-01
-400				.380E-02	.119E-01	
-500						
-600						.100E-01
-900						.412E-02
-1200						

MAXIMUM CONCENTRATION = .554E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.641E-01
600	.175E+00
400	.288E+00
200	.114E+00
0	.254E-01

TABLE 8-37

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.437E-02	.429E-02	.228E-02	.131E-01	.135E-01	.739E-02
-100						
-200			.176E-01	.374E-01	.350E-01	
-300						.386E-01
-400				.253E-01	.262E-01	
-500						
-600						.246E-01
-900						0.
-1200						

MAXIMUM CONCENTRATION = .386E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.190E+00
600	.666E+00
400	.461E+00
200	.969E-01
0	.135E-01

TABLE 8-38

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	.134E-02	0.	
100						
0	.494E-02	.754E-02	.614E-02	.288E-01	.191E-01	.603E-02
-100						
-200			.291E-01	.490E-01	.437E-01	
-300						.553E-01
-400				.291E-01	.310E-01	
-500						
-600						.273E-01
-900						.246E-01
-1200						

MAXIMUM CONCENTRATION = .553E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.267E-03
600	.726E-01
400	.322E+00
200	.350E-01
0	.191E-01

TABLE 8-39

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SW WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						.872E-02
500						
400				0.	.242E-03	
300						.699E-02
200			.170E-02	.456E-02	.182E-02	
100						
0	.460E-02	.426E-02	.484E-02	.760E-02	.131E-01	.140E-01
-100						
-200			.158E-01	.218E-01	.196E-01	
-300						.286E-01
-400				.188E-01	.155E-01	
-500						
-600						.173E-01
-900						.201E-01
-1200						

MAXIMUM CONCENTRATION = .286E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.952E+00
600	.497E+00
400	.802E-01
200	.195E-01
0	.131E-01

TABLE 8-40

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = SW WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = 500 1000 2000 3000 4000 5000 / Y						
1200						
900						0.
600						.380E-03
500						
400				0.	0.	
300						0.
200			.171E-02	0.	0.	
100						
0	0.	0.	0.	0.	0.	.167E-02
-100						
-200			.191E-02	.513E-02	.399E-02	
-300						.101E-01
-400				.620E-02	.429E-02	
-500						
-600						.572E-02
-900						.475E-02
-1200						

MAXIMUM CONCENTRATION = .101E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.756E+00
600	.366E+00
400	.332E-01
200	.858E-02
0	0.

TABLE 8-41

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SW WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.502E-03
200			0.	0.	0.	
100						
0	0.	0.	0.	.352E-02	.454E-02	.620E-02
-100						
-200			.469E-02	.694E-02	.100E-01	
-300						.165E-01
-400				.770E-02	.469E-02	
-500						
-600						.854E-02
-900						.974E-02
-1200						

MAXIMUM CONCENTRATION = .165E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.341E+00
600	.271E+00
400	.503E-01
200	.871E-02
0	.454E-02

TABLE 8-42

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SW WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.533E-02	0.	0.	0.	.170E-02	.608E-03
-100						
-200			0.	.387E-02	.581E-02	
-300						.114E-01
-400				.182E-02	.334E-02	
-500						
-600						.760E-02
-900						.920E-02
-1200						

MAXIMUM CONCENTRATION = .114E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.446E+00
600	.129E+01
400	.603E+00
200	.517E-01
0	.170E-02

TABLE 8-43

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SW WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.380E-03
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.255E-01	.906E-02	.152E-02	0.	.608E-02	.105E-01
-100						
-200			.930E-02	.114E-01	.123E-01	
-300						.207E-01
-400				.157E-01	.129E-01	
-500						
-600						.119E-01
-900						.513E-02
-1200						

MAXIMUM CONCENTRATION = .255E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.104E+00
600	.743E+00
400	.475E+00
200	.880E-01
0	.608E-02

TABLE 8-44

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = SW WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.534E-03
500						
400				0.	0.	
300						0.
200			0.	.117E-02	0.	
100						
0	.774E-02	.385E-02	.534E-02	.144E-01	.164E-01	.233E-01
-100						
-200			.204E-01	.458E-01	.577E-01	
-300						.600E-01
-400				.240E-01	.359E-01	
-500						
-600						.213E-01
-900						.113E-01
-1200						

MAXIMUM CONCENTRATION = .600E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.104E+00
400	.427E+00
200	.118E+00
0	.164E-01

TABLE 8-45

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = W WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.121E-02	.912E-03	0.	0.	.242E-03	.304E-02
-100						
-200			0.	.242E-02	.484E-03	
-300						.218E-02
-400				.912E-03	0.	
-500						
-600						.122E-02
-900						.969E-03
-1200						

MAXIMUM CONCENTRATION = .304E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.159E+01
600	.789E+00
400	.162E+00
200	.353E-01
0	.242E-03

TABLE 8-46

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = W WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.380E-03
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.570E-03	0.	.950E-03	0.	.570E-03	0.
-100						
-200			0.	.114E-02	.532E-02	
-300						.135E-01
-400				.238E-03	.954E-03	
-500						
-600						.381E-02
-900						.323E-02
-1200						

MAXIMUM CONCENTRATION = .135E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.991E-01
600	.530E+00
400	.125E+00
200	.126E-01
0	.570E-03

TABLE 8-47

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = W WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.267E-03
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	0.	0.
-100						
-200			0.	0.	.667E-03	
-300						.133E-02
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .133E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.174E+00
600	.308E+00
400	.395E-01
200	.102E-01
0	0.

TABLE 8-48

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = W WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.266E-02	0.	0.	0.	0.	0.
-100						
-200			0.	0.	0.	
-300						.242E-03
-400				0.	0.	
-500						
-600						0.
-900						.726E-03
-1200						

MAXIMUM CONCENTRATION = .266E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.116E+01
600	.102E+01
400	.146E+00
200	.155E-01
0	0.

TABLE 8-49

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = W WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.950E-03	0.	
300						0.
200			0.	0.	0.	
100						
0	.380E-02	.954E-03	.760E-03	0.	.133E-02	.310E-02
-100						
-200			0.	.114E-02	.190E-02	
-300						.912E-02
-400				0.	.405F-02	
-500						
-600						.429E-02
-900						.760E-03
-1200						

MAXIMUM CONCENTRATION = .912E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.627E-02
600	.110E+01
400	.459E+00
200	.630E-01
0	.133E-02

TABLE 8-50

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = W WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.800E-02	0.	0.	0.	.120E-02	.435E-02
-100						
-200			0.	.100E-01	.680E-02	
-300						.195E-01
-400				.285E-02	.821E-02	
-500						
-600						.636E-02
-900						.160E-02
-1200						

MAXIMUM CONCENTRATION = .195E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.993E-01
400	.482E+00
200	.840E-01
0	.120E-02

TABLE 8-51

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 350
SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.242E-03	
300						0.
200			0.	0.	.395E-02	
100						
0	0.	0.	.145E-02	0.	.969E-03	0.
-100						
-200			0.	0.	0.	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .395E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.596E+00
600	.328E-01
400	.124E-01
200	0.
0	.969E-03

TABLE 8-52

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	0.	0.
-100						
-200			0.	0.	.133E-02	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .133E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.956E+00
600	.338E+00
400	.452E-01
200	.429E-02
0	0.

TABLE 8-53

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.667E-03	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	0.	0.
-100						
-200			0.	0.	0.	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .667E-03
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.792E+00
600	.137E+00
400	.255E-01
200	.100E-02
0	0.

TABLE 8-54

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.182E-02
200			0.	0.	.912E-03	
100						
0	.266E-02	0.	0.	0.	0.	.182E-02
-100						
-200			0.	0.	.242E-03	
-300						0.
-400				0.	.395E-02	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .395E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.698E+00
600	.158E+01
400	.297E+00
200	.307E-01
0	0.

TABLE 8-55

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.262E-02
200			0.	0.	.119E-02	
100						
0	.266E-02	0.	0.	.238E-02	.120E-01	.188E-01
-100						
-200			0.	.304E-02	.817E-02	
-300						.760E-03
-400				0.	.143E-02	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .188E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.115E+00
600	.744E+00
400	.375E+00
200	.783E-01
0	.120E-01

TABLE 8-56

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 350
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.133E-03
500						
400				0.	0.	
300						.318E-02
200			.800E-03	.335E-03	.670E-03	
100						
0	0.	0.	0.	.218E-02	.640E-02	.737E-02
-100						
-200			0.	.107E-02	.213E-02	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .737E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.507E-01
600	.239E+00
400	.206E+00
200	.437E-01
0	.640E-02

TABLE 8-57

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.484E-03	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	0.	0.
-100						
-200			0.	0.	0.	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .484E-03
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.147E+01
600	.651E+00
400	.103E+00
200	.942E-02
0	0.

TABLE 8-58

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	.570E-03	.238E-03
-100						
-200			0.	0.	.570E-03	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .570E-03
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.900E+00
600	.476E+00
400	.481E-01
200	.286E-02
0	.570E-03

TABLE 8-59

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.167E-03
200			0.	0.	0.	
100						
0	0.	0.	.400E-03	0.	.173E-02	0.
-100						
-200			0.	.667E-03	.267E-03	
-300						.454E-02
-400				0.	0.	
-500						
-600						.670E-03
-900						0.
-1200						

MAXIMUM CONCENTRATION = .454E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.120E+00
600	.102E+00
400	.148E-01
200	.653E-02
0	.173E-02

TABLE 8-60

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 350
SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.266E-02	0.	0.	.456E-02	.242E-02	.517E-02
-100						
-200			0.	0.	.291E-02	
-300						.242E-02
-400				0.	.182E-02	
-500						
-600						.608E-03
-900						0.
-1200						

MAXIMUM CONCENTRATION = .517E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.129E+01
600	.112E+01
400	.299E+00
200	.435E-01
0	.242E-02

TABLE 8-61

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 350
SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.215E-02
200			0.	0.	.238E-03	
100						
0	0.	0.	0.	0.	.760E-02	.811E-02
-100						
-200			0.	.437E-02	.104E-01	
-300						0.
-400				0.	.358E-02	
-500						
-600						.198E-01
-900						0.
-1200						

MAXIMUM CONCENTRATION = .198E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.137E+00
600	.731E+00
400	.172E+00
200	.382E-01
0	.760E-02

TABLE 8-62

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 1000 2000 3000 4000 5000
Y **********
1200
900 0.
600 0.
500
400 0. .120E-02
300 .419E-02
200 .800E-03 .218E-02 .419E-02
100
0 .934E-03 0. .800E-03 .100E-01 .226E-01 .330E-01
-100
-200 .519E-02 .414E-02 .378E-01
-300 .426E-01
-400 .260E-01 .159E-01
-500
-600 .251E-02
-900 .800E-03
-1200

MAXIMUM CONCENTRATION = .426E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	0.
600	.320E-01
400	.212E+00
200	.493E-01
0	.226E-01

TABLE 8-63

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 350
SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	.969E-03	0.
-100						
-200			0.	0.	0.	
-300						.145E-02
-400				0.	0.	
-500						
-600						0.
-900						.121E-02
-1200						

MAXIMUM CONCENTRATION = .145E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.867E+00
600	.248E+00
400	.453E-01
200	.395E-02
0	.969E-03

TABLE 8-64

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	.190E-02	0.
-100						
-200			0.	0.	0.	
-300						.266E-02
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .266E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.430E+00
600	.162E+00
400	.779E-01
200	.112E-01
0	.190E-02

TABLE 8-65

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	.400E-03	0.	0.	0.	0.	.117E-02
-100						
-200			0.	.400E-03	.800E-03	
-300						.267E-03
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .117E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.136E+00
600	.143E+00
400	.167E-01
200	0.
0	0.

TABLE 8-66

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .749E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.274E-02
200			0.	0.	0.	
100						
0	0.	0.	0.	0.	.148E-01	.103E-01
-100						
-200			0.	.702E-02	.150E-01	
-300						.109E-01
-400				0.	.669E-02	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .150E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.714E+00
600	.144E+01
400	.158E+00
200	.648E-01
0	.148E-01

TABLE 8-67

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 350

SOURCE STRENGTH (MICRO GRAMS/SEC) = .446E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.171E-02	
300						.358E-02
200			.247E-02	.167E-02	.453E-02	
100						
0	.171E-02	0.	0.	.134E-01	.205E-01	.258E-01
-100						
-200			.310E-02	.158E-01	.313E-01	
-300						.317E-01
-400				.124E-01	.176E-01	
-500						
-600						.262E-02
-900						.190E-03
-1200						

MAXIMUM CONCENTRATION = .317E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.819E-01
600	.667E+00
400	.316E+00
200	.742E-01
0	.205E-01

TABLE 8-68

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = 1 WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 350
SOURCE STRENGTH (MICRO GRAMS/SEC) = .224E+09

X = 500 1000 2000 3000 4000 5000 / Y						
1200						
900						0.
600						.267E-03
500						
400				0.	.173E-02	
300						.137E-01
200			.227E-02	.754E-02	.112E-01	
100						
0	.200E-02	.201E-02	.454E-02	.325E-01	.414E-01	.467E-01
-100						
-200			.131E-01	.244E-01	.390E-01	
-300						.344E-01
-400				.787E-02	.149E-01	
-500						
-600						.402E-02
-900						0.
-1200						

MAXIMUM CONCENTRATION = .467E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.534E-03
600	.241E+00
400	.355E+00
200	.132E+00
0	.414E-01

TABLE 8-69

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.323E-02	.444E-02	
300						.375E-01
200			.646E-02	.811E-02	.263E-01	
100						
0	.194E-01	.274E-01	.726E-02	.552E-01	.149E+00	.147E+00
-100						
-200			.466E-01	.169E+00	.186E+00	
-300						.239E+00
-400				.107E+00	.149E+00	
-500						
-600						.139E+00
-900						.274E-01
-1200						

MAXIMUM CONCENTRATION = .239E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.119E+01
600	.214E+01
400	.145E+01
200	.377E+00
0	.149E+00

TABLE 8-70

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.317E-03
500						
400				0.	.633E-03	
300						.676E-02
200			.193E-01	.342E-01	.115E-01	
100						
0	.196E-01	.795E-02	0.	.863E-01	.136E+00	.118E+00
-100						
-200			.600E-01	.164E+00	.165E+00	
-300						.164E+00
-400				.879E-01	.978E-01	
-500						
-600						.489E-01
-900						.120E-01
-1200						

MAXIMUM CONCENTRATION = .165E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.156E+00
600	.952E+00
400	.790E+00
200	.435E+00
0	.136E+00

TABLE 8-71

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = E WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.289E-02
500						
400				.445E-03	.220E-01	
300						.679E-01
200			.153E-01	.212E-01	.592E-01	
100						
0	.801E-02	.558E-02	0.	.852E-01	.143E+00	.115E+00
-100						
-200			.628E-01	.138E+00	.162E+00	
-300						.191E+00
-400				.123E+00	.102E+00	
-500						
-600						.908E-01
-900						.367E-01
-1200						

MAXIMUM CONCENTRATION = .191E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.403E-01
600	.499E+00
400	.486E+00
200	.237E+00
0	.143E+00

TABLE 8-72

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.174E-01
500						
400				.258E-01	.464E-01	
300						.234E+00
200			.622E-01	.131E+00	.210E+00	
100						
0	.266E-01	.314E-01	.170E-01	.201E+00	.277E+00	.397E+00
-100						
-200			.124E+00	.310E+00	.410E+00	
-300						.453E+00
-400				.209E+00	.181E+00	
-500						
-600						.129E+00
-900						.262E-01
-1200						

MAXIMUM CONCENTRATION = .453E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.182E+00
600	.922E+00
400	.126E+01
200	.696E+00
0	.277E+00

TABLE 8-73

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.633E-02
500						
400				.396E-01	.640E-01	
300						.142E+00
200			.118E+00	.152E+00	.126E+00	
100						
0	.225E-01	.310E-01	.358E-01	.249E+00	.330E+00	.326E+00
-100						
-200			.153E+00	.440E+00	.388E+00	
-300						.470E+00
-400				.242E+00	.318E+00	
-500						
-600						.177E+00
-900						.336E-01
-1200						

MAXIMUM CONCENTRATION = .470E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.507E-01
600	.450E+00
400	.887E+00
200	.716E+00
0	.330E+00

TABLE 8-74

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = E WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.309E-01
500						
400				.108E+00	.187E+00	
300						.196E+00
200			.152E+00	.221E+00	.182E+00	
100						
0	.538E-01	.422E-01	.398E-01	.252E+00	.292E+00	.284E+00
-100						
-200			.225E+00	.354E+00	.371E+00	
-300						.404E+00
-400				.287E+00	.277E+00	
-500						
-600						.169E+00
-900						.452E-01
-1200						

MAXIMUM CONCENTRATION = .404E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.122E+00
600	.269E+00
400	.434E+00
200	.407E+00
0	.292E+00

TABLE 8-75

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.174E-01
500						
400				.444E-02	.307E-01	
300						.709E-01
200			.888E-02	.117E-01	.426E-01	
100						
0	.743E-01	.284E-01	.165E-01	.436E-01	.904E-01	.760E-01
-100						
-200			.324E-01	.723E-01	.828E-01	
-300						.480E-01
-400				.415E-01	.329E-01	
-500						
-600						.177E-01
-900						.194E-01
-1200						

MAXIMUM CONCENTRATION = .904E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.253E+01
600	.145E+01
400	.777E+00
200	.193E+00
0	.904E-01

TABLE 8-76

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.275E-01
500						
400				.348E-02	.253E-01	
300						.871E-01
200			.127E-01	.302E-01	.429E-01	
100						
0	.399E-01	.215E-01	.174E-01	.485E-01	.116E+00	.120E+00
-100						
-200			.374E-01	.988E-01	.147E+00	
-300						.223E+00
-400				.759E-01	.157E+00	
-500						
-600						.962E-01
-900						.374E-01
-1200						

MAXIMUM CONCENTRATION = .223E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.833E+00
600	.194E+01
400	.128E+01
200	.504E+00
0	.116E+00

TABLE 8-77

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = SE WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.245E-02
500						
400				.556E-02	.200E-02	
300						.260E-01
200			.400E-02	.114E-01	.274E-01	
100						
0	.145E-01	.865E-02	.445E-02	.545E-01	.770E-01	.858E-01
-100						
-200			.274E-01	.104E+00	.107E+00	
-300						.125E+00
-400				.592E-01	.651E-01	
-500						
-600						.436E-01
-900						.934E-02
-1200						

MAXIMUM CONCENTRATION = .125E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.423E-01
600	.385E+00
400	.562E+00
200	.246E+00
0	.770E-01

TABLE 8-78

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.404E-03
500						
400				0.	.525E-02	
300						.208E-01
200			.404E-02	.233E-01	.182E-01	
100						
0	.581E-01	.263E-01	.194E-01	.142E+00	.193E+00	.231E+00
-100						
-200			.111E+00	.200E+00	.336E+00	
-300						.308E+00
-400				.160E+00	.173E+00	
-500						
-600						.148E+00
-900						.428E-01
-1200						

MAXIMUM CONCENTRATION = .336E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.545E-01
600	.125E+01
400	.185E+01
200	.649E+00
0	.193E+00

TABLE 8-79

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.570E-02	
300						0.
200			.127E-02	.358E-02	.596E-02	
100						
0	.361E-01	.131E-01	.317E-02	.525E-01	.589E-01	.827E-01
-100						
-200			.982E-01	.163E+00	.126E+00	
-300						.196E+00
-400				.175E+00	.156E+00	
-500						
-600						.879E-01
-900						.199E-01
-1200						

MAXIMUM CONCENTRATION = .196E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.187E-01
600	.319E+00
400	.367E+00
200	.115E+01
0	.589E-01

TABLE 8-80

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = SE WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.445E-03	.178E-02	
300						.184E-01
200			.305E-01	.109E-01	.865E-02	
100						
0	.623E-02	.246E-01	.169E-01	.841E-01	.877E-01	.108E+00
-100						
-200			.198E+00	.233E+00	.142E+00	
-300						.217E+00
-400				.212E+00	.241E+00	
-500						
-600						.149E+00
-900						.897E-01
-1200						

MAXIMUM CONCENTRATION = .241E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.305E-01
600	0.
400	.396E+00
200	.475E+00
0	.877E-01

TABLE 8-81

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	.114E-01	.228E-02	0.	0.	0.
-100						
-200			0.	.455E-03	0.	
-300						0.
-400				0.	0.	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .114E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.157E+01
600	.201E+01
400	.570E+00
200	.320E-01
0	0.

TABLE 8-82

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.633E-03
500						
400				0.	0.	
300						0.
200			0.	0.	0.	
100						
0	0.	.636E-02	0.	.795E-03	0.	.477E-02
-100						
-200			.835E-02	0.	.633E-03	
-300						.317E-02
-400				0.	0.	
-500						
-600						.119E-02
-900						0.
-1200						

MAXIMUM CONCENTRATION = .835E-02
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FFET

HEIGHT	CONCENTRATION
800	.244E+01
600	.199E+01
400	.153E+00
200	.250E-01
0	0.

TABLE 8-83

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = S WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = 500 1000 2000 3000 4000 5000 / Y						
1200						
900						0.
600						.289E-02
500						
400				0.	0.	
300						0.
200			0.	.837E-03	0.	
100						
0	0.	.112E-02	0.	0.	.645E-02	.558E-02
-100						
-200			0.	.311E-02	.645E-02	
-300						.118E-01
-400				0.	.279E-03	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .118E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.952E+00
600	.463E+00
400	.103E+00
200	.103E-01
0	.645E-02

TABLE 8-84

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.242E-02	
300						.238E-01
200			.161E-02	0.	.203E-02	
100						
0	.161E-02	.709E-02	.161E-01	.760E-02	.565E-02	.279E-01
-100						
-200			.101E-02	.190E-01	.242E-01	
-300						.190E-01
-400				.861E-02	.355E-02	
-500						
-600						.101E-02
-900						0.
-1200						

MAXIMUM CONCENTRATION = .279E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.179E+01
600	.162E+01
400	.690E+00
200	.145E+00
0	.565E-02

TABLE 8-85

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	.127E-02	
300						.795E-03
200			.104E-01	0.	0.	
100						
0	.158E-02	.517E-02	.380E-02	.266E-01	.146E-01	.290E-01
-100						
-200			.155E-01	.294E-01	.345E-01	
-300						.886E-02
-400				.135E-01	.183E-01	
-500						
-600						.477E-02
-900						.950E-03
-1200						

MAXIMUM CONCENTRATION = .345E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.302E+00
600	.664E+00
400	.400E+00
200	.106E+00
0	.146E-01

TABLE 8-86

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = S WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				0.	0.	
300						.614E-02
200			.334E-02	.307E-02	.447E-02	
100						
0	0.	.447E-02	0.	.165E-01	.160E-01	.179E-01
-100						
-200			.223E-01	.211E-01	.176E-01	
-300						.185E-01
-400				.134E-01	.168E-01	
-500						
-600						0.
-900						0.
-1200						

MAXIMUM CONCENTRATION = .223E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.388E+00
600	.476E+00
400	.277E+00
200	.821E-01
0	.160E-01

TABLE 8-87

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS. CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = SW WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.202E-02
500						
400				0.	.444E-02	
300						.811E-02
200			.226E-01	.162E-01	.279E-01	
100						
0	.101E+00	.861E-02	.605E-02	.542E-01	.815E-01	.831E-01
-100						
-200			.127E-01	.537E-01	.678E-01	
-300						.634E-01
-400				.431E-01	.319E-01	
-500						
-600						.167E-01
-900						.101E-01
-1200						

MAXIMUM CONCENTRATION = .101E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.212E+01
600	.938E+00
400	.279E+00
200	.122E+00
0	.815E-01

TABLE 8-88

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = SW WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.317E-02	.253E-02	
300						.874E-02
200			.101E-01	.179E-01	.914E-02	
100						
0	.389E-01	.795E-03	.633E-02	.183E-01	.513E-01	.509E-01
-100						
-200			.119E-01	.814E-01	.751E-01	
-300						.995E-01
-400				.163E-01	.350E-01	
-500						
-600						.954E-02
-900						.127E-02
-1200						

MAXIMUM CONCENTRATION = .995E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.175E+01
600	.956E+00
400	.240E+00
200	.807E-01
0	.513E-01

TABLE 8-89

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = SW WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = 500 1000 2000 3000 4000 5000 Y					
1200					
900					0.
600					0.
500					
400			.445E-03	.178E-02	
300					.726E-02
200		.578E-02	.810E-02	.126E-01	
100					
0	.196E-01 0.	0.	.483E-01	.532E-01	.589E-01
-100					
-200		.530E-02	.307E-01	.659E-01	
-300					.703E-01
-400			.109E-01	.276E-01	
-500					
-600					.810E-02
-900					.445E-03
-1200					

MAXIMUM CONCENTRATION = .703E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.558E+00
600	.497E+00
400	.199E+00
200	.751E-01
0	.532E-01

TABLE 8-90

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = SW WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.202E-02
500						
400				.726E-02	.137E-01	
300						.410E-01
200			.456E-01	.360E-01	.451E-01	
100						
0	.630E-01	.208E-01	.242E-01	.119E+00	.245E+00	.289E+00
-100						
-200			.491E-01	.170E+00	.340E+00	
-300						.476E-01
-400				.826E-01	.181E+00	
-500						
-600						0.
-900						.282E-02
-1200						

MAXIMUM CONCENTRATION = .340E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.868E-01
600	.998E+00
400	.152E+01
200	.587E+00
0	.245E+00

TABLE 8-91

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = SW WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.507E-02	.104E-01	
300						.286E-01
200			.237E-01	.199E-01	.481E-01	
100						
0	.146E-01	.139E-01	.117E-01	.660E-01	.138E+00	.137E+00
-100						
-200			.974E-01	.221E+00	.254E+00	
-300						.345E+00
-400				.154E+00	.218E+00	
-500						
-600						.121E+00
-900						.754E-01
-1200						

MAXIMUM CONCENTRATION = .345E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.191E+00
600	.667E+00
400	.820E+00
200	.398E+00
0	.138E+00

TABLE 8-92

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = SW WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.105E-01
500						
400				.623E-02	.296E-01	
300						.681E-01
200			.300E-01	.464E-01	.816E-01	
100						
0	.234E-01	.154E-01	.125E-01	.180E+00	.237E+00	.244E+00
-100						
-200			.127E+00	.267E+00	.311E+00	
-300						.270E+00
-400				.150E+00	.171E+00	
-500						
-600						.575E-01
-900						.289E-02
-1200						

MAXIMUM CONCENTRATION = .311E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.567E-01
600	.237E+00
400	.525E+00
200	.272E+00
0	.237E+00

TABLE 8-93

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = W WIND SPEED (MPH) = 20 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = 500 1000 2000 3000 4000 5000 Y						
1200						
900						0.
600						.291E-01
500						
400				.311E-01	.287E-01	
300						.426E-01
200			.460E-01	.248E-01	.203E-01	
100						
0	.151E+00	.253E-02	0.	.279E-01	.553E-01	.730E-01
-100						
-200			.760E-02	.266E-01	.371E-01	
-300						.529E-01
-400				.912E-02	.258E-01	
-500						
-600						.861E-02
-900						0.
-1200						

MAXIMUM CONCENTRATION = .151E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.259E+01
600	.126E+01
400	.327E+00
200	.109E+00
0	.553E-01

TABLE 8-94

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = W WIND SPEED (MPH) = 20 LOAD = 60 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.260E-01
500						
400				.101E-01	.190E-01	
300						.421E-01
200			.972E-01	.151E-01	.223E-01	
100						
0	.405E-01	.278E-02	.158E-02	.246E-01	.605E-01	.783E-01
-100						
-200			.159E-02	.427E-01	.599E-01	
-300						.801E-01
-400				.258E-01	.485E-01	
-500						
-600						.993E-02
-900						.127E-02
-1200						

MAXIMUM CONCENTRATION = .972E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.116E+01
600	.114E+01
400	.355E+00
200	.155E+00
0	.605E-01

TABLE 8-95

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = W WIND SPEED (MPH) = 20 LOAD = 30 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.156E-02
500						
400				0.	.289E-02	
300						.137E-01
200			.556E-02	.726E-02	.190E-01	
100						
0	.265E-01	.279E-03	0.	.103E-01	.276E-01	.343E-01
-100						
-200			.223E-02	.305E-01	.496E-01	
-300						.701E-01
-400				.201E-01	.299E-01	
-500						
-600						.126E-01
-900						.356E-02
-1200						

MAXIMUM CONCENTRATION = .701E-01
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.411E+00
600	.545E+00
400	.238E+00
200	.662E-01
0	.276E-01

TABLE 8-96

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = W WIND SPEED (MPH) = 30 LOAD = 100 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .225E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.121E-02
500						
400				.145E-01	.726E-02	
300						.228E-01
200			.218E-01	.228E-01	.375E-01	
100						
0	.144E+00	.111E-01	.807E-02	.720E-01	.182E+00	.215E+00
-100						
-200			.233E-01	.108E+00	.191E+00	
-300						.270E+00
-400				.638E-01	.119E+00	
-500						
-600						.755E-01
-900						.121E-01
-1200						

MAXIMUM CONCENTRATION = .270E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.365E+00
600	.139E+01
400	.159E+01
200	.569E+00
0	.182E+00

TABLE 8-97

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME

UNIT NUMBER = ALL WIND ANGLE = W WIND SPEED (MPH) = 30 LOAD = 60 STRATIFICATION = NEUTRAL

STACK HEIGHT (FT) = 300

SOURCE STRENGTH (MICRO GRAMS/SEC) = .134E+10

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						0.
500						
400				.120E-01	.440E-01	
300						.457E-01
200			.136E-01	.262E-01	.167E-01	
100						
0	.364E-01	.795E-03	0.	.397E-01	.104E+00	.198E+00
-100						
-200			.306E-01	.114E+00	.171E+00	
-300						.250E+00
-400				.723E-01	.154E+00	
-500						
-600						.121E+00
-900						.149E-01
-1200						

MAXIMUM CONCENTRATION = .250E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.332E-01
600	.615E+00
400	.832E+00
200	.428E+00
0	.104E+00

TABLE 8-98

WELSH POWER STATION, SARGENT AND LUNDY ENGINEERS, CONCENTRATION = PARTS PER MILLION BY VOLUME
UNIT NUMBER = ALL WIND ANGLE = W WIND SPEED (MPH) = 30 LOAD = 30 STRATIFICATION = NEUTRAL
STACK HEIGHT (FT) = 300
SOURCE STRENGTH (MICRO GRAMS/SEC) = .673E+09

X = / Y	500	1000	2000	3000	4000	5000
1200						
900						0.
600						.600E-02
500						
400				.147E-01	.307E-01	
300						.626E-01
200			.269E-01	.628E-01	.575E-01	
100						
0	.156E-01	.977E-02	.109E-01	.986E-01	.139E+00	.209E+00
-100						
-200			.701E-01	.174E+00	.229E+00	
-300						.294E+00
-400				.112E+00	.150E+00	
-500						
-600						.129E+00
-900						.843E-01
-1200						

MAXIMUM CONCENTRATION = .294E+00
STACK LOCATION, X = -100.00 Y = -33.00

VERTICAL PROFILE AT X = 4000 FEET

HEIGHT	CONCENTRATION
800	.187E+00
600	.181E-01
400	.192E+00
200	.426E+00
0	.139E+00

TABLE 8-99