



CALCULATION COVER SHEET

PROJECT BROWNS FERRY	JOB NO. 19106-926	CALC. NO. M-2	SHEET 1
SUBJECT TOXIC BARGE STUDY		TOTAL NO. OF SHEETS 52	LAST SHEET NO. 286
		DISCIPLINE ENVIRONMENTAL	

CALCULATION STATUS DESIGNATION	PRELIMINARY	COMMITTED	CONFIRMED	SUPERSEDED	CANCELED
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

COMPUTER PROGRAM	SCP	MAP	NCP	NONE	PROGRAM NO(S)	VERSION/RELEASE NO.
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	MAP 126	1

Attachment A - List of Chemicals, 2 sheets
Attachment B - MAP126 computer run for chlorine, 16 sheets
Attachment C - MAP126 computer run for nitrogen, 4 sheets
Attachment D - AREAT computer program, 1 sheet
Attachment E - MAP126 computer run for chlorine safe distance,
11 sheets

No.	Description	By	Date	Checked	Date	Approved	Date	Accepted	Date
0		P. L. W.	5/18/90	AME	5/18/90	AME	5/18/90	RE	5/23/90
REVISIONS									

9008230086 900816
PDR ADOCK 05000259
PDC



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BEPC-2706 Rev. 3-87 (ED-69)

JOB NO.	19106-426	CALC. NO.	M-2	REV. NO.	0	SHEET NO.	28, 28
ORIGINATOR	Y. J. Lin	DATE	5/18/90	CHECKED	<i>[Signature]</i>	DATE	5/18/90

1.0 PROBLEM STATEMENT

The purpose of this calculation is to evaluate control room habitability for the Browns Ferry Nuclear Plant (BFNP) following a potential accident due to the barge shipment of hazardous chemicals on the Tennessee River.

2.0 INPUT DATA

- o List of chemicals barged past the site and the frequency of shipment is obtained from a TVA letter to NRC, dated June 27, 1989 (see Attachment A).
- o The shortest distance between the river (center-line) and the control room air intake = 1816' (Drawing 10E200-01, see Fig. 1).
- o Height of the control room air intake above the river = 635' - 556' = 79' (where 556' is the elevation of the Tennessee River, see Drawing 10N200)
- o Control room air flow rate = 4000 CFM (FSAR, Vol. 5, Fig. 10.12-2)
- o Control room volume = 156,709 ft³ (TVA Cal. No. ND-Q0999-880158 R2, 1988)
- o Joint frequency tables of wind speed, wind direction and atmospheric stability (see Table 1).
- o Chlorine barge dimensions (Telephone conversation with Chlorine Institute in Washington, D.C.):
Each 1200-ton chlorine barge consists of 4 compartments.



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3.0 ASSUMPTIONS

- o Wind blows directly toward the control room air intake (Regulatory Guide 1.78).
- o For chlorine releases, only one of the four compartments is involved in the accident. This assumption satisfies the requirement of Regulatory Guide 1.78.
- o For other chemicals, the entire shipment is involved in the accident. Since the number of compartment is unknown for these barges, this assumption is conservative.
- o For low boiling point chemicals, a higher ambient temperature will result in larger puff size. As a result, in this calculation the maximum river temperature of 95 F (BFN-50-715, Rev. 2) is conservatively assumed to be the ambient temperature (T_a) at the BFN site.
- o It is conservatively assumed that during the accident, the toxic chemical will spill onto the river. The final thickness of the spill is assumed to be 1 cm (NUREG-0570).

4.0 Methods Used

Please note that all equations are taken from NUREG-0570, unless otherwise indicated.

4.1 Evaporation Rates

4.1.1 Normal Boiling Point Liquids

The evaporation rate is estimated by the following formulas:

$$dm/dt = h_d M A(t) (P_s - P_a) / [R (T_s + 273)]$$

$$h_d = 0.037 (D/L) (Re)^{0.8} (Sc)^{1/3}$$

$$A(t) = \pi (r_o^2 + 2t[(gV/\pi)(d_i - d)/d_i]^{1/2})$$



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where

dm/dt = evaporation rate, g/s

h_d = mass transfer coefficient, cm/sec

M = molecular weight, g/mole

$A(t)$ = surface area of a spill, cm^2

P_s = saturation vapor pressure of the liquid at temperature T_s , mmHg

P_a = actual vapor pressure of the liquid in air, mmHg

R = universal gas constant = 1.987 cal/C mole

T_a = ambient temperature, C

D = diffusion coefficient, cm^2/sec

L = characteristic length, cm

Re = Reynold number = Lud/μ

u = wind speed, cm/s

μ = viscosity of air, g/cm sec

Sc = Schmidt number = μ/Dd

d = density of air, g/cm³

d_l = density of the liquid, g/cm³

t = time, sec

g = gravity, cm/sec²

$V_o = \pi r_o^3$

r_o = initial radius of the spill, cm

4.1.2 Low Boiling Point Liquids

For low boiling point liquids, the heat balance in the instantaneous puff formation is given below:

$$m C_p (T_s - T_b) = m_p H_v$$

where

m = total initial mass of the liquid, g

C_p = heat capacity of the liquid, cal/g C

T_b = normal boiling point of the liquid, C

m_p = mass of the instantaneously vaporized liquid, g

H_v = heat of vaporization of the liquid, cal/g



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The vaporization rate of the remaining liquid after instantaneous flashing is given below:

$$dm/dt = A(t) (q_r + q_c + q_d) / H_v$$

where

$$q_r = \text{atmospheric and solar radiation flux, cal/m}^2/\text{sec}$$

$$= q_s + q_a$$

$$q_c = \text{heat flux due to forced convection of air}$$

$$= h_c (T_s - T_b), \text{ cal/m}^2/\text{sec}$$

$$h_c = \text{heat transfer coefficient, cal/m}^2/\text{sec/C}$$

$$= 0.0945 + 1.5577u - 0.0899u^2 + 0.003u^3 \quad (\text{Lin, 1989})$$

$$q_d = \text{heat flux due to water conduction}$$

$$= K_w (T_s - T_b) / [\pi K_w t / d_w C_{pw}]^{1/2}, \text{ cal/m}^2/\text{sec}$$

$$= 205.75 (T_s - T_b) / t^{1/2}$$

where

$$K_w = \text{thermal conductivity of water, cal/cm/sec/C}$$

$$d_w = \text{density of water, g/cm}^3$$

$$C_{pw} = \text{heat capacity of water, cal/g/C}$$

Solar radiation is estimated as:

$$q_s = S (C + 0.0263 P_v^{1/2}) (T_s + 273)$$

where

$$q_s = \text{solar radiation flux, cal/m}^2/\text{sec}$$

$$S = \text{Stefan-Boltzmann constant} = 1.355\text{E-}08 \text{ cal/m}^2 \text{ sec K}^4$$

$$C = 0.735$$

$$P_v = \text{vapor pressure of water at } T_s, \text{ mb}$$

4.2 Diffusion Equations

4.2.1 Normal Boiling Point Liquids

$$X = [Q / (\pi u \sigma_y \sigma_z)] \text{Exp} [(-1/2) (H/\sigma_z)^2]$$

where

$$X = \text{concentration, g/m}^3$$

$$Q = \text{emission rate, g/s}$$

$$\sigma_y, \sigma_z = \text{horizontal and vertical dispersion coefficients, m}$$

$$H = \text{air intake height above the release elevation, m}$$



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4.2.2 Low Boiling Point Liquids

4.2.2.1 Puff Concentration

The chlorine puff concentration outside the air intake are computed using the lower value from the following equations.

$$X_{p1} = Q_1 [7.87 (\sigma_y^2 + \sigma_z^2) (\sigma_z^2 + \sigma_1^2)^{1/2}]^{-1} \text{Exp} [(-1/2) (x-ut)^2 / (\sigma_y^2 + \sigma_1^2)]$$

(Reg. Guide 1.78)

where

X_p = puff concentration, g/m³

σ_1 = initial standard deviation of the puff, m

= $(Q_1 / 7.87 X_0)^{1/3}$ where Q_1 is the puff release quantity, g, and X_0 is the density of the gas at standard conditions, g/m³.

x, z = distance from the puff center in the horizontal alongwind and vertical crosswind directions, respectively, m

$x = D - ut$

D = source-receptor distance

$$X_{p2} = (Q_1 / [6.28 (\sigma_y^2 + \sigma_1^2) H]) \text{Exp} [(-1/2) (x-ut)^2 / (\sigma_y^2 + \sigma_1^2)]$$

(NUREG/CR-3786)

where

H = air intake height, m

For other low boiling point chemicals only the first equation (X_{p1}) is used. The second equation (X_{p2}) (applicable to chlorine only) assumes that the chlorine release will experience an uniform mixing between the air intake height and the grade due to the mechanical turbulence.

4.2.2.2 Plume Concentration

Similarly, for the continuous chlorine release, plume concentrations at air intake height are computed using the lower value from the following equations (Vogle, 1984):



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$$X = Q / [(2\pi)^{1/2} \sigma_y H u]$$

$$X = Q / (\pi u \sigma_y \sigma_z)$$

For other low boiling point chemicals, the dispersion equation used is:

$$X = Q / (\pi u \sigma_y \sigma_z) \text{ Exp } [(-1/2)(H/\sigma_z)^2]$$

4.3 Control Room Build-Up Concentrations

The dilution factor (F) due to the control room air exchange is estimated by:

$$F = 1 - \text{Exp } (-W\tau/V_c)$$

where

W = air flow rate in control room, m³/sec

τ = time duration, sec

V_c = control room free volume, m³

The concentration build-up inside control room (C_r) at time t_i is:

$$C_r(t_i) = C_r(t_{i-1}) + [C_o(t_i) - C_r(t_{i-1})] F$$

where

C_o = concentration at the outside air intake at time t_i

F = dilution factor as defined above

t_{i-1} = previous time, used when defining τ for the dilution factor determination above

4.4 Meandering Factor

Regulatory Guide 1.145 (1982) provides procedures for assessing the consequences of potential offsite accidental releases.

Based on this guide, experimental tests have confirmed the

existence of plume meander during low windspeed conditions and

neutral and stable atmospheric stability conditions. Therefore,

the concentrations estimated in this calculation are adjusted by

the meandering factors (see Fig. 2) as long as the model-

dependent 5 percentile meteorology conditions determined in this



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study satisfy the requirements (the wind speed is less than 6 m/s and the stability class is neutral or stable) as stated in Regulatory Guide 1.145.

5.0 CALCULATIONS

5.1 Low-Boiling-Point Chemicals

The control room concentrations for both liquified chlorine and nitrogen are estimated by a Bechtel MAP-126 computer program. This program estimates concentrations outside and inside the control room air intake for low-boiling-point chemicals. MAP-126 program was developed based on NUREG-0570 and Regulatory Guides 1.78 and 1.95.

Conservatively assuming a transmission coefficient of 0.9, the direct solar radiation (q_s) at a latitude of 34° is estimated to be about 96 cal/m²/sec (Lin, 1989).

The atmospheric radiation is estimated below. Assuming a relative humidity of 80% and an ambient temperature of 95 F, the vapor pressure of water is:

$$P_v = 0.8 \times 42.18 \text{ mmHg} \times 1013 \text{ mb}/760 \text{ mmHg} = 44.97 \text{ mb}$$

Where 42.18 mmHg is the water vapor pressure at 100% relative humidity (Perry, P3-45, 1973).

$$\begin{aligned} q_a &= 1.355\text{E-}08 [0.735 + 0.0263 (44.97)^{1/2}] (273 + 35)^4 \\ &= 111.13 \text{ cal/m}^2\text{-sec} \end{aligned}$$

Regulatory Guide 1.78 requires that wind speed be selected to maximize the 2-minute concentration within the control room. Maximum 2-minute concentrations within the control room for various wind speeds were obtained using the MAP-126 program for the entire spectrum of meteorological conditions presented in Table 1. These maximum concentrations were then ranked in descending order to determine the 5% meteorology and to select



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the associated wind speed. The extremely stable G stability class produces higher 2-minute concentrations within the control room for low-boiling-point chemicals. Results from the MAP-126 program for G stability are presented in Attachment B for reference. The model-dependent 5% meteorology is G stability with a wind speed of 1.1 m/s. Using this 5% meteorology, the chlorine and nitrogen concentrations at the control room intake and in the control room are shown in Attachments B and C, respectively. It should be noted that the MAP-126 program does not consider the meander factor. For G stability and a wind speed of 1.1 m/s, the value of the meander factor is 6 (see Fig. 2). Therefore, the chlorine and nitrogen concentrations reported in Attachments B and C, respectively need to be divided by six.

5.2 Normal-Boiling-Point Chemicals

The atmospheric dilution factor values (X/Q) for the entire spectrum of meteorology (Table 1) are calculated using the formula in Section 4.2.1 and are presented in Table 2. After ranking these X/Q values in the descending order, the 5% meteorology is determined to be D (neutral) stability with a wind speed of 1.1 m/s (see Table 3).

Calculations involving evaporation rate estimates are provided in a spread sheet (see Table 4). A sample calculation is provided below for benzene for verification purposes.

Assuming the entire 1500-ton barge is involved in an accident, the characteristic length of the spill is estimated as:

$$\begin{aligned}\text{Volume} &= 1500 \text{ ton} \times 2000 \text{ lb/ton} \times 453.6 \text{ g/lb} / 0.879 \text{ g/cm}^3 \\ &= 1548.123 \times 10^6 \text{ cm}^3\end{aligned}$$

where 0.879 g/cm³ is the density of liquid benzene (Perry, P. 3-26, 1973).



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$$\begin{aligned} \text{Area} &= 154812.3 \text{ m}^2 = \pi r^2 \quad (\text{the spill thickness} = 1 \text{ cm}) \\ r &= 221.99 \text{ m} \quad L = 2 r = 44397.4 \text{ cm} \end{aligned}$$

The above area is the maximum spill area with a thickness of 1 cm. Before the spill area reaches this maximum size, the time-dependent areas are estimated by a simple computer program "AREAT" (see Attachment D). The AREAT program uses input in Table 4 to estimate the time-dependent areas and then compute the corresponding time-dependent concentrations outside the control room air intake. Another computer program "CRCON" (Bechtel Turkey Point Calculation No. M-26, 1990) uses the output of AREAT as input and produces the buildup concentrations within the control room based on the control room air flow rate and free volume.

Density of the air at 0 C is $1.2928\text{E-}03 \text{ g/cm}^3$ (Perry, 1973), therefore at 95 F, the air density is about:

$$d = 1.2928\text{E-}03 \times 273 / (273 + 35) = 1.1459\text{E-}03 \text{ g/cm}^3$$

$$\begin{aligned} R_e &= L u d / \mu = 44397.4 \times 110 \times 1.1459\text{E-}03 / 170.8\text{E-}06 \\ &= 32764918 \end{aligned}$$

$$D = 0.077 \text{ cm}^2/\text{sec} \text{ (NUREG-0570)}$$

$$S_c = \mu / D d = 170.8\text{E-}06 / (0.077 \times 1.1459\text{E-}03) = 1.936$$

$$\begin{aligned} h_d &= 0.037 (D/L) R_e^{0.8} S_c^{1/3} \\ &= 0.037 (0.077/44397.4) (32764918)^{0.8} (1.936)^{1/3} = 0.082 \text{ cm/sec} \end{aligned}$$

The vapor pressure of benzene at 35 C is about 155.3 mmHg (Perry, p. 3-49, 1973). When the spill area reaches its maximum size, the evaporation rate is:

$$\begin{aligned} dm/dt &= 0.082 \times 78.1 \times 1548123000 \times 155.3 / [(273+35) (62350.4)] \\ &= 80177.4 \text{ g/s} \end{aligned}$$



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1
2
3 Multiplying this evaporation rate by the 5% X/Q value provided in
4 Table 3, the benzene concentration at the control room air intake
5 is estimated as:

6
7
$$X = 80177.4 \times 1.72 \times 10^{-4} = 13.79 \text{ g/m}^3$$

8
9 Under D stability with a wind speed of 1.1 m/s, the meander
10 factor is 2 (see Fig. 2). Thus, the benzene concentration at the
11 air intake is half of the above value, that is 6.9 g/m^3 .

12
13 For comparison purposes, this value is further converted into ppm
14 (use a conversion factor of 24500 and the molecular weight of
15 benzene is 78.1 g/g-mole):

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$$6.9 \times 24500 / 78.1 = 2163 \text{ ppm}$$

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6.0 REFERENCES

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2. Lin, Y.J., Accidental Chemical Releases into the Atmosphere, 6th Joint Conference on Application of Air Pollution Meteorology, American Meteorological Society, 1989.
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8. MAP-126, TOXGAS, User/Theoretical Manual, Rev. 1, Bechtel Power Corporation, Gaithersburg, 1988.
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11. CHRIS, Hazardous Chemical Data, U.S. Coast Guard, 1978.



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12. OSHA Safety and Health Standards, OSHA 2206, 29-CFR-1910, 1983.

7.0 CONCLUSIONS

Chlorine -

The toxicity of chlorine is 15 ppm for 2 minutes (Regulatory Guide 1.78). Results from Attachment B indicates that the chlorine concentrations exceed 19 ppm within the first 15 second inside the control room. The chlorine concentration inside the control room reaches 859 ppm at 2 minutes after the arrival of the puff. A chlorine barge accident (1200 ton) on the Tennessee River will have adverse effects on the control room operators.

As input to a probability study, the MAP-126 program is used to determine a distance at which no adverse effects would occur to the control room operators during a potential chlorine barge accident. At a distance of 5.5 km from the control room (see Attachment E), a 1200-ton chlorine barge accident will produce a buildup concentration of 14.5 ppm within the control room at two minutes after the arrival of the puff.

Nitrogen -

The additional nitrogen concentration inside the control room following a barge accident never exceeds 4829 ppm. Nitrogen is not toxic by itself, the main concern for nitrogen is its asphyxiation effects due to its replacement of oxygen. Oxygen may be diminished to 2/3 of its normal percentage in air before appreciable symptoms develop, and this in turn requires the presence of a simple asphyxiant in a concentration of 33% in the mixture of air and gas (Sax, 1979). Since the maximum nitrogen concentration never exceed 0.5% (< 33%) by volume inside the control room, the nitrogen barge (2400 ton) accident will not cause any adverse effects on the control room operators.



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Xylene -

The toxicity limit for xylene is 400 ppm (Reg. Guide 1.78); however, the maximum xylene concentration at the control room air intake is about 195 ppm (see Table 4) after a xylene barge accident. This maximum concentration is estimated assuming the spill area instantaneously reaches its maximum; thus, no time-dependent spill area is computed. As a result of this small concentration, no adverse effects are expected on the control room operators. Thus, the time-dependent buildup concentrations inside the control room are not examined.

Benzene -

The maximum benzene concentration at the control room air intake is about 2169 ppm (see Table 4). This concentration exceeds the benzene toxicity limit of 50 ppm (Reg. Guide 1.78). NRC requires that a toxic chemical's buildup concentration inside a control room should not be greater than the toxicity limit within 2 minutes after the detection of the chemical so that the control room operators have enough time to don breathing apparatus (Reg. Guide 1.78). Thus, the buildup concentrations within the control room are estimated using the AREAT and CRCON computer programs. As stated in Section 5.2, the AREAT program is used to estimate concentrations outside the control room intake, and the CRCON program is used to estimated buildup concentrations within the control room (see Fig. 3).

The benzene odor threshold value is 4.68 ppm (CHRIS, 1978). The control room operators should be able to smell this pollutant about 77 seconds after the arrival of the plume (see Fig. 3). The buildup concentration will not reach the toxicity limit before $t = 818$ seconds, which is more than 12 minutes after the detection of the smell. As a result, the operators will have sufficient time to don the breathing apparatuses. Therefore, a benzene barge accident (1500 ton) will have insignificant effects on the control room operators.



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Ethyl benzene-

NRC does not provide a toxicity limit for this chemical. The maximum ethyl benzene concentration at the control room air intake is estimated to be 252 ppm (see Table 4). This value is higher than a threshold limit value (TLV) of 100 ppm for a 8-hour weighted average (CHRIS, 1978). The TLV is defined as the concentration of the substance in air that can be breathed for 5 consecutive 8-hour workdays by most people without adverse effect (CHRIS, 1978).

The odor threshold value for ethyl benzene is 140 ppm (CHRIS, 1978); therefore, the control room operator will be able to detect this chemical about 103 minutes after the arrival of the plume (see Fig. 4). At 2 minutes after the detection, the buildup concentration is about 141 ppm. Although no data are available regarding the effect of chronic exposure, it has been found that a concentration of 1000 ppm causes irritation to human eyes, and a concentration of 2000 ppm is extremely irritant at first, then causes dizziness (Sax, 1979). These toxic concentrations are extremely high comparing to the 2-minute (after detection) buildup concentration (141 ppm) that may occur within the control room. The control room operators are expected to have sufficient time to don the breathing apparatuses. Thus, an ethyl benzene barge (1500 ton) accident is not expected to have significant adverse effects on the control room operators.

Toluene -

The NRC does not provide a toxicity limit for this chemical. The maximum toluene concentration is estimated to be 759 ppm at the control room air intake (see Table 4). The TLV of this chemical is 200 ppm (OSHA, 1983), and the odor threshold value is 0.17 ppm (CHRIS, 1978). Because of this low odor threshold value, Figure 5 shows that the control room operators are able to detect this chemical almost instantly upon the arrival of the plume. Within



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two minutes, the buildup concentration is only about 4.4 ppm (see Fig. 5). Therefore, the operators have sufficient time to take the proper actions. Thus, a toluene barge (1500 ton) accident will not have adverse effects on the control room operators.

Vinyl Acetate -

The NRC does not provide a toxicity limit for this chemical. The maximum vinyl acetate concentration is estimated to be 3125 ppm at the control room air intake (see Table 4). This concentration exceeds a TLV of 10 ppm (CHRIS, 1978).

The odor threshold value for vinyl acetate is 0.12 ppm (CHRIS, 1978). Because of this low odor threshold value, the operators are able to smell this chemical almost instantly upon the arrival of the plume (see Fig. 6). Fig. 6 also shows that at time $t = 104$ seconds the buildup concentration within the control room reaches the TLV value (10 ppm). Although no other limits for health effect have been found for this chemical, comparing the concentration during an accident to a TLV is very conservative. Since within two minutes of detection the buildup concentration is about 13 ppm (see Fig. 6), slightly above the conservative long-term TLV value of 10 ppm, it is believe that the operators have sufficient time to react and don protective equipment without adverse effects.

Styrene -

The NRC does not provide a toxicity limit for this chemical. The maximum styrene concentration is estimated to be about 74 ppm at the control room air intake (see Table 4). This value is less than a long-term TLV of 100 ppm (CHRIS, 1978); thus, no adverse effects are expected on the control room operators during a 2000-ton barge accident. Because of this low control room outside concentration, the estimate of the concentration within the control room is not necessary.



CALCULATION SHEET

BEPIC-2706 Rev. 3-87 (ED-6)

JOB NO	19106 426	CALC NO.	M-2	REV NO	0	SHEET NO.	178 28
ORIGINATOR	Y. J. LIN	DATE	5/18/90	CHECKED	YML	DATE	5/18/90

Acrylonitrile -

The maximum acrylonitrile concentration at the control room air intake is estimated to be 7584 ppm (see Table 4). This value exceeds the toxicity limit of 40 ppm (Reg. Guide 1.78).

The odor threshold value of acrylonitrile is 21.4 ppm (CHRIS, 1978). Fig. 7 shows that the operators are able to smell the buildup of this chemical at $t = 207$ seconds after the arrival of the plume. It takes about three more minutes (at $t = 380$ seconds) for the buildup concentration to reach the toxicity limit (40 ppm). Therefore, the control room operators have time to don protective equipment.

Other Chemicals -

Chemicals that are transported on the Tennessee River (see attachment A) and are not considered in this study are: nitrogenous fertilizers, ethanol, residual fuel oil, caustic soda, urea, potash, and sulphate potash. The rationale for not including these chemical in this calculation is provided as follows:

Nitrogenous fertilizers -

The case of the 2400-ton nitrogen barge envelopes this case.

Ethanol -

Although ethanol possesses narcotic properties, concentrations sufficient to produce this effect are not reached in industrial feedstocks (Sax, 1979). The same reference states that exposure to concentration of 5,000-100,000 ppm results in irritation of the eyes and mucous membranes of the upper respiratory tract. Judging by the chemical properties (i.e., vapor pressure and diffusion coefficient) of ethanol, a 1500-ton ethanol barge accident is not expected to produce a concentration above 5,000 ppm outside the control room air intake; thus, ethanol was not considered in this study.



CALCULATION SHEET

JOB NO.	19106-426	CALC. NO.	M-2	REV. NO.	0	SHEET NO.	18 of 22
ORIGINATOR	Y. J. Lin	DATE	5/18/90	CHECKED	YMF	DATE	5/19/90

Residual fuel oil -

No TLV is available for fuel oil (CHRIS, 1978). It is toxic only through oral routes (CHRIS, 1978); thus, poses no threat to the control room operators during a barge accident.

Caustic soda -

Usually transported as 50% solution or in solid form. No TLV is available for this chemical (CHRIS, 1978). Additionally, this chemical is toxic only through oral routes (CHRIS, 1978). Thus, caustic soda barge is not a concern for the control room operators.

Urea -

No TLV is available and no hazard label required by Code of Federal Regulations during transportation (CHRIS, 1978).

Potash and Sulphate potash -

Same reason as urea.



CALCULATION SHEET

BEP-2706 Rev. 3-87 (ED-49)

JOB NO. 19106-426	CALC NO. M-2	REV NO. 0	SHEET NO. 18a 228
ORIGINATOR Y. J. LIN	DATE 5/18/90	CHECKED JMS	DATE 5/19/90

Supplementary information -

By the project's request, the maximum buildup concentrations within the control room for toluene and vinyl acetate are to be determined and presented. For this purpose, the entire histories of the time-dependent concentrations are presented in curves until the spill is completely evaporated.

Toluene -

The buildup concentration of toluene reaches the TLV (200 ppm) at 29 minutes after the arrival of the plume. As stated in Sheet 17, it is very conservative to compare a short-term concentration to a long-term (5 consecutive 8-hour workdays) based TLV.

Toluene has a short-term inhalation limit of 600 ppm for 30 minutes (CHRIS, 1978). Additionally, at 200-500 ppm, headache and impairment of coordination and reaction time are reported, but are not usually accompanied by any laboratory or physical findings of significance (Sax, 1979).

The buildup concentrations within the control room stabilizes at a maximum of 411 ppm between 4.5 hours and 11.4 hours after the arrival of the plume (see Fig. 8). The entire spill will be vaporized within about 11 hours and 23 minutes. Therefore, the concentration within the control room starts to decrease after that time. Thus, the maximum concentration within the control room never exceeds the maximums stated by CHRIS (600 ppm) and Sax (500 ppm). In addition, the river flow will carry the spill out of the zones that will have potential impact on the Browns Ferry plant site. The river velocity at Browns Ferry (where the reservoir is wide and the slope of the water surface is small) is only about 0.3 ft/sec during summer months (BFNP FSAR 2.4-3). During other months and at other section of the river, the river velocity is higher. Using this lowest river velocity of 0.3 ft/sec, it takes only about 32.9 minutes for the toluene plume with a width of 177.6 m to be carried beyond the control room air intake. A plume width of 177.6 m is estimated by the standard



CALCULATION SHEET

DEPC-2706 Rev. 3-87 (ED-69)

JOB NO.	19106-426	CALC NO.	M-2	REV NO.	0	SHEET NO.	186228
ORIGINATOR	Y. J. LIN	DATE	5/18/90	CHECKED	JMS	DATE	5/18/90

deviation of the plume (41.3 m, see Table 4) under D stability class. This plume width is obtained by multiplying the standard deviation by a factor of 4.3. Therefore, in theory, the plume will not impact the control room air intake 32.9 minutes after the occurrence of the accident. It should be noted that the estimate is very conservative. The calculation assumes that the control room air intake is receiving the plume centerline concentration during the entire episode. In reality, as a result of the river velocity, the plume centerline will be moving at the same speed parallel to the control room air intake. Thus, the plume centerline concentration will not impact the air intake continuously.

Vinyl Acetate -

As stated in Sheet 16, the concentration of vinyl acetate within the control room reaches the TLV (10 ppm) at 104 seconds after the arrival of the plume. The comparison of the short-term concentration to a TLV is conservative. The concentration within the control room stabilizes at about 57 ppm at 160 minutes after the arrival of the plume (see Fig. 10). Since the entire spill vaporizes 3.9 hours after the accident, the buildup concentration starts to decrease after that. Similarly, the plume will be carried away by the river flow within 32.9 minutes after the accident (see discussion for toluene). Therefore, the maximum concentration within the control room (57 ppm) could not be expected to be maintained more than 32.9 minutes.



CALCULATION SHEET

JOB NO.	19106-426	CALC NO.	M-2	REV NO.	C
ORIGINATOR	Y. J. Lin	DATE	5/18/90	CHECKED	SM/S
				DATE	5/18

Table 1

JOINT PERCENTAGE FREQUENCIES OF WIND SPEED BY STABILITY CLASS

BROWN FERRY NUCLEAR PL

JAN 1, 77 - DEC 31, 79

WIND SPEED (MPH)	STABILITY CLASS					
	A	B	C	D	E	F
CALM	0.0	0.0	0.0	0.00	0.01	0.01
0.0-1.4	0.0	0.0	0.0	0.05	0.00	0.50
1.5-3.4	0.00	0.34	0.50	5.77	10.41	0.48
3.5-7.4	2.29	2.11	1.52	0.77	0.77	4.03
7.5-12.4	1.19	1.00	1.04	0.62	0.55	1.99
12.5-18.4	0.90	1.63	1.22	0.89	4.50	0.90
18.5-24.4	0.62	0.07	0.33	3.36	0.70	0.04
24.5-30.4	0.62	0.06	0.06	0.46	0.07	0.01
30.5-36.4	0.0	0.0	0.0	0.03	0.0	0.0
36.5-42.4	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	4.91	9.61	4.07	32.55	31.09	12.96

TOTAL HOURS OF VALID STABILITY OBSERVATIONS
TOTAL HOURS OF VALID WIND DIRECTION-WIND SPEED STABILITY OBSERVATIONS
TOTAL HOURS OF OBSERVATIONS
JOINT RECOVERABILITY PERCENTAGE

25935
25977
26806
97.3

METEOLOGICAL FACILITY: MET FACILITY LOCATED ABOUT 0.9 MI ESE OF BROWN FERRY NUCLEAR PLANT
STABILITY BASED ON LAPSE RATE MEASURED BETWEEN 10.03 AND 45.30 METERS
WIND SPEED AND DIRECTION MEASURED AT THE 10.00 METER LEVEL

DATE PRINTED: 10



CALCULATION SHEET

JOB NO.

19106-426

CALC NO.

M-2

REV NO.

0

SHEET NO.

2082

ORIGINATOR

T. J. Lids

DATE

5/18/90

CHECKED

JML

DATE

5/18/90

Table 2

BFNP CONTROL ROOM X/Q (NORMAL BOILING POINT CHEMICALS)

Stab.	Sigma y	Sigma z	Wind Speed (m/s)						
			0.45	1.1	2	2.2	4.4	6.9	9.6
A	113.7	166.9	3.69E-05	1.51E-05	8.30E-06	5.72E-06	3.77E-06	2.41E-06	1.73E-06
B	84.4	63.3	1.22E-04	5.01E-05	2.75E-05	1.90E-05	1.25E-05	7.98E-06	5.74E-06
C	58.6	37.3	2.63E-04	1.08E-04	5.92E-05	4.08E-05	2.69E-05	1.72E-05	1.23E-05
D	41.3	20.3	4.19E-04	1.72E-04	9.44E-05	6.51E-05	4.29E-05	2.74E-05	1.97E-05
E	30.3	14.0	3.84E-04	1.57E-04	8.63E-05	5.95E-05	3.92E-05	2.50E-05	1.80E-05
F	21.3	8.4	6.67E-05	2.73E-05	1.50E-05	1.04E-05	6.83E-06	4.35E-06	3.13E-06
G	14.5	5.1	1.49E-07	6.08E-08	3.34E-08	2.31E-08	1.52E-08	9.69E-09	6.96E-09

Table 3

5% METEOROLOGY

FOR NORMAL BOILING POINT CHEMICALS

X/Q	STAB.	u (m/s)	F (%)	CF (%)
4.19E-04	D	0.45	0.05	0.00
3.84E-04	E	0.45	0.68	0.73
2.63E-04	C	0.45	0.00	0.73
1.72E-04	D	1.10	5.77	6.50

F - frequency

CF - cumulative frequency

5% meteorology = D stability, u = 1.1 m/s



CALCULATION SHEET

JOB NO.

19106-426

CALC NO.

M-2

REV NO.

0

SHEET NO.

21823

ORIGINATOR

Y. J. Lin

DATE

5/18/90

CHECKED

JML

DATE

5/18/90

Table 4

BFNP CONTROL ROOM CONCENTRATIONS AT INTAKE DUE TO POTENTIAL TOXIC BARGE ACCIDENTS

Chemical	Q (ton)	Mt	A (m ²)	L (cm)	Re	D (cm ² /s)	Sc	hd (cm/s)	Vp (mmHg)	dm/dt (g/s)	X (g/m ³)	X (ppm)	Limit (ppm)
Xylene	1500	106.2	158233	44885	33124956	0.0660	2.26	0.074	15.2	9846.7	8.47E-01	195.4	400
Benzene	1500	78.1	154812	44397	32764918	0.0770	1.94	0.082	155.3	80396.0	6.91E+00	2168.9	50
Ethyl Benzene	1500	106.2	156955	44704	32990915	0.0810	1.84	0.085	17.2	12679.5	1.09E+00	251.6	100
Toluene	1500	92.1	157136	44729	33009932	0.0924	1.61	0.093	47.5	33187.6	2.85E+00	759.2	200
Vinyl Acetate	2000	86.1	194678	49787	36742205	0.0800	1.86	0.082	177.5	127714.6	1.10E+01	3125.4	10
Styrene	2000	104.1	200930	50580	37327523	0.0142	10.50	0.024	13.0	3675.0	3.16E-01	74.4	100
Acrylonitrile	4000	53.1	447448	75479	55702933	0.0990	1.51	0.087	176.7	191139.3	1.64E+01	7584.4	40

Notes:

A meandering factor of 2 is considered in estimating the concentrations.

The site meteorology is D (neutral) stability with a wind speed of 1.1 m/s.

Mt - molecular weight A - spill area L - characteristic length

Re - Reynold number Sc - Schmidt number D - diffusion coefficient

Vp - vapor pressure dm/dt - evaporation rate

hd - mass transfer coefficient

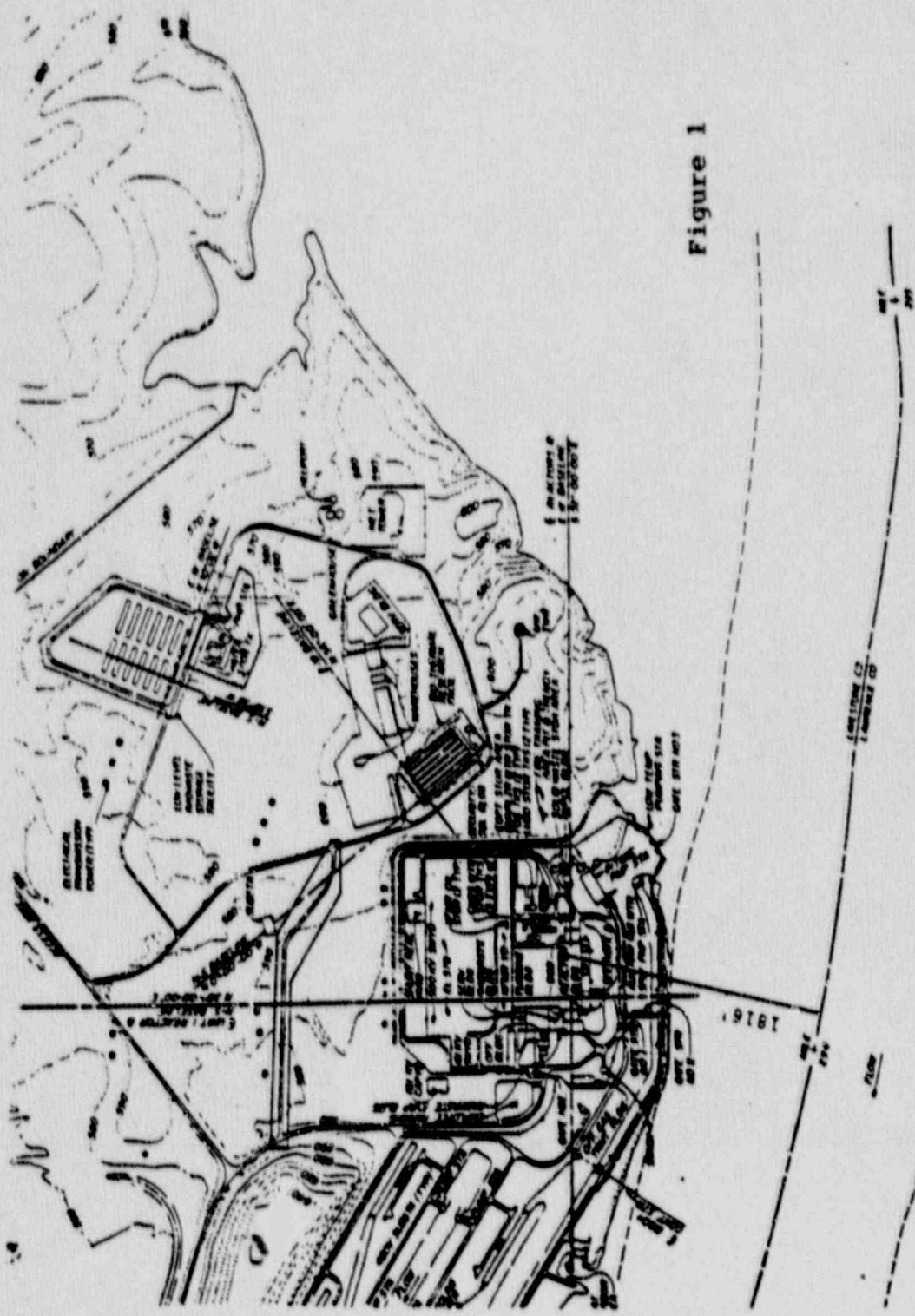
X - maximum concentration outside the control room air intake



CALCULATION SHEET

JOB NO.	19106-426	CALC. NO.	M-2	REV. NO.	0	SHEET NO.	22 of 28
ORIGINATOR	Y. J. Lin	DATE	5/18/90	CHECKED	JMS	DATE	5/18/90

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Scale: 1 inch = 100 feet
Drawing is not to scale
Drawing is not to scale

REMARKS: THIS DRAWING IS FOR INFORMATION ONLY. IT IS NOT TO BE USED FOR CONSTRUCTION. IT IS NOT TO BE USED FOR CONSTRUCTION. IT IS NOT TO BE USED FOR CONSTRUCTION.



CALCULATION SHEET

JOB NO.	19106-426	CALC. NO.	M-2	REV. NO.	0	SHEET NO.	258
ORIGINATOR	Y. J. Lin	DATE	5/18/90	CHECKED	DMF	DATE	5/18/90

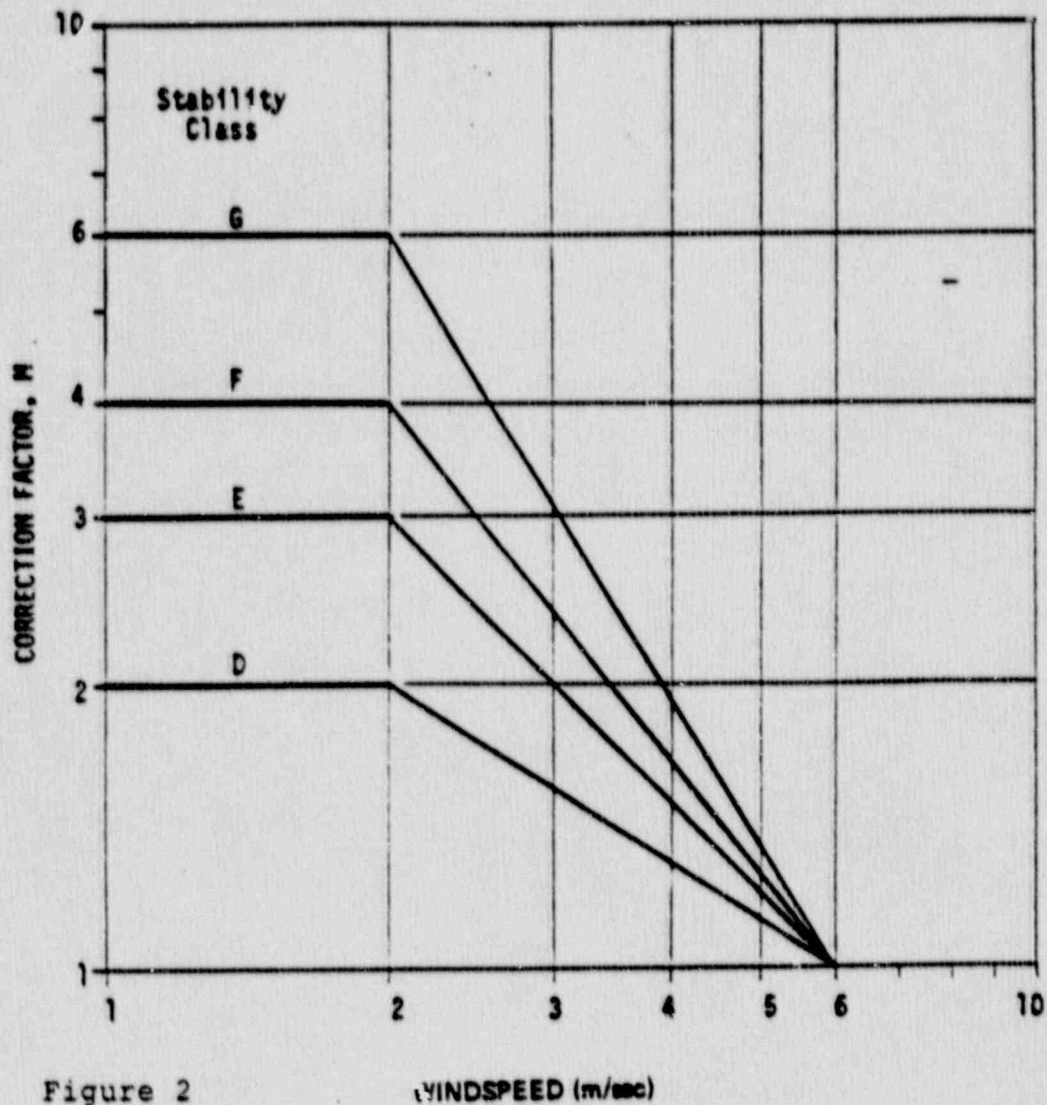


Figure 2

Correction factors for c_y values by atmospheric stability class



CALCULATION SHEET

JOB NO.	19106-426	CALC NO.	M-2	REV NO.	0	SHEET NO.	2480
ORIGINATOR	R. J. Lins	DATE	5/18/90	CHECKED	SMF	DATE	5/18/90

CONTROL ROOM BUILDUP CONCENTRATIONS FLOW RATE • 4000 CFM

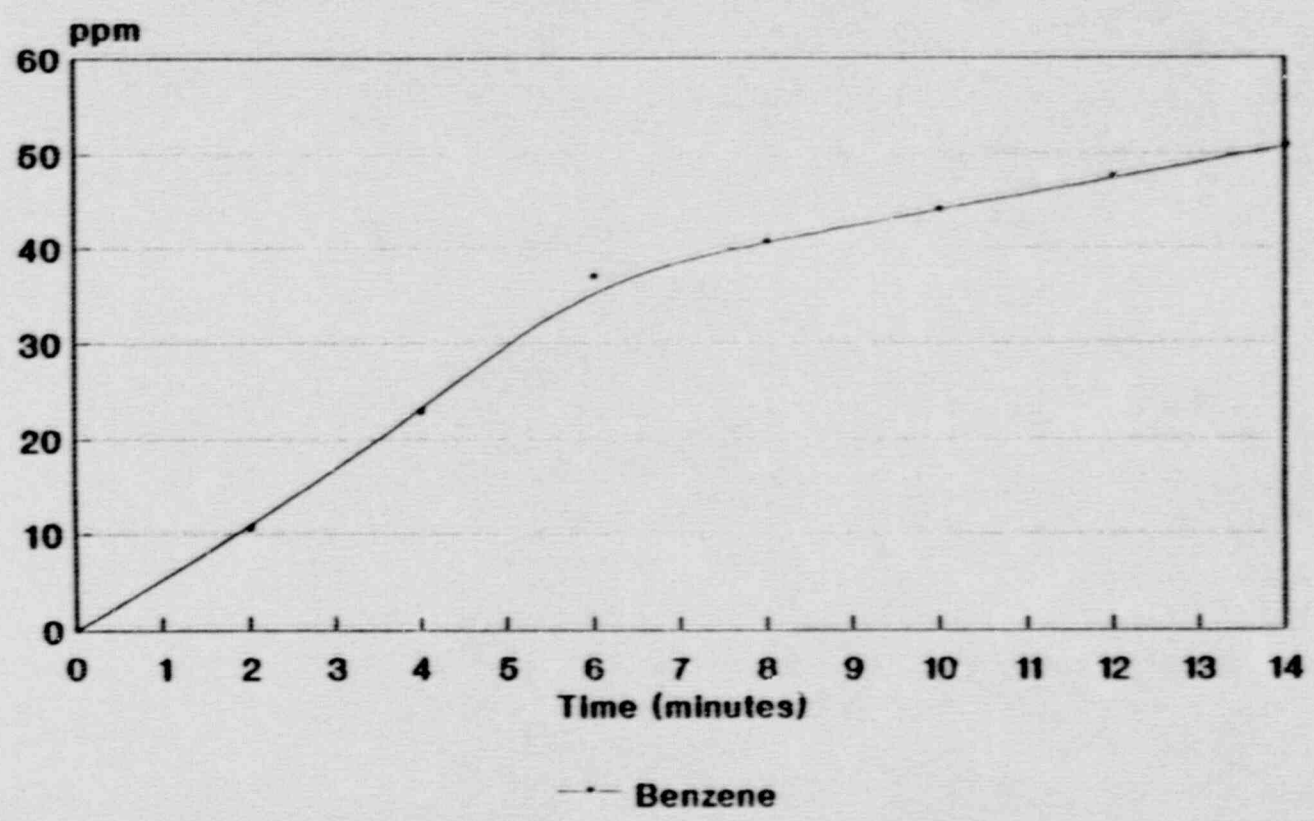


Figure 2



CALCULATION SHEET

JOB NO	19108-426	CALC NO	M-2	REV NO	0	SHEET NO	2522
ORIGINATOR	T. J. Lin	DATE	5/18/90	CHECKED	2/11/90	DATE	5/18/90

CONTROL ROOM BUILDUP CONCENTRATIONS NORMAL FLOW RATE • 4000 CFM

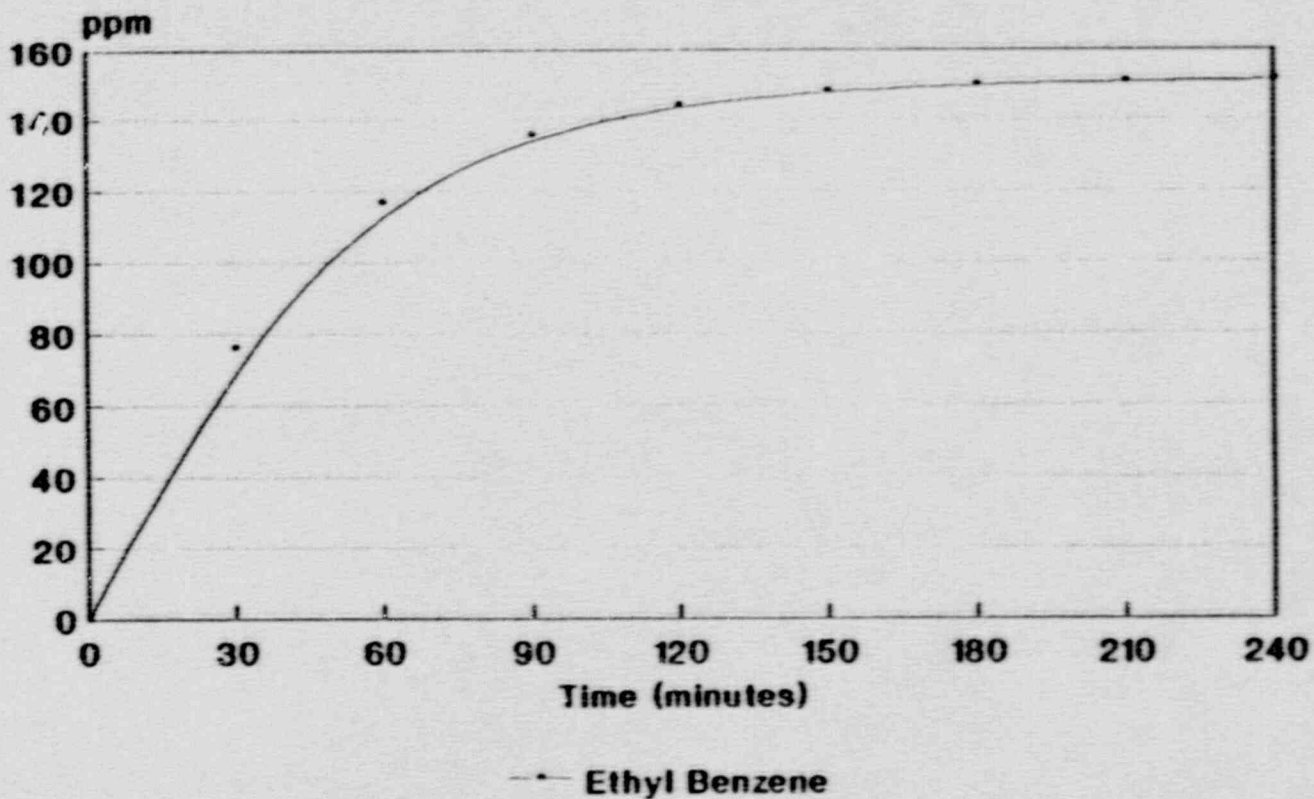
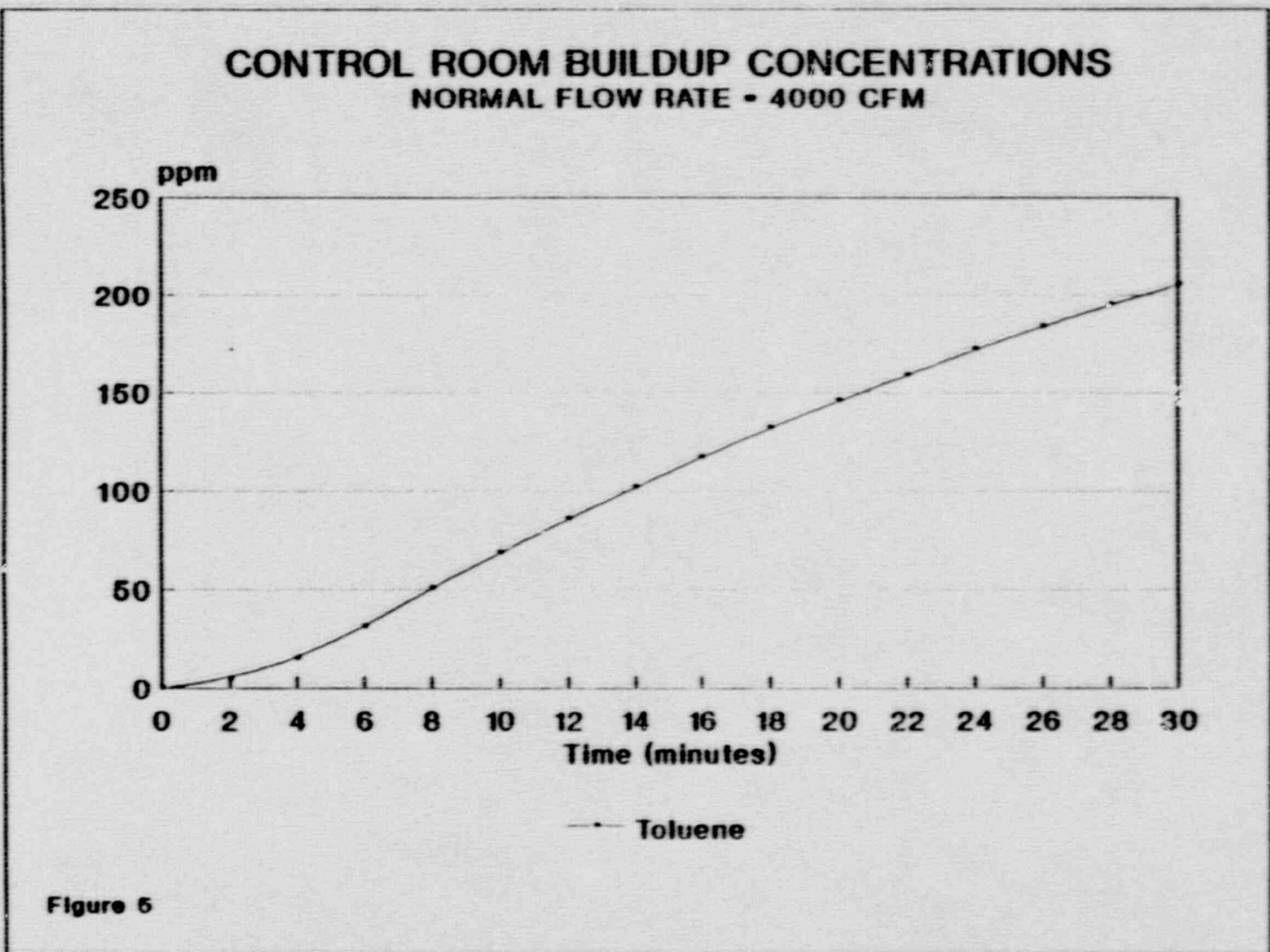


Figure 4



CALCULATION SHEET

JOB NO	19106-426	CALC NO	M-2	REV NO	0	SHEET NO	2682
ORIGINATOR	R. J. Lins	DATE	5/18/90	CHECKED	MM	DATE	5/18/90





CALCULATION SHEET

JOB NO.	19166-426	CALC NO.	M-2	REV NO.	0	SHEET NO.	2722
ORIGINATOR	Y. J. Lin	DATE	5/18/90	CHECKED	SMB	DATE	5/18/90

CONTROL ROOM BUILDUP CONCENTRATIONS NORMAL FLOW RATE • 4000 CFM

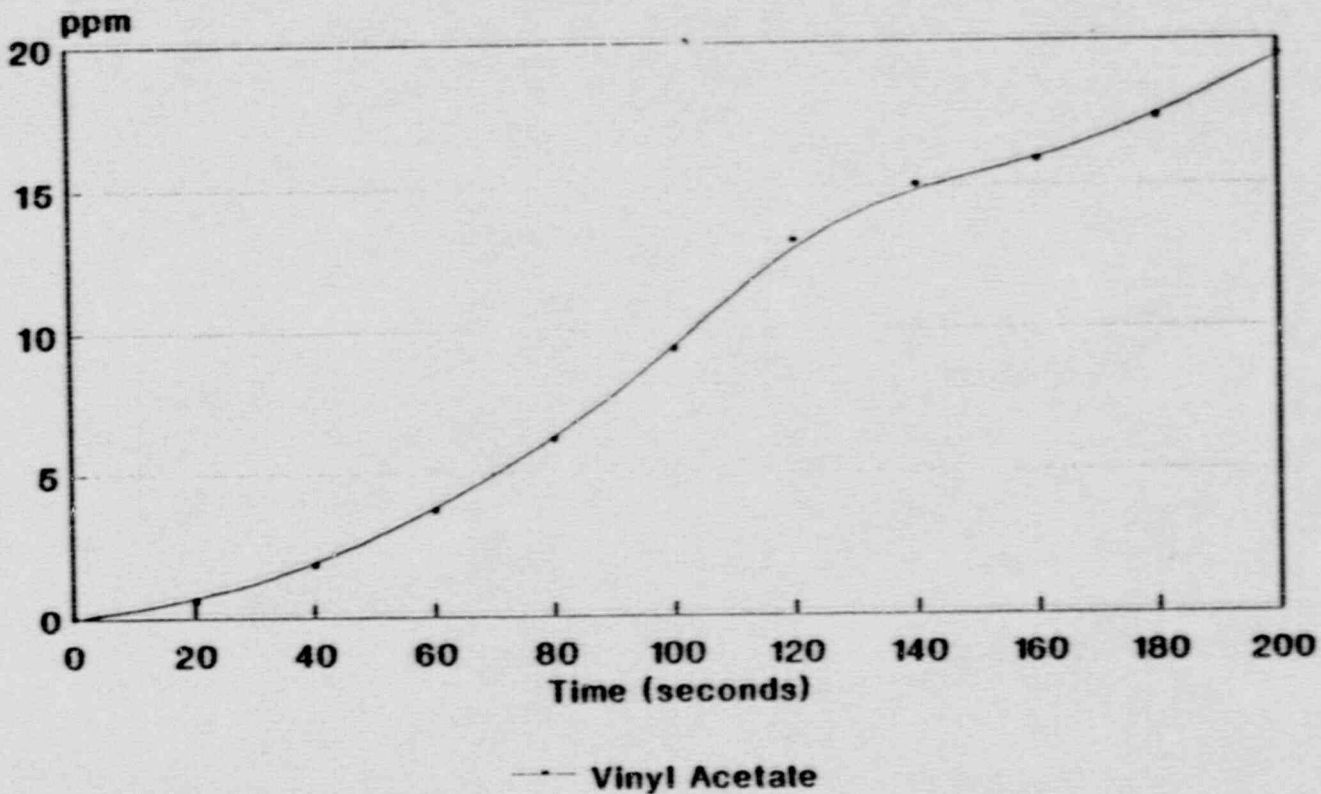


Figure 6



CALCULATION SHEET

JOB NO.	19106-426	CALC. NO.	M-2	REV. NO.	0	SHEET NO.	28 of 2
ORIGINATOR	T. J. Lin	DATE		CHECKED	gmj	DATE	5/15/90

CONTROL ROOM BUILDUP CONCENTRATIONS NORMAL FLOW RATE = 4000 CFM

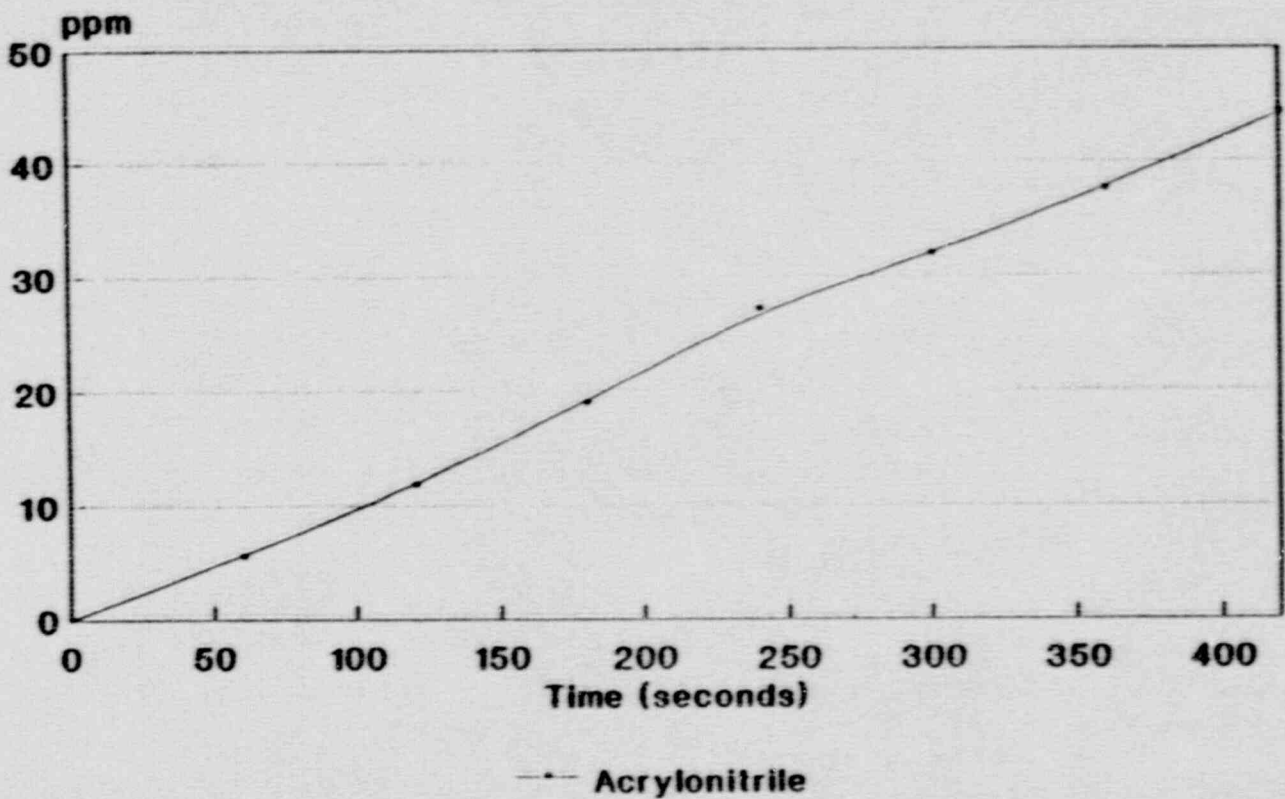


Figure 7



CALCULATION SHEET

BEPC-2706 Rev. 3-87 (ED-6)

JOB NO.	19104-426	CALC NO.	M-2	REV NO.	0	SHEET NO.	282
ORIGINATOR	R. J. Lind	DATE	5/18/90	CHECKED	RMH	DATE	5/18/90

CONTROL ROOM BUILDUP CONCENTRATIONS FLOW RATE = 4000 CFM

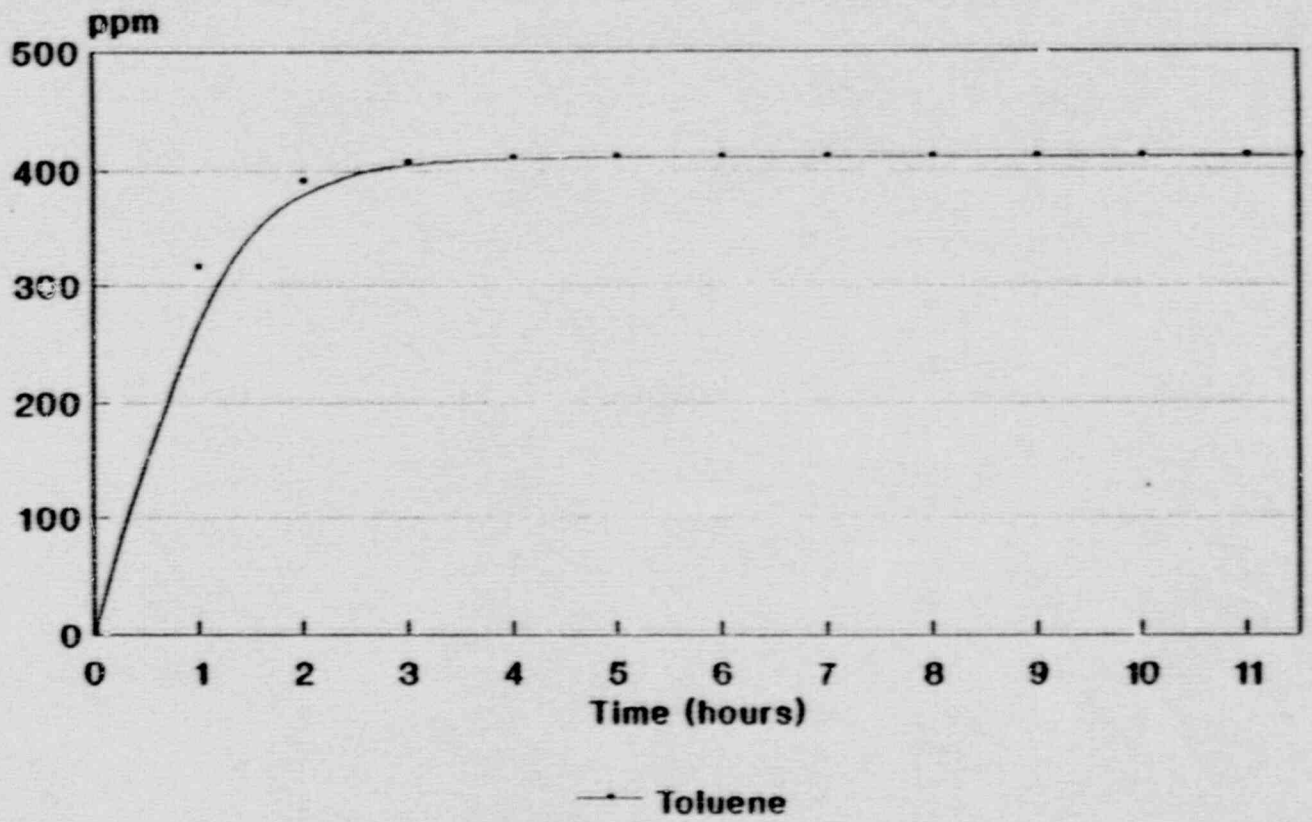


Figure 8



CALCULATION SHEET

BE PC-2706 Rev. 3-87 (ED-69)

JOB NO	19104-426	CALC NO	M-2	REV NO	0	SHEET NO	286
ORIGINATOR	T. Linn	DATE	5/18/90	CHECKED	gmm	DATE	5/18/90

CONTROL ROOM BUILDUP CONCENTRATIONS FLOW RATE = 4000 CFM

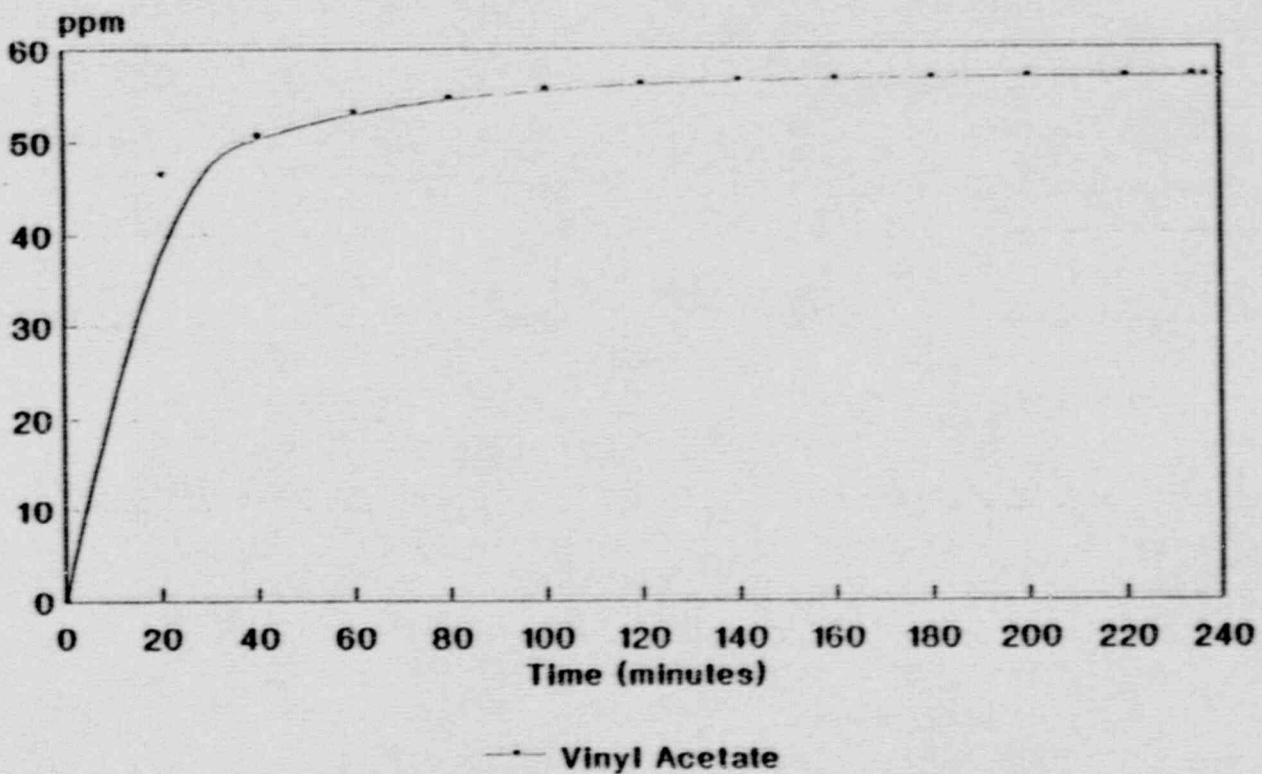


Figure 9

ATTACHMENT A
(2 pages)

PRESENT HAZARDOUS RIVER TRAFFIC COMMODITIES
THAT PASS BROWNS FERRY NUCLEAR PLANT
1989

1. Dock A - Decatur, Alabama

Commodities handled. Nitrogenous Chemical Fertilizers (Potash, Urea)
Ethanol, Crude Coal Tar, and Residual Fuel Oil, Creosote
Fertilizers - 8 barges annually (4 in Spring, 4 in Fall of year).
Residual Fuel Oil - 1 barge every 5-6 months at 1500 tons per barge
Ethanol - 1 barge every month at 1500 tons per barge
Crude Coal Tar - 1 barges every two months, creosote, 1 barge every
3 months.

2. Dock B - Decatur, Alabama

Commodities handled - Xylene, Flammable liquid, Heavy Aromatics,
(combustible liquid) e.g., ethylbenzene, xylene
Light Aromatics, (flammable liquid) e.g. Benzene, Ethylbenzene,
Toluene, Xylene
Fuel oil No. 6.
Xylene - total 216,000 tons
Fuel Oil No. 6 total 12,000 tons
Heavy Aromatics 30,000 tons
Light Aromatics 90,000 tons

Estimation of quantities and frequency

Xylene, 4 barges a tow at 1500 tons a barge 36 tows per year
Heavy Aromatics, 2 barges a tow at 1500 tons a barge 10 tows per
year
Light Aromatics, 3 barge tow at 1500 tons a barge 20 tows per year
Fuel Oil No 6, 2 barge tow at 1500 tons a barge 4 tows per year

3. Dock C - Decatur, Alabama

Commodities handled - Chemical Fertilizers (Potash) and Nitrogen solution
Total - 7,500 tons
Nitrogen solution - 1 barge every 5 months at 2,400 tons per barge
Fertilizer - 1 barge every 5 months at 1500 tons per barge

4. Dock D - Decatur, Alabama

Commodities handled - Acrylonitrile, Vinyl Acetate and Styrene
Total - 230,000 tons
Acrylonitrile - 3 barges every 24 days at 4,000 tons per barge
Vinyl Acetate and Styrene - 1 barge every month at 4,000 tons per barge
(2,000 tons of each chemical).

5. Dock E - Stevenson, Alabama

Commodities handled - Residual Fuel Oil
Total - 45,000 tons
Residual Fuel Oil - 4 barges every seven weeks at 1500 tons per barge
(maximum)

-2-

6. Dock F - Chattanooga, Tennessee

Commodities handled - Residual Fuel Oil

Total - 234,000 tons

Residual Fuel Oil - 4 barges every two weeks at 2,000 tons per barge -
maximum delivery has been 8 barges

7. Dock G - Chattanooga, Tennessee

Commodities handled - Vegetable Oil

Vegetable Oil - 4 barges every month at 1,500 tons per barge maximum
total barges a year - 57

8. Dock H - Chattanooga, Tennessee

Commodities handled - Residual Fuel Oil

Total - 7,500 tons

Residual Fuel Oil - 1 barge every 3 months at 1,500 tons per barge

9. Dock I - Charleston, Tennessee*

Commodities handled - Chlorine, Caustic soda

Total Chlorine barges annually - 30

1 barge at 1,200 tons per barge every 2 weeks

Caustic soda - 18 barges annually

1 barge every 3-4 weeks at 1,500 ton per barge

10. Dock J - Lenoir City, Tennessee

Commodities handled - Urea, Phosphate, Potash, Sulphate Potash

Total - 31,500 tons

Urea - 6 barges a year (3 in Spring, 3 in Fall of year) at 1,500 tons
barge

Potash - 1 barge every two months at 1,500 tons per barge

Phosphate - 1 barge every two months at 1,500 tons per barge

Sulphate Potash - 1 barge every four months at 1,500 tons per barge.

11. Dock K - Knoxville, Tennessee

Commodities handled - Residual Fuel Oil

Residual Fuel Oil - 2 barges every 3 months at 1,500 tons per barge

*Chlorine shipments from Charleston, Tennessee are not reflected in Corps of
Engineers' WCSC data table.

0160E

Calc 1/4 M-2

ATTACHMENT B

(16 pages)

PROGRAM TOXGAS - MAP126(REV. 1)

 * Copyright 1988, Bechtel Power Corporation. *
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TOTAL QUANTITY(KG)= 272160.0 T(C)= 35.0 TB(C)= -34.10
 HV(CAL/G)= 68.8 CP(CAL/G*C)= .226
 LIQ DENSITY(G/CM**3)= 1.570 GAS DENSITY(G/M**3)= 3220.40
 AIR DENSITY(G/CM**3)=.0011459

INITIAL SIGMA(M)= 13.5 SOLAR RAD.(CAL/M**2-S)= 96.0
 ATMOSPHERIC RAD.=111.1 VOLUME OF THE SPILL(CM**3)=134002300.0
 CONTROL ROOM AIR INTAKE HEIGHT ABOVE THE GRADE(M)= 24.08

PUFF Q(KG)= 61776.36 PLUME Q(KG)= 210383.60
 MAX. AREA(M**2)= 13400.23 MOLECULAR WT.(G/MOLE)= 70.9

NO. OF DIST= 1 DIST(M)= 554.
 STABILITY=7 NO. OF WIND SPEED= 4
 SPEEDS(M/S)= .45 1.10 2.00 2.90

DISTANCE(M)= 554. SIGMA Y(M)= 14.0 SIGMA Z(M)= 5.4

PUFF CENTER ARRIVAL TIME(SEC)= 1231 PUFF FRONT LEADS PLUME 92.7 SEC
 WIND SPEED(M/S)= .45

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(FPM)
-----------	------	-------	------------

DIMENSION ARRAY EXCEEDS LIMIT

1139	.128026E+05	.000000E+00	.128026E+05
1144	.162880E+05	.000000E+00	.162880E+05
1149	.204457E+05	.000000E+00	.204457E+05
1154	.253221E+05	.000000E+00	.253221E+05
1159	.309432E+05	.000000E+00	.309432E+05
1164	.373074E+05	.000000E+00	.373074E+05
1169	.443803E+05	.000000E+00	.443803E+05
1174	.520896E+05	.000000E+00	.520896E+05
1179	.603222E+05	.000000E+00	.603222E+05
1184	.689238E+05	.000000E+00	.689238E+05
1189	.777009E+05	.000000E+00	.777009E+05
1194	.864269E+05	.000000E+00	.864269E+05
1199	.948499E+05	.000000E+00	.948499E+05
1204	.102705E+06	.000000E+00	.102705E+06
1209	.109726E+06	.000000E+00	.109726E+06
1214	.115663E+06	.000000E+00	.115663E+06
1219	.120294E+06	.000000E+00	.120294E+06
1224	.123441E+06	.000000E+00	.123441E+06
1229	.124980E+06	.000000E+00	.124980E+06
1234	.124849E+06	.474962E+05	.172346E+06
1239	.123055E+06	.745994E+05	.197654E+06

1244	.119667E+06	.950500E+05	.214717E+06
1249	.114820E+06	.112365E+06	.227185E+06
1254	.108699E+06	.127756E+06	.236455E+06
1259	.101531E+06	.141812E+06	.243343E+06
1264	.935703E+05	.154871E+06	.248441E+06
1269	.850829E+05	.167149E+06	.252232E+06
1274	.763330E+05	.178795E+06	.255128E+06
1279	.675690E+05	.189913E+06	.257482E+06
1284	.590131E+05	.200584E+06	.259597E+06
1289	.508527E+05	.210869E+06	.261722E+06
1294	.432361E+05	.220817E+06	.264053E+06
1299	.362696E+05	.230466E+06	.266736E+06
1304	.300196E+05	.239849E+06	.269869E+06
1309	.245151E+05	.248992E+06	.273507E+06
1314	.197527E+05	.257919E+06	.277671E+06
1319	.157031E+05	.266647E+06	.282350E+06
1344	.000000E+00	.283376E+06	.283376E+06
1369	.000000E+00	.260820E+06	.260820E+06
1394	.000000E+00	.243676E+06	.243676E+06
1419	.000000E+00	.230078E+06	.230078E+06
1444	.000000E+00	.218950E+06	.218950E+06
1469	.000000E+00	.209625E+06	.209625E+06
1494	.000000E+00	.201664E+06	.201664E+06
1519	.000000E+00	.194763E+06	.194763E+06
1544	.000000E+00	.188706E+06	.188706E+06
1569	.000000E+00	.183335E+06	.183335E+06
1594	.000000E+00	.178528E+06	.178528E+06
1619	.000000E+00	.174194E+06	.174194E+06
1644	.000000E+00	.170260E+06	.170260E+06
1669	.000000E+00	.166667E+06	.166667E+06
1694	.000000E+00	.163370E+06	.163370E+06
1719	.000000E+00	.160329E+06	.160329E+06
1744	.000000E+00	.157513E+06	.157513E+06
1769	.000000E+00	.154896E+06	.154896E+06
1794	.000000E+00	.152455E+06	.152455E+06
1819	.000000E+00	.150172E+06	.150172E+06
1844	.000000E+00	.148030E+06	.148030E+06
1869	.000000E+00	.146014E+06	.146014E+06

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
1139	.128026E+05	.000000E+00
1144	.162880E+05	.300513E+02
1149	.204457E+05	.680052E+02
1154	.253221E+05	.115316E+03
1159	.309432E+05	.173516E+03
1164	.373074E+05	.244168E+03
1169	.443803E+05	.328802E+03
1174	.520896E+05	.428839E+03
1179	.603222E+05	.545508E+03
1184	.689238E+05	.679762E+03
1189	.777009E+05	.832189E+03

1194	.864269E+05	.100294E+04
1199	.948499E+05	.119164E+04
1204	.102705E+06	.139741E+04
1209	.109726E+06	.161876E+04
1214	.115663E+06	.185367E+04
1219	.120294E+06	.209962E+04
1224	.123441E+06	.235365E+04
1229	.124980E+06	.261248E+04
1234	.172346E+06	.290333E+04
1239	.197654E+06	.328686E+04
1244	.214717E+06	.371524E+04
1249	.227185E+06	.417472E+04
1254	.236455E+06	.465683E+04
1259	.243343E+06	.515546E+04
1264	.248441E+06	.566606E+04
1269	.252232E+06	.618522E+04
1274	.255128E+06	.671050E+04
1279	.257482E+06	.724030E+04
1284	.259597E+06	.777373E+04
1289	.261722E+06	.831048E+04
1294	.264053E+06	.885076E+04
1299	.266736E+06	.939512E+04
1304	.269869E+06	.994439E+04
1309	.273507E+06	.104996E+05
1314	.277671E+06	.110618E+05
1319	.282350E+06	.116320E+05
1324	.275194E+06	.122115E+05
1329	.283574E+06	.127773E+05
1334	.291799E+06	.133596E+05
1339	.288804E+06	.139509E+05
1344	.283376E+06	.145301E+05
1349	.278296E+06	.150969E+05
1354	.273530E+06	.156519E+05
1359	.269046E+06	.161959E+05
1364	.264817E+06	.167294E+05
1369	.260820E+06	.172530E+05
1374	.257034E+06	.177672E+05
1379	.253442E+06	.182724E+05
1384	.250028E+06	.187690E+05
1389	.246777E+06	.192575E+05
1394	.243676E+06	.197382E+05
1399	.240715E+06	.202114E+05
1404	.237884E+06	.206774E+05
1409	.235172E+06	.211365E+05
1414	.232573E+06	.215890E+05
1419	.230078E+06	.220350E+05
1424	.227680E+06	.224749E+05
1429	.225374E+06	.229089E+05
1434	.223154E+06	.233371E+05
1439	.221014E+06	.237598E+05
1444	.218950E+06	.241771E+05
1449	.216957E+06	.245891E+05
1454	.215032E+06	.249961E+05
1459	.213171E+06	.253983E+05
1464	.211369E+06	.257956E+05
1469	.209625E+06	.261884E+05
1474	.207935E+06	.265766E+05
1479	.206296E+06	.269605E+05
1484	.204707E+06	.273401E+05
1489	.203163E+06	.277156E+05

1494	.201664E+06	.280870E+05
1499	.200207E+06	.284545E+05
1504	.198790E+06	.288182E+05
1509	.197411E+06	.291781E+05
1514	.196070E+06	.295343E+05
1519	.194763E+06	.298870E+05
1524	.193490E+06	.302362E+05
1529	.192249E+06	.305819E+05
1534	.191039E+06	.309243E+05
1539	.189859E+06	.312635E+05
1544	.188706E+06	.315994E+05
1549	.187582E+06	.319322E+05
1554	.186483E+06	.322619E+05
1559	.185410E+06	.325886E+05
1564	.184361E+06	.329124E+05
1569	.183335E+06	.332332E+05
1574	.182332E+06	.335513E+05
1579	.181350E+06	.338665E+05
1584	.180390E+06	.341790E+05
1589	.179449E+06	.344888E+05
1594	.178528E+06	.347960E+05
1599	.177626E+06	.351005E+05
1604	.176742E+06	.354026E+05
1609	.175876E+06	.357021E+05
1614	.175027E+06	.359991E+05
1619	.174194E+06	.362938E+05
1624	.173377E+06	.365860E+05
1629	.172576E+06	.368759E+05
1634	.171789E+06	.371635E+05
1639	.171018E+06	.374489E+05
1644	.170260E+06	.377320E+05
1649	.169515E+06	.380129E+05
1654	.168784E+06	.382916E+05
1659	.168066E+06	.385682E+05
1664	.167361E+06	.388427E+05
1669	.166667E+06	.391152E+05
1674	.165985E+06	.393855E+05
1679	.165315E+06	.396539E+05
1684	.164656E+06	.399203E+05
1689	.164007E+06	.401847E+05
1694	.163370E+06	.404473E+05
1699	.162742E+06	.407078E+05
1704	.162124E+06	.409666E+05
1709	.161516E+06	.412234E+05
1714	.160918E+06	.414785E+05
1719	.160329E+06	.417317E+05
1724	.159749E+06	.419832E+05
1729	.159177E+06	.422328E+05
1734	.158614E+06	.424808E+05
1739	.158060E+06	.427270E+05
1744	.157513E+06	.429716E+05
1749	.156975E+06	.432145E+05
1754	.156444E+06	.434557E+05
1759	.155921E+06	.436953E+05
1764	.155405E+06	.439332E+05
1769	.154896E+06	.441696E+05
1774	.154394E+06	.444044E+05
1779	.153900E+06	.446376E+05
1784	.153412E+06	.448693E+05
1789	.152930E+06	.450995E+05

1794	.152455E+06	.453282E+05
1799	.151986E+06	.455554E+05
1804	.151524E+06	.457811E+05
1809	.151067E+06	.460053E+05
1814	.150617E+06	.462281E+05
1819	.150172E+06	.464495E+05
1824	.149733E+06	.466695E+05
1829	.149299E+06	.468881E+05
1834	.148870E+06	.471053E+05
1839	.148447E+06	.473211E+05
1844	.148030E+06	.475356E+05
1849	.147617E+06	.477487E+05
1854	.147209E+06	.479605E+05
1859	.146806E+06	.481710E+05
1864	.146408E+06	.483802E+05
1869	.146014E+06	.485881E+05
1874	.145626E+06	.487948E+05
1879	.145318E+06	.490001E+05
1884	.145318E+06	.492047E+05
1889	.145318E+06	.494089E+05
1894	.145318E+06	.496126E+05
1899	.145318E+06	.498160E+05
1904	.145318E+06	.500188E+05
1909	.145318E+06	.502213E+05
1914	.145318E+06	.504233E+05
1919	.145318E+06	.506249E+05
1924	.145318E+06	.508261E+05
1929	.145318E+06	.510268E+05
1934	.145318E+06	.512271E+05

DISTANCE(M)= 554. SIGMAY(M)= 14.0 SIGMAZ(M)= 5.4

PUFF CENTER ARRIVAL TIME(SEC)= 503 PUFF FRONT LEADS PLUME 37.9 SEC
WIND SPEED(M/S)= 1.10

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

466	.128732E+05	.000000E+00	.128732E+05
471	.226298E+05	.000000E+00	.226298E+05
476	.367123E+05	.000000E+00	.367123E+05
481	.549640E+05	.000000E+00	.549640E+05
486	.759420E+05	.000000E+00	.759420E+05
491	.968328E+05	.000000E+00	.968328E+05
496	.113946E+06	.000000E+00	.113946E+06
501	.123741E+06	.000000E+00	.123741E+06
506	.124012E+06	.195768E+05	.143589E+06
511	.114697E+06	.308867E+05	.145584E+06
516	.978986E+05	.394750E+05	.137374E+06
521	.771147E+05	.467806E+05	.123895E+06
526	.560577E+05	.532991E+05	.109357E+06
531	.376071E+05	.592714E+05	.968784E+05
536	.232831E+05	.648359E+05	.881190E+05
541	.133030E+05	.700811E+05	.833841E+05
566	.000000E+00	.931470E+05	.931470E+05
591	.000000E+00	.113006E+06	.113006E+06
616	.000000E+00	.120561E+06	.120561E+06
641	.000000E+00	.111334E+06	.111334E+06

666	.000000E+00	.104320E+06	.104320E+06
691	.000000E+00	.987573E+05	.987573E+05
716	.000000E+00	.942050E+05	.942050E+05
741	.000000E+00	.903904E+05	.903904E+05
766	.000000E+00	.871334E+05	.871334E+05
791	.000000E+00	.843104E+05	.843104E+05
816	.000000E+00	.818327E+05	.818327E+05
841	.000000E+00	.796353E+05	.796353E+05
866	.000000E+00	.776689E+05	.776689E+05
891	.000000E+00	.758958E+05	.758958E+05
916	.000000E+00	.742863E+05	.742863E+05
941	.000000E+00	.728166E+05	.728166E+05
966	.000000E+00	.714676E+05	.714676E+05
991	.000000E+00	.702236E+05	.702236E+05
1016	.000000E+00	.690718E+05	.690718E+05
1041	.000000E+00	.680011E+05	.680011E+05
1066	.000000E+00	.670026E+05	.670026E+05
1091	.000000E+00	.660685E+05	.660685E+05
1116	.000000E+00	.651921E+05	.651921E+05
1141	.000000E+00	.643678E+05	.643678E+05
1166	.000000E+00	.635905E+05	.635905E+05
1191	.000000E+00	.628560E+05	.628560E+05

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
466	.128732E+05	.000000E+00
471	.226298E+05	.349470E+02
476	.367123E+05	.941624E+02
481	.549640E+05	.186839E+03
486	.759420E+05	.320777E+03
491	.968328E+05	.499500E+03
496	.113946E+06	.719665E+03
501	.123741E+06	.970019E+03
506	.143589E+06	.124540E+04
511	.145584E+06	.155172E+04
516	.137374E+06	.185201E+04
521	.123895E+06	.212897E+04
526	.109357E+06	.237516E+04
531	.968784E+05	.259128E+04
536	.881190E+05	.278344E+04
541	.833841E+05	.296005E+04
546	.750673E+05	.311257E+04
551	.798379E+05	.326952E+04
556	.844256E+05	.343611E+04
561	.888553E+05	.361195E+04
566	.931470E+05	.379671E+04
571	.973165E+05	.399009E+04
576	.101377E+06	.419182E+04
581	.105340E+06	.440167E+04
586	.109214E+06	.461941E+04
591	.113006E+06	.484484E+04
596	.116725E+06	.507779E+04

601	.120375E+06	.531809E+04
606	.123963E+06	.556558E+04
611	.122782E+06	.581708E+04
616	.120561E+06	.606365E+04
621	.118483E+06	.630510E+04
626	.116533E+06	.654173E+04
631	.114699E+06	.677382E+04
636	.112969E+06	.700160E+04
641	.111334E+06	.722531E+04
646	.109785E+06	.744515E+04
651	.108315E+06	.766130E+04
656	.106919E+06	.787393E+04
661	.105589E+06	.808319E+04
666	.104320E+06	.828925E+04
671	.103109E+06	.849221E+04
676	.101951E+06	.869222E+04
681	.100841E+06	.888939E+04
686	.997780E+05	.908382E+04
691	.987573E+05	.927561E+04
696	.977765E+05	.946487E+04
701	.968331E+05	.965167E+04
706	.959248E+05	.983610E+04
711	.950494E+05	.100182E+05
716	.942050E+05	.101981E+05
721	.933899E+05	.103759E+05
726	.926023E+05	.105516E+05
731	.918408E+05	.107253E+05
736	.911039E+05	.108969E+05
741	.903904E+05	.110667E+05
746	.896990E+05	.112346E+05
751	.890286E+05	.114008E+05
756	.883782E+05	.115651E+05
761	.877468E+05	.117278E+05
766	.871334E+05	.118887E+05
771	.865374E+05	.120481E+05
776	.859577E+05	.122058E+05
781	.853938E+05	.123620E+05
786	.848449E+05	.125167E+05
791	.843104E+05	.126699E+05
796	.837896E+05	.128216E+05
801	.832819E+05	.129720E+05
806	.827869E+05	.131209E+05
811	.823040E+05	.132685E+05
816	.818327E+05	.134147E+05
821	.813725E+05	.135597E+05
826	.809231E+05	.137034E+05
831	.804840E+05	.138458E+05
836	.800549E+05	.139870E+05
841	.796353E+05	.141270E+05
846	.792249E+05	.142658E+05
851	.788233E+05	.144035E+05
856	.784304E+05	.145400E+05
861	.780456E+05	.146754E+05
866	.776689E+05	.148097E+05
871	.772999E+05	.149429E+05
876	.769383E+05	.150751E+05
881	.765839E+05	.152062E+05
886	.762365E+05	.153363E+05
891	.758958E+05	.154654E+05
896	.755617E+05	.155935E+05

901	.752338E+05	.157206E+05
906	.749121E+05	.158467E+05
911	.745963E+05	.159719E+05
916	.742863E+05	.160962E+05
921	.739818E+05	.162196E+05
926	.736828E+05	.163420E+05
931	.733890E+05	.164636E+05
936	.731003E+05	.165843E+05
941	.728166E+05	.167041E+05
946	.725377E+05	.168231E+05
951	.722635E+05	.169412E+05
956	.719938E+05	.170585E+05
961	.717285E+05	.171750E+05
966	.714676E+05	.172906E+05
971	.712109E+05	.174055E+05
976	.709582E+05	.175196E+05
981	.707095E+05	.176329E+05
986	.704647E+05	.177455E+05
991	.702236E+05	.178573E+05
996	.699863E+05	.179683E+05
1001	.697525E+05	.180786E+05
1006	.695222E+05	.181882E+05
1011	.692953E+05	.182971E+05
1016	.690718E+05	.184052E+05
1021	.688515E+05	.185126E+05
1026	.686343E+05	.186194E+05
1031	.684203E+05	.187255E+05
1036	.682092E+05	.188309E+05
1041	.680011E+05	.189356E+05
1046	.677959E+05	.190396E+05
1051	.675935E+05	.191430E+05
1056	.673939E+05	.192458E+05
1061	.671970E+05	.193479E+05
1066	.670026E+05	.194494E+05
1071	.668109E+05	.195503E+05
1076	.666217E+05	.196505E+05
1081	.664349E+05	.197501E+05
1086	.662505E+05	.198491E+05
1091	.660685E+05	.199476E+05
1096	.658888E+05	.200454E+05
1101	.657114E+05	.201426E+05
1106	.655361E+05	.202393E+05
1111	.653631E+05	.203354E+05
1116	.651921E+05	.204309E+05
1121	.650233E+05	.205258E+05
1126	.648565E+05	.206202E+05
1131	.646916E+05	.207140E+05
1136	.645288E+05	.208073E+05
1141	.643678E+05	.209001E+05
1146	.642087E+05	.209923E+05
1151	.640515E+05	.210840E+05
1156	.638961E+05	.211751E+05
1161	.637424E+05	.212657E+05
1166	.635905E+05	.213558E+05
1171	.634403E+05	.214454E+05
1176	.632918E+05	.215345E+05
1181	.631449E+05	.216231E+05
1186	.629997E+05	.217112E+05
1191	.628560E+05	.217988E+05
1196	.627139E+05	.218859E+05

1201	.625733E+05	.219725E+05
1206	.624619E+05	.220586E+05
1211	.624619E+05	.221444E+05
1216	.624619E+05	.222301E+05
1221	.624619E+05	.223156E+05
1226	.624619E+05	.224008E+05
1231	.624619E+05	.224860E+05
1236	.624619E+05	.225709E+05
1241	.624619E+05	.226556E+05
1246	.624619E+05	.227402E+05
1251	.624619E+05	.228246E+05
1256	.624619E+05	.229088E+05
1261	.624619E+05	.229928E+05

DISTANCE(M)= 554. SIGMAY(M)= 14.0 SIGMAZ(M)= 5.4

PUFF CENTER ARRIVAL TIME(SEC)= 277 PUFF FRONT LEADS PLUME 20.9 SEC
WIND SPEED(M/S)= 2.00

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

257	.149746E+05	.000000E+00	.149746E+05
262	.379082E+05	.000000E+00	.379082E+05
267	.735969E+05	.000000E+00	.735969E+05
272	.109581E+06	.000000E+00	.109581E+06
277	.125130E+06	.000000E+00	.125130E+06
282	.109581E+06	.137094E+05	.123290E+06
287	.735969E+05	.193095E+05	.929064E+05
292	.379082E+05	.238560E+05	.617642E+05
297	.149746E+05	.278337E+05	.428084E+05
322	.000000E+00	.437503E+05	.437503E+05
347	.000000E+00	.565980E+05	.565980E+05
372	.000000E+00	.679530E+05	.679530E+05
397	.000000E+00	.679537E+05	.679537E+05
422	.000000E+00	.632784E+05	.632784E+05
447	.000000E+00	.596768E+05	.596768E+05
472	.000000E+00	.567921E+05	.567921E+05
497	.000000E+00	.544144E+05	.544144E+05
522	.000000E+00	.524106E+05	.524106E+05
547	.000000E+00	.506920E+05	.506920E+05
572	.000000E+00	.491967E+05	.491967E+05
597	.000000E+00	.478803E+05	.478803E+05
622	.000000E+00	.467097E+05	.467097E+05
647	.000000E+00	.456599E+05	.456599E+05
672	.000000E+00	.447114E+05	.447114E+05
697	.000000E+00	.438489E+05	.438489E+05
722	.000000E+00	.430601E+05	.430601E+05
747	.000000E+00	.423351E+05	.423351E+05
772	.000000E+00	.416658E+05	.416658E+05
797	.000000E+00	.410453E+05	.410453E+05
822	.000000E+00	.404680E+05	.404680E+05
847	.000000E+00	.399292E+05	.399292E+05
872	.000000E+00	.394247E+05	.394247E+05
897	.000000E+00	.389510E+05	.389510E+05
922	.000000E+00	.385051E+05	.385051E+05
947	.000000E+00	.380844E+05	.380844E+05
972	.000000E+00	.376866E+05	.376866E+05

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
257	.149746E+05	.000000E+00
262	.379082E+05	.488499E+02
267	.735969E+05	.158061E+03
272	.109581E+06	.346358E+03
277	.125130E+06	.596640E+03
282	.123290E+06	.869852E+03
287	.929064E+05	.110604E+04
292	.617642E+05	.127315E+04
297	.428084E+05	.138316E+04
302	.314416E+05	.144883E+04
307	.347841E+05	.151543E+04
312	.379241E+05	.158880E+04
317	.409032E+05	.166855E+04
322	.437503E+05	.175434E+04
327	.464866E+05	.184590E+04
332	.491282E+05	.194299E+04
337	.516877E+05	.204542E+04
342	.541748E+05	.215301E+04
347	.565980E+05	.226559E+04
352	.589637E+05	.238304E+04
357	.612776E+05	.250521E+04
362	.635445E+05	.263200E+04
367	.657685E+05	.276330E+04
372	.679530E+05	.289901E+04
377	.701010E+05	.303904E+04
382	.715292E+05	.318331E+04
387	.702564E+05	.332741E+04
392	.690675E+05	.346857E+04
397	.679537E+05	.360697E+04
402	.669074E+05	.374276E+04
407	.659221E+05	.387610E+04
412	.649920E+05	.400711E+04
417	.641123E+05	.413591E+04
422	.632784E+05	.426261E+04
427	.624866E+05	.438730E+04
432	.617334E+05	.451008E+04
437	.610158E+05	.463103E+04
442	.603311E+05	.475023E+04
447	.596768E+05	.486774E+04
452	.590507E+05	.498364E+04
457	.584509E+05	.509798E+04
462	.578756E+05	.521083E+04
467	.573232E+05	.532224E+04
472	.567921E+05	.543225E+04
477	.562811E+05	.554093E+04
482	.557889E+05	.564830E+04
487	.553144E+05	.575441E+04
492	.548566E+05	.585930E+04
497	.544144E+05	.596301E+04

502	.539871E+05	.606557E+04
507	.535737E+05	.616702E+04
512	.531737E+05	.626739E+04
517	.527862E+05	.636671E+04
522	.524106E+05	.646500E+04
527	.520463E+05	.656229E+04
532	.516928E+05	.665862E+04
537	.513496E+05	.675399E+04
542	.510161E+05	.684845E+04
547	.506920E+05	.694200E+04
552	.503767E+05	.703467E+04
557	.500699E+05	.712649E+04
562	.497712E+05	.721746E+04
567	.494802E+05	.730761E+04
572	.491967E+05	.739696E+04
577	.489203E+05	.748552E+04
582	.486508E+05	.757332E+04
587	.483877E+05	.766036E+04
592	.481310E+05	.774666E+04
597	.478803E+05	.783224E+04
602	.476354E+05	.791710E+04
607	.473962E+05	.800128E+04
612	.471622E+05	.808477E+04
617	.469335E+05	.816759E+04
622	.467097E+05	.824975E+04
627	.464908E+05	.833127E+04
632	.462765E+05	.841215E+04
637	.460667E+05	.849241E+04
642	.458612E+05	.857206E+04
647	.456599E+05	.865111E+04
652	.454626E+05	.872956E+04
657	.452693E+05	.880743E+04
662	.450797E+05	.888472E+04
667	.448938E+05	.896146E+04
672	.447114E+05	.903764E+04
677	.445324E+05	.911327E+04
682	.443568E+05	.918836E+04
687	.441844E+05	.926293E+04
692	.440151E+05	.933697E+04
697	.438489E+05	.941050E+04
702	.436856E+05	.948352E+04
707	.435251E+05	.955604E+04
712	.433674E+05	.962807E+04
717	.432124E+05	.969961E+04
722	.430601E+05	.977068E+04
727	.429103E+05	.984127E+04
732	.427629E+05	.991139E+04
737	.426180E+05	.998106E+04
742	.424754E+05	.100503E+05
747	.423351E+05	.101190E+05
752	.421970E+05	.101874E+05
757	.420611E+05	.102552E+05
762	.419273E+05	.103227E+05
767	.417955E+05	.103897E+05
772	.416658E+05	.104563E+05
777	.415380E+05	.105225E+05
782	.414121E+05	.105883E+05
787	.412880E+05	.106537E+05
792	.411658E+05	.107187E+05
797	.410453E+05	.107832E+05

802	.409266E+05	.108474E+05
807	.408095E+05	.109112E+05
812	.406941E+05	.109746E+05
817	.405803E+05	.110377E+05
822	.404680E+05	.111003E+05
827	.403573E+05	.111626E+05
832	.402481E+05	.112246E+05
837	.401404E+05	.112861E+05
842	.400341E+05	.113473E+05
847	.399292E+05	.114082E+05
852	.398257E+05	.114687E+05
857	.397235E+05	.115288E+05
862	.396226E+05	.115887E+05
867	.395230E+05	.116481E+05
872	.394247E+05	.117073E+05
877	.393276E+05	.117661E+05
882	.392317E+05	.118245E+05
887	.391369E+05	.118827E+05
892	.390434E+05	.119405E+05
897	.389510E+05	.119980E+05
902	.388596E+05	.120552E+05
907	.387694E+05	.121120E+05
912	.386803E+05	.121686E+05
917	.385922E+05	.122248E+05
922	.385051E+05	.122808E+05
927	.384190E+05	.123364E+05
932	.383339E+05	.123918E+05
937	.382498E+05	.124468E+05
942	.381666E+05	.125015E+05
947	.380844E+05	.125560E+05
952	.380031E+05	.126102E+05
957	.379226E+05	.126640E+05
962	.378431E+05	.127176E+05
967	.377644E+05	.127709E+05
972	.376866E+05	.128240E+05
977	.376096E+05	.128767E+05
982	.375335E+05	.129292E+05
987	.374581E+05	.129814E+05
992	.373835E+05	.130333E+05
997	.373244E+05	.130850E+05
1002	.373244E+05	.131365E+05
1007	.373244E+05	.131879E+05
1012	.373244E+05	.132391E+05
1017	.373244E+05	.132903E+05
1022	.373244E+05	.133414E+05
1027	.373244E+05	.133923E+05
1032	.373244E+05	.134432E+05
1037	.373244E+05	.134939E+05
1042	.373244E+05	.135445E+05
1047	.373244E+05	.135950E+05
1052	.373244E+05	.136454E+05

DISTANCE(M)= 554. SIGMAY(M)= 14.0 SIGMAZ(M)= 5.4

PUFF CENTER ARRIVAL TIME(SEC)= 191 PUFF FRONT LEADS PLUME 14.4 SEC
WIND SPEED(M/S)= 2.90

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

177	.138933E+05	.000000E+00	.138933E+05
182	.503267E+05	.000000E+00	.503267E+05
187	.104346E+06	.000000E+00	.104346E+06
192	.123835E+06	.503439E+04	.128869E+06
197	.84118E+05	.104396E+05	.945584E+05
202	.327062E+05	.142033E+05	.469095E+05
227	.000000E+00	.272707E+05	.272707E+05
252	.000000E+00	.371707E+05	.371707E+05
277	.000000E+00	.457901E+05	.457901E+05
302	.000000E+00	.502872E+05	.502872E+05
327	.000000E+00	.467010E+05	.467010E+05
352	.000000E+00	.439866E+05	.439866E+05
377	.000000E+00	.418397E+05	.418397E+05
402	.000000E+00	.400868E+05	.400868E+05
427	.000000E+00	.386203E+05	.386203E+05
452	.000000E+00	.373699E+05	.373699E+05
477	.000000E+00	.362873E+05	.362873E+05
502	.000000E+00	.353380E+05	.353380E+05
527	.000000E+00	.344968E+05	.344968E+05
552	.000000E+00	.337445E+05	.337445E+05
577	.000000E+00	.330665E+05	.330665E+05
602	.000000E+00	.324514E+05	.324514E+05
627	.000000E+00	.318900E+05	.318900E+05
652	.000000E+00	.313748E+05	.313748E+05
677	.000000E+00	.309000E+05	.309000E+05
702	.000000E+00	.304605E+05	.304605E+05
727	.000000E+00	.300520E+05	.300520E+05
752	.000000E+00	.296712E+05	.296712E+05
777	.000000E+00	.293150E+05	.293150E+05
802	.000000E+00	.289809E+05	.289809E+05
827	.000000E+00	.286668E+05	.286668E+05
852	.000000E+00	.283706E+05	.283706E+05
877	.000000E+00	.280907E+05	.280907E+05
902	.000000E+00	.278258E+05	.278258E+05

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
177	.138933E+05	.000000E+00
182	.503267E+05	.554087E+02
187	.104346E+06	.208648E+03
192	.123835E+06	.456985E+03
197	.84118E+05	.708500E+03
202	.327062E+05	.864602E+03
207	.173396E+05	.934499E+03
212	.201198E+05	.971761E+03
217	.226629E+05	.101463E+04
222	.250333E+05	.106266E+04
227	.272707E+05	.111551E+04
232	.294017E+05	.117290E+04
237	.314449E+05	.123462E+04

242	.334142E+05	.130048E+04
247	.353200E+05	.137034E+04
252	.371707E+05	.144404E+04
257	.389728E+05	.152148E+04
262	.407316E+05	.160254E+04
267	.424517E+05	.168714E+04
272	.441369E+05	.177517E+04
277	.457901E+05	.186658E+04
282	.474143E+05	.196127E+04
287	.490116E+05	.205920E+04
292	.505843E+05	.216028E+04
297	.511529E+05	.226426E+04
302	.502872E+05	.236738E+04
307	.494781E+05	.246848E+04
312	.487196E+05	.256769E+04
317	.480068E+05	.266513E+04
322	.473352E+05	.276087E+04
327	.467010E+05	.285502E+04
332	.461008E+05	.294765E+04
337	.455317E+05	.303883E+04
342	.449912E+05	.312864E+04
347	.444768E+05	.321713E+04
352	.439866E+05	.330436E+04
357	.435187E+05	.339039E+04
362	.430714E+05	.347525E+04
367	.426434E+05	.355900E+04
372	.422332E+05	.364168E+04
377	.418397E+05	.372333E+04
382	.414618E+05	.380398E+04
387	.410984E+05	.388367E+04
392	.407486E+05	.396243E+04
397	.404116E+05	.404028E+04
402	.400868E+05	.411727E+04
407	.397732E+05	.419342E+04
412	.394704E+05	.426874E+04
417	.391776E+05	.434328E+04
422	.388944E+05	.441703E+04
427	.386203E+05	.449004E+04
432	.383547E+05	.456232E+04
437	.380973E+05	.463389E+04
442	.378476E+05	.470477E+04
447	.376053E+05	.477497E+04
452	.373699E+05	.484451E+04
457	.371412E+05	.491341E+04
462	.369189E+05	.498169E+04
467	.367027E+05	.504935E+04
472	.364922E+05	.511641E+04
477	.362873E+05	.518289E+04
482	.360877E+05	.524880E+04
487	.358932E+05	.531415E+04
492	.357035E+05	.537895E+04
497	.355185E+05	.544321E+04
502	.353380E+05	.550695E+04
507	.351618E+05	.557017E+04
512	.349897E+05	.563289E+04
517	.348216E+05	.569511E+04
522	.346574E+05	.575685E+04
527	.344968E+05	.581810E+04
532	.343397E+05	.587890E+04
537	.341861E+05	.593923E+04

542	.340357E+05	.599910E+04
547	.338886E+05	.605854E+04
552	.337445E+05	.611754E+04
557	.336004E+05	.617611E+04
562	.334651E+05	.623426E+04
567	.333296E+05	.629199E+04
572	.331968E+05	.634931E+04
577	.330665E+05	.640624E+04
582	.329388E+05	.646277E+04
587	.328135E+05	.651890E+04
592	.326905E+05	.657466E+04
597	.325699E+05	.663004E+04
602	.324514E+05	.668504E+04
607	.323351E+05	.673968E+04
612	.322208E+05	.679396E+04
617	.321086E+05	.684788E+04
622	.319983E+05	.690145E+04
627	.318900E+05	.695467E+04
632	.317834E+05	.700755E+04
637	.316787E+05	.706010E+04
642	.315758E+05	.711231E+04
647	.314745E+05	.716419E+04
652	.313748E+05	.721575E+04
657	.312768E+05	.726699E+04
662	.311804E+05	.731792E+04
667	.310855E+05	.736853E+04
672	.309920E+05	.741883E+04
677	.309000E+05	.746883E+04
682	.308094E+05	.751853E+04
687	.307202E+05	.756794E+04
692	.306323E+05	.761704E+04
697	.305458E+05	.766586E+04
702	.304605E+05	.771440E+04
707	.303764E+05	.776265E+04
712	.302936E+05	.781062E+04
717	.302119E+05	.785831E+04
722	.301314E+05	.790573E+04
727	.300520E+05	.795288E+04
732	.299738E+05	.799976E+04
737	.298966E+05	.804637E+04
742	.298204E+05	.809273E+04
747	.297453E+05	.813882E+04
752	.296712E+05	.818466E+04
757	.295981E+05	.823024E+04
762	.295259E+05	.827557E+04
767	.294547E+05	.832066E+04
772	.293844E+05	.836550E+04
777	.293150E+05	.841009E+04
782	.292465E+05	.845444E+04
787	.291789E+05	.849856E+04
792	.291121E+05	.854243E+04
797	.290461E+05	.858607E+04
802	.289809E+05	.862948E+04
807	.289166E+05	.867266E+04
812	.288530E+05	.871561E+04
817	.287902E+05	.875834E+04
822	.287281E+05	.880084E+04
827	.286668E+05	.884312E+04
832	.286061E+05	.888518E+04
837	.285462E+05	.892703E+04

842	.284870E+05	.896866E+04
847	.284284E+05	.901007E+04
852	.283706E+05	.905127E+04
857	.283133E+05	.909227E+04
862	.282568E+05	.913305E+04
867	.282008E+05	.917363E+04
872	.281455E+05	.921400E+04
877	.280907E+05	.925417E+04
882	.280366E+05	.929414E+04
887	.279830E+05	.933392E+04
892	.279300E+05	.937349E+04
897	.278776E+05	.941286E+04
902	.278258E+05	.945204E+04
907	.277744E+05	.949103E+04
912	.277237E+05	.952983E+04
917	.276834E+05	.956844E+04
922	.276834E+05	.960692E+04
927	.276834E+05	.964532E+04
932	.276834E+05	.968364E+04
937	.276834E+05	.972188E+04
942	.276834E+05	.976004E+04
947	.276834E+05	.979811E+04
952	.276834E+05	.983611E+04
957	.276834E+05	.987402E+04
962	.276834E+05	.991186E+04
967	.276834E+05	.994961E+04
972	.276834E+05	.998729E+04

Calc # M-2

ATTACHMENT C

(4 pages)

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TOTAL QUANTITY(KG)= 544320.0 T(C)= 35.0 TB(C)=-195.80
 HV(CAL/G)= 47.5 CF(CAL/G*C)= .474
 LIQ DENSITY(G/CM**3)= .806 GAS DENSITY(G/M**3)= 1250.70
 AIR DENSITY(G/CM**3)=.0011460

INITIAL SIGMA(M)= 38.1 SOLAR RAD.(CAL/M**2-S)= 96.0
 ATMOSPHERIC RAD.=111.1 VOLUME OF THE SPILL(CM**3)= .0
 CONTROL ROOM AIR INTAKE HEIGHT ABOVE THE GRADE(M)= 24.00

PUFF Q(KG)= 544320.00 PLUME Q(KG)= .00
 MAX. AREA(M**2)= .00 MOLECULAR WT.(G/MOLE)= 28.0

NO. OF DIST= 1 DIST(M)= 554.
 STABILITY=7 NO. OF WIND SPEED= 1
 SPEEDS(M/S)= 1.10

DISTANCE(M)= 554. SIGMA Y(M)= 14.0 SIGMA Z(M)= 5.4

PUFF CENTER ARRIVAL TIME(SEC)= 503 PUFF FRONT LEADS PLUME 79.3 SEC
 WIND SPEED(M/S)= 1.10

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

424	.781476E+05	.000000E+00	.781476E+05
429	.103610E+06	.000000E+00	.103610E+06
434	.134870E+06	.000000E+00	.134870E+06
439	.172364E+06	.000000E+00	.172364E+06
444	.216273E+06	.000000E+00	.216273E+06
449	.266429E+06	.000000E+00	.266429E+06
454	.322242E+06	.000000E+00	.322242E+06
459	.382654E+06	.000000E+00	.382654E+06
464	.446121E+06	.000000E+00	.446121E+06
469	.510648E+06	.000000E+00	.510648E+06
474	.573871E+06	.000000E+00	.573871E+06
479	.633182E+06	.000000E+00	.633182E+06
484	.685908E+06	.000000E+00	.685908E+06
489	.729501E+06	.000000E+00	.729501E+06
494	.761744E+06	.000000E+00	.761744E+06
499	.780934E+06	.000000E+00	.780934E+06
504	.786037E+06	.000000E+00	.786037E+06
509	.776772E+06	.000000E+00	.776772E+06
514	.753646E+06	.000000E+00	.753646E+06
519	.717900E+06	.000000E+00	.717900E+06
524	.671402E+06	.000000E+00	.671402E+06

529	.616488E+06	.000000E+00	.616488E+06
534	.555763E+06	.000000E+00	.555763E+06
539	.491900E+06	.000000E+00	.491900E+06
544	.427451E+06	.000000E+00	.427451E+06
549	.364686E+06	.000000E+00	.364686E+06
554	.305474E+06	.000000E+00	.305474E+06
559	.251219E+06	.000000E+00	.251219E+06
564	.202840E+06	.000000E+00	.202840E+06
569	.160797E+06	.000000E+00	.160797E+06
574	.125148E+06	.000000E+00	.125148E+06
579	.956295E+05	.000000E+00	.956295E+05
604	.000000E+00	.000000E+00	.000000E+00
629	.000000E+00	.000000E+00	.000000E+00
654	.000000E+00	.000000E+00	.000000E+00
679	.000000E+00	.000000E+00	.000000E+00
704	.000000E+00	.000000E+00	.000000E+00
729	.000000E+00	.000000E+00	.000000E+00
754	.000000E+00	.000000E+00	.000000E+00
779	.000000E+00	.000000E+00	.000000E+00
804	.000000E+00	.000000E+00	.000000E+00
829	.000000E+00	.000000E+00	.000000E+00
854	.000000E+00	.000000E+00	.000000E+00
879	.000000E+00	.000000E+00	.000000E+00
904	.000000E+00	.000000E+00	.000000E+00
929	.000000E+00	.000000E+00	.000000E+00
954	.000000E+00	.000000E+00	.000000E+00

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4434.9

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
424	.781476E+05	.000000E+00
429	.103610E+06	.186834E+03
434	.134870E+06	.432235E+03
439	.172364E+06	.748807E+03
444	.216273E+06	.114986E+04
449	.266429E+06	.164877E+04
454	.322242E+06	.225818E+04
459	.382654E+06	.298907E+04
464	.446121E+06	.384972E+04
469	.510648E+06	.484473E+04
474	.573871E+06	.597410E+04
479	.633182E+06	.723258E+04
484	.685908E+06	.860932E+04
489	.729501E+06	.100878E+05
494	.761744E+06	.116466E+05
499	.780934E+06	.132597E+05
504	.786037E+06	.148982E+05
509	.776772E+06	.165319E+05
514	.753646E+06	.181305E+05
519	.717900E+06	.196656E+05
524	.671402E+06	.211118E+05
529	.616488E+06	.224486E+05
534	.555763E+06	.236604E+05

539	.491900E+06	.247375E+05
544	.427451E+06	.256756E+05
549	.364686E+06	.264758E+05
554	.305474E+06	.271436E+05
559	.251219E+06	.276881E+05
564	.202840E+06	.281210E+05
569	.160797E+06	.284556E+05
574	.125148E+06	.287055E+05
579	.956295E+05	.288844E+05
584	.000000E+00	.289727E+05
589	.000000E+00	.289111E+05
594	.000000E+00	.288496E+05
599	.000000E+00	.287883E+05
604	.000000E+00	.287271E+05
609	.000000E+00	.286660E+05
614	.000000E+00	.286051E+05
619	.000000E+00	.285443E+05
624	.000000E+00	.284836E+05
629	.000000E+00	.284231E+05
634	.000000E+00	.283627E+05
639	.000000E+00	.283024E+05
644	.000000E+00	.282422E+05
649	.000000E+00	.281822E+05
654	.000000E+00	.281223E+05
659	.000000E+00	.280625E+05
664	.000000E+00	.280028E+05
669	.000000E+00	.279433E+05
674	.000000E+00	.278839E+05
679	.000000E+00	.278246E+05
684	.000000E+00	.277655E+05
689	.000000E+00	.277065E+05
694	.000000E+00	.276476E+05
699	.000000E+00	.275888E+05
704	.000000E+00	.275302E+05
709	.000000E+00	.274717E+05
714	.000000E+00	.274133E+05
719	.000000E+00	.273550E+05
724	.000000E+00	.272968E+05
729	.000000E+00	.272388E+05
734	.000000E+00	.271809E+05
739	.000000E+00	.271231E+05
744	.000000E+00	.270655E+05
749	.000000E+00	.270080E+05
754	.000000E+00	.269505E+05
759	.000000E+00	.268933E+05
764	.000000E+00	.268361E+05
769	.000000E+00	.267791E+05
774	.000000E+00	.267221E+05
779	.000000E+00	.266653E+05
784	.000000E+00	.266086E+05
789	.000000E+00	.265521E+05
794	.000000E+00	.264956E+05
799	.000000E+00	.264393E+05
804	.000000E+00	.263831E+05
809	.000000E+00	.263270E+05
814	.000000E+00	.262711E+05
819	.000000E+00	.262152E+05
824	.000000E+00	.261595E+05
829	.000000E+00	.261039E+05
834	.000000E+00	.260484E+05

Calc. # M-2

ATTACHMENT D

(1 page)

839	.000000E+00	.259931E+05
844	.000000E+00	.259378E+05
849	.000000E+00	.258827E+05
854	.000000E+00	.258277E+05
859	.000000E+00	.257728E+05
864	.000000E+00	.257180E+05
869	.000000E+00	.256633E+05
874	.000000E+00	.256088E+05
879	.000000E+00	.255543E+05
884	.000000E+00	.255000E+05
889	.000000E+00	.254458E+05
894	.000000E+00	.253917E+05
899	.000000E+00	.253377E+05
904	.000000E+00	.252839E+05
909	.000000E+00	.252301E+05
914	.000000E+00	.251765E+05
919	.000000E+00	.251230E+05
924	.000000E+00	.250696E+05
929	.000000E+00	.250163E+05
934	.000000E+00	.249631E+05
939	.000000E+00	.249101E+05
944	.000000E+00	.248571E+05
949	.000000E+00	.248043E+05
954	.000000E+00	.247515E+05
959	.000000E+00	.246989E+05
964	.000000E+00	.246464E+05
969	.000000E+00	.245940E+05
974	.000000E+00	.245418E+05
979	.000000E+00	.244896E+05
984	.000000E+00	.244375E+05
989	.000000E+00	.243856E+05
994	.000000E+00	.243338E+05
999	.000000E+00	.242820E+05
1004	.000000E+00	.242304E+05
1009	.000000E+00	.241789E+05
1014	.000000E+00	.241275E+05
1019	.000000E+00	.240762E+05

Calc # H-2

ATTACHMENT E

(11 pages)

PROGRAM TOXGAS - MAP126(REV. 1)

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TOTAL QUANTITY(KG)= 272160.0 T(C)= 35.0 TB(C)= -34.10
 HV(CAL/G)= 68.8 CP(CAL/G*C)= .226
 LIQ DENSITY(G/CM**3)= 1.570 GAS DENSITY(G/M**3)= 3220.40
 AIR DENSITY(G/CM**3)=.0011459

INITIAL SIGMA(M)= 13.5 SOLAR RAD.(CAL/M**2-S)= 96.0
 ATMOSPHERIC RAD.=111.1 VOLUME OF THE SPILL(CM**3)=134002300.0
 CONTROL ROOM AIR INTAKE HEIGHT ABOVE THE GRADE(M)= 24.08

PUFF Q(KG)= 61776.36 PLUME Q(KG)= 210383.60
 MAX. AREA(M**2)= 13400.23 MOLECULAR WT.(G/MOLE)= 70.9

NO. OF DIST= 3 DIST(M)= 5000. 5500. 6000.
 STABILITY=7 NO. OF WIND SPEED= 1
 SPEEDS(M/S)= 1.10

DISTANCE(M)= 5000. SIGMAY(M)= 102.4 SIGMAZ(M)= 21.1

PUFF CENTER ARRIVAL TIME(SEC)= 4545 PUFF FRONT LEADS PLUME 201.8 SEC
 WIND SPEED(M/S)= 1.10

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

4344	.639469E+03	.000000E+00	.639469E+03
4349	.715910E+03	.000000E+00	.715910E+03
4354	.799218E+03	.000000E+00	.799218E+03
4359	.889692E+03	.000000E+00	.889692E+03
4364	.987601E+03	.000000E+00	.987601E+03
4369	.109318E+04	.000000E+00	.109318E+04
4374	.120661E+04	.000000E+00	.120661E+04
4379	.132804E+04	.000000E+00	.132804E+04
4384	.145755E+04	.000000E+00	.145755E+04
4389	.159516E+04	.000000E+00	.159516E+04
4394	.174081E+04	.000000E+00	.174081E+04
4399	.189438E+04	.000000E+00	.189438E+04
4404	.205565E+04	.000000E+00	.205565E+04
4409	.222433E+04	.000000E+00	.222433E+04
4414	.240003E+04	.000000E+00	.240003E+04
4419	.258228E+04	.000000E+00	.258228E+04
4424	.277048E+04	.000000E+00	.277048E+04
4429	.296399E+04	.000000E+00	.296399E+04
4434	.316202E+04	.000000E+00	.316202E+04
4439	.336372E+04	.000000E+00	.336372E+04
4444	.356815E+04	.000000E+00	.356815E+04

4449	.377427E+04	.000000E+00	.377427E+04
4454	.398100E+04	.000000E+00	.398100E+04
4459	.418714E+04	.000000E+00	.418714E+04
4464	.439148E+04	.000000E+00	.439148E+04
4469	.459274E+04	.000000E+00	.459274E+04
4474	.478962E+04	.000000E+00	.478962E+04
4479	.498078E+04	.000000E+00	.498078E+04
4484	.516489E+04	.000000E+00	.516489E+04
4489	.534063E+04	.000000E+00	.534063E+04
4494	.550670E+04	.000000E+00	.550670E+04
4499	.566184E+04	.000000E+00	.566184E+04
4504	.580486E+04	.000000E+00	.580486E+04
4509	.593463E+04	.000000E+00	.593463E+04
4514	.605010E+04	.000000E+00	.605010E+04
4519	.615035E+04	.000000E+00	.615035E+04
4524	.623453E+04	.000000E+00	.623453E+04
4529	.630196E+04	.000000E+00	.630196E+04
4534	.635207E+04	.000000E+00	.635207E+04
4539	.638444E+04	.000000E+00	.638444E+04
4544	.639878E+04	.000000E+00	.639878E+04
4549	.639499E+04	.276146E+04	.915645E+04
4554	.637308E+04	.406931E+04	.104424E+05
4559	.633325E+04	.509660E+04	.114298E+05
4564	.627584E+04	.598136E+04	.122572E+05
4569	.620133E+04	.677591E+04	.129772E+05
4574	.611033E+04	.750675E+04	.136171E+05
4579	.600361E+04	.818951E+04	.141931E+05
4584	.588204E+04	.883429E+04	.147163E+05
4589	.574660E+04	.944812E+04	.151947E+05
4594	.559836E+04	.100361E+05	.156344E+05
4599	.543850E+04	.106020E+05	.160405E+05
4604	.526823E+04	.111488E+05	.164170E+05
4609	.508883E+04	.116789E+05	.167677E+05
4614	.490161E+04	.121941E+05	.170957E+05
4619	.470790E+04	.126961E+05	.174040E+05
4624	.450903E+04	.131862E+05	.176953E+05
4629	.430632E+04	.136655E+05	.179718E+05
4634	.410108E+04	.141349E+05	.182359E+05
4639	.389454E+04	.145952E+05	.184897E+05
4644	.368793E+04	.150471E+05	.187351E+05
4649	.348238E+04	.154913E+05	.189737E+05
4654	.327897E+04	.151997E+05	.184786E+05
4659	.307870E+04	.149274E+05	.180061E+05
4664	.288246E+04	.146726E+05	.175550E+05
4669	.269109E+04	.144333E+05	.171244E+05
4674	.250530E+04	.142080E+05	.167133E+05
4679	.232573E+04	.139955E+05	.163212E+05
4684	.215291E+04	.137946E+05	.159475E+05
4689	.198728E+04	.136042E+05	.155915E+05
4694	.182920E+04	.134234E+05	.152526E+05
4699	.167893E+04	.132516E+05	.149305E+05
4704	.153663E+04	.130879E+05	.146245E+05
4709	.140241E+04	.129318E+05	.143342E+05
4714	.127628E+04	.127826E+05	.140589E+05
4719	.115821E+04	.126400E+05	.137982E+05
4724	.104808E+04	.125033E+05	.135514E+05
4729	.945733E+03	.123723E+05	.133180E+05
4734	.850964E+03	.122464E+05	.130974E+05
4739	.763521E+03	.121255E+05	.128890E+05
4744	.683123E+03	.120092E+05	.126923E+05

4769	.000000E+00	.114872E+05	.114872E+05
4794	.000000E+00	.110460E+05	.110460E+05
4819	.000000E+00	.106666E+05	.106666E+05
4844	.000000E+00	.103359E+05	.103359E+05
4869	.000000E+00	.100442E+05	.100442E+05
4894	.000000E+00	.978443E+04	.978443E+04
4919	.000000E+00	.955118E+04	.955118E+04
4944	.000000E+00	.934021E+04	.934021E+04
4969	.000000E+00	.914819E+04	.914819E+04
4994	.000000E+00	.897243E+04	.897243E+04
5019	.000000E+00	.881077E+04	.881077E+04
5044	.000000E+00	.866142E+04	.866142E+04
5069	.000000E+00	.852288E+04	.852288E+04

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
4344	.639469E+03	.000000E+00
4349	.715910E+03	.142232E+01
4354	.799218E+03	.300980E+01
4359	.889692E+03	.477693E+01
4364	.987601E+03	.673878E+01
4369	.109318E+04	.891095E+01
4374	.120661E+04	.113094E+02
4379	.132804E+04	.139506E+02
4384	.145755E+04	.168510E+02
4389	.159516E+04	.200272E+02
4394	.174081E+04	.234958E+02
4399	.189438E+04	.272733E+02
4404	.205565E+04	.313756E+02
4409	.222433E+04	.358181E+02
4414	.240003E+04	.406156E+02
4419	.258228E+04	.457818E+02
4424	.277048E+04	.513293E+02
4429	.296399E+04	.572695E+02
4434	.316202E+04	.636122E+02
4439	.336372E+04	.703653E+02
4444	.356815E+04	.775351E+02
4449	.377427E+04	.851255E+02
4454	.398100E+04	.931385E+02
4459	.418714E+04	.101573E+03
4464	.439148E+04	.110427E+03
4469	.459274E+04	.119693E+03
4474	.478962E+04	.129364E+03
4479	.498078E+04	.139428E+03
4484	.516489E+04	.149870E+03
4489	.534063E+04	.160675E+03
4494	.550670E+04	.171822E+03
4499	.566184E+04	.183289E+03
4504	.580486E+04	.195052E+03
4509	.593463E+04	.207082E+03
4514	.605010E+04	.219350E+03
4519	.615035E+04	.231825E+03

4524	.623453E+04	.244472E+03
4529	.630196E+04	.257258E+03
4534	.635207E+04	.270145E+03
4539	.638444E+04	.283096E+03
4544	.639878E+04	.296073E+03
4549	.915645E+04	.311641E+03
4554	.104424E+05	.331598E+03
4559	.114298E+05	.352951E+03
4564	.122572E+05	.378206E+03
4569	.129772E+05	.404069E+03
4574	.136171E+05	.431335E+03
4579	.141931E+05	.459846E+03
4584	.147163E+05	.489474E+03
4589	.151947E+05	.520111E+03
4594	.156344E+05	.551666E+03
4599	.160405E+05	.584058E+03
4604	.164170E+05	.617218E+03
4609	.167677E+05	.651085E+03
4614	.170957E+05	.685606E+03
4619	.174040E+05	.720732E+03
4624	.176953E+05	.756424E+03
4629	.179718E+05	.792646E+03
4634	.182359E+05	.829368E+03
4639	.184897E+05	.866564E+03
4644	.187351E+05	.904212E+03
4649	.189737E+05	.942296E+03
4654	.184786E+05	.980177E+03
4659	.180061E+05	.101694E+04
4664	.175550E+05	.105265E+04
4669	.171244E+05	.108734E+04
4674	.167133E+05	.112105E+04
4679	.163212E+05	.115384E+04
4684	.159475E+05	.118574E+04
4689	.155915E+05	.121680E+04
4694	.152526E+05	.124704E+04
4699	.149305E+05	.127652E+04
4704	.146245E+05	.130526E+04
4709	.143342E+05	.133331E+04
4714	.140589E+05	.136069E+04
4719	.137982E+05	.138744E+04
4724	.135514E+05	.141360E+04
4729	.133180E+05	.143918E+04
4734	.130974E+05	.146423E+04
4739	.128890E+05	.148876E+04
4744	.126923E+05	.151281E+04
4749	.118972E+05	.153613E+04
4754	.117892E+05	.155805E+04
4759	.116850E+05	.157970E+04
4764	.115844E+05	.160108E+04
4769	.114872E+05	.162221E+04
4774	.113932E+05	.164308E+04
4779	.113023E+05	.166372E+04
4784	.112142E+05	.168412E+04
4789	.111288E+05	.170429E+04
4794	.110460E+05	.172424E+04
4799	.109657E+05	.174398E+04
4804	.108877E+05	.176350E+04
4809	.108119E+05	.178282E+04
4814	.107382E+05	.180194E+04
4819	.106666E+05	.182086E+04

4824	.105969E+05	.183959E+04
4829	.105291E+05	.185814E+04
4834	.104630E+05	.187650E+04
4839	.103986E+05	.189469E+04

DISTANCE(M)= 5500. SIGMAY(M)= 111.2 SIGMAZ(M)= 22.2

PUFF CENTER ARRIVAL TIME(SEC)= 4999 PUFF FRONT LEADS PLUME 218.9 SEC
WIND SPEED(M/S)= 1.10

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

4782	.547773E+03	.000000E+00	.547773E+03
4787	.607753E+03	.000000E+00	.607753E+03
4792	.672676E+03	.000000E+00	.672676E+03
4797	.742742E+03	.000000E+00	.742742E+03
4802	.818132E+03	.000000E+00	.818132E+03
4807	.899003E+03	.000000E+00	.899003E+03
4812	.985491E+03	.000000E+00	.985491E+03
4817	.107770E+04	.000000E+00	.107770E+04
4822	.117569E+04	.000000E+00	.117569E+04
4827	.127951E+04	.000000E+00	.127951E+04
4832	.138914E+04	.000000E+00	.138914E+04
4837	.150454E+04	.000000E+00	.150454E+04
4842	.162559E+04	.000000E+00	.162559E+04
4847	.175216E+04	.000000E+00	.175216E+04
4852	.188403E+04	.000000E+00	.188403E+04
4857	.202096E+04	.000000E+00	.202096E+04
4862	.216261E+04	.000000E+00	.216261E+04
4867	.230862E+04	.000000E+00	.230862E+04
4872	.245855E+04	.000000E+00	.245855E+04
4877	.261191E+04	.000000E+00	.261191E+04
4882	.276816E+04	.000000E+00	.276816E+04
4887	.292669E+04	.000000E+00	.292669E+04
4892	.308686E+04	.000000E+00	.308686E+04
4897	.324794E+04	.000000E+00	.324794E+04
4902	.340920E+04	.000000E+00	.340920E+04
4907	.356986E+04	.000000E+00	.356986E+04
4912	.372908E+04	.000000E+00	.372908E+04
4917	.388603E+04	.000000E+00	.388603E+04
4922	.403982E+04	.000000E+00	.403982E+04
4927	.418960E+04	.000000E+00	.418960E+04
4932	.433446E+04	.000000E+00	.433446E+04
4937	.447354E+04	.000000E+00	.447354E+04
4942	.460596E+04	.000000E+00	.460596E+04
4947	.473088E+04	.000000E+00	.473088E+04
4952	.484748E+04	.000000E+00	.484748E+04
4957	.495500E+04	.000000E+00	.495500E+04
4962	.505272E+04	.000000E+00	.505272E+04
4967	.513995E+04	.000000E+00	.513995E+04
4972	.521609E+04	.000000E+00	.521609E+04
4977	.528062E+04	.000000E+00	.528062E+04

4982	.533308E+04	.000000E+00	.533308E+04
4987	.537308E+04	.000000E+00	.537308E+04
4992	.540035E+04	.000000E+00	.540035E+04
4997	.541469E+04	.000000E+00	.541469E+04
5002	.541600E+04	.213606E+04	.755206E+04
5007	.540426E+04	.337010E+04	.877436E+04
5012	.537956E+04	.430719E+04	.968675E+04
5017	.534208E+04	.510431E+04	.104464E+05
5022	.529209E+04	.581555E+04	.111076E+05
5027	.522994E+04	.646720E+04	.116971E+05
5032	.515608E+04	.707436E+04	.122304E+05
5037	.507102E+04	.764667E+04	.127177E+05
5042	.497535E+04	.819072E+04	.131661E+05
5047	.486973E+04	.871125E+04	.135810E+05
5052	.475488E+04	.921182E+04	.139667E+05
5057	.463156E+04	.969516E+04	.143267E+05
5062	.450057E+04	.101634E+05	.146640E+05
5067	.436276E+04	.106184E+05	.149811E+05
5072	.421898E+04	.110614E+05	.152804E+05
5077	.407012E+04	.114938E+05	.155639E+05
5082	.391706E+04	.119165E+05	.158335E+05
5087	.376067E+04	.123303E+05	.160910E+05
5092	.360184E+04	.127361E+05	.163379E+05
5097	.344140E+04	.131344E+05	.165758E+05
5102	.328020E+04	.135258E+05	.168060E+05
5107	.311901E+04	.133969E+05	.165159E+05
5112	.295861E+04	.131546E+05	.161132E+05
5117	.279970E+04	.129279E+05	.157276E+05
5122	.264294E+04	.127151E+05	.153581E+05
5127	.248896E+04	.125150E+05	.150039E+05
5132	.233830E+04	.123262E+05	.146645E+05
5137	.219147E+04	.121478E+05	.143393E+05
5142	.204891E+04	.119788E+05	.140277E+05
5147	.191102E+04	.118185E+05	.137295E+05
5152	.177811E+04	.116661E+05	.134442E+05
5157	.165047E+04	.115210E+05	.131714E+05
5162	.152829E+04	.113826E+05	.129109E+05
5167	.141176E+04	.112504E+05	.126622E+05
5172	.130097E+04	.111240E+05	.124250E+05
5177	.119598E+04	.110030E+05	.121990E+05
5182	.109683E+04	.108870E+05	.119838E+05
5187	.100347E+04	.107756E+05	.117790E+05
5192	.915844E+03	.106686E+05	.115844E+05
5197	.833859E+03	.105656E+05	.113995E+05
5202	.757386E+03	.104665E+05	.112239E+05
5207	.686269E+03	.103710E+05	.110573E+05
5212	.620333E+03	.102789E+05	.108992E+05
5217	.559381E+03	.101899E+05	.107493E+05
5242	.000000E+00	.978721E+04	.978721E+04
5267	.000000E+00	.944224E+04	.944224E+04
5292	.000000E+00	.914242E+04	.914242E+04
5317	.000000E+00	.887870E+04	.887870E+04
5342	.000000E+00	.864436E+04	.864436E+04
5367	.000000E+00	.843433E+04	.843433E+04
5392	.000000E+00	.824467E+04	.824467E+04
5417	.000000E+00	.807228E+04	.807228E+04
5442	.000000E+00	.791471E+04	.791471E+04
5467	.000000E+00	.776994E+04	.776994E+04
5492	.000000E+00	.763632E+04	.763632E+04
5517	.000000E+00	.751250E+04	.751250E+04

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
4782	.547773E+03	.000000E+00
4787	.607753E+03	.121385E+01
4792	.672676E+03	.255671E+01
4797	.742742E+03	.403898E+01
4802	.818132E+03	.567144E+01
4807	.899003E+03	.746523E+01
4812	.985491E+03	.943177E+01
4817	.107770E+04	.115827E+02
4822	.117569E+04	.139299E+02
4827	.127951E+04	.164852E+02
4832	.138914E+04	.192605E+02
4837	.150454E+04	.222678E+02
4842	.162559E+04	.255187E+02
4847	.175216E+04	.290246E+02
4852	.188403E+04	.327964E+02
4857	.202096E+04	.368447E+02
4862	.216261E+04	.411794E+02
4867	.230862E+04	.458095E+02
4872	.245855E+04	.507435E+02
4877	.261191E+04	.559884E+02
4882	.276816E+04	.615506E+02
4887	.292669E+04	.674349E+02
4892	.308686E+04	.736450E+02
4897	.324794E+04	.801831E+02
4902	.340920E+04	.870498E+02
4907	.356986E+04	.942441E+02
4912	.372908E+04	.101763E+03
4917	.388603E+04	.109603E+03
4922	.403982E+04	.117757E+03
4927	.418960E+04	.126217E+03
4932	.433446E+04	.134973E+03
4937	.447354E+04	.144014E+03
4942	.460596E+04	.153325E+03
4947	.473088E+04	.162892E+03
4952	.484748E+04	.172697E+03
4957	.495500E+04	.182721E+03
4962	.505272E+04	.192944E+03
4967	.513995E+04	.203344E+03
4972	.521609E+04	.213898E+03
4977	.528062E+04	.224381E+03
4982	.533308E+04	.235369E+03
4987	.537308E+04	.246235E+03
4992	.540035E+04	.257151E+03
4997	.541469E+04	.268092E+03
5002	.755206E+04	.280408E+03
5007	.877436E+04	.296976E+03
5012	.968675E+04	.315794E+03
5017	.104464E+05	.336368E+03
5022	.111076E+05	.358421E+03

5027	.116971E+05	.381769E+03
5032	.122304E+05	.406269E+03
5037	.127177E+05	.431809E+03
5042	.131661E+05	.458297E+03
5047	.135810E+05	.485651E+03
5052	.139667E+05	.513803E+03
5057	.143267E+05	.542692E+03
5062	.146640E+05	.572265E+03
5067	.149811E+05	.602475E+03
5072	.152804E+05	.633278E+03
5077	.155639E+05	.664638E+03
5082	.158335E+05	.696521E+03
5087	.160910E+05	.728898E+03
5092	.163379E+05	.761745E+03
5097	.165758E+05	.795039E+03
5102	.168060E+05	.828760E+03
5107	.165159E+05	.862563E+03
5112	.161132E+05	.895472E+03
5117	.157276E+05	.927470E+03
5122	.153581E+05	.958594E+03
5127	.150039E+05	.988880E+03
5132	.146645E+05	.101836E+04
5137	.143393E+05	.104707E+04
5142	.140277E+05	.107504E+04
5147	.137295E+05	.110231E+04
5152	.134442E+05	.112889E+04
5157	.131714E+05	.115481E+04
5162	.129109E+05	.118012E+04
5167	.126622E+05	.120483E+04
5172	.124250E+05	.122896E+04
5177	.121990E+05	.125255E+04
5182	.119838E+05	.127562E+04
5187	.117790E+05	.129819E+04
5192	.115844E+05	.132029E+04
5197	.113995E+05	.134194E+04
5202	.112239E+05	.136315E+04
5207	.110573E+05	.138396E+04
5212	.108992E+05	.140437E+04
5217	.107493E+05	.142442E+04
5222	.101040E+05	.144343E+04
5227	.100209E+05	.146176E+04
5232	.994050E+04	.147988E+04
5237	.986265E+04	.149778E+04
5242	.978721E+04	.151549E+04
5247	.971406E+04	.153300E+04
5252	.964309E+04	.155032E+04
5257	.957420E+04	.156745E+04

DISTANCE(M) = 6000. SIGMAY(M) = 119.9 SIGMAZ(M) = 23.1

PUFF CENTER ARRIVAL TIME(SEC) = 5454 PUFF FRONT LEADS PLUME 235.8 SEC
WIND SPEED(M/S) = 1.10

*** CONCENTRATIONS OUTSIDE CONTROL ROOM AIR INTAKE ***

TIME(SEC)	PUFF	PLUME	TOTAL(PPM)
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DIMENSION ARRAY EXCEEDS LIMIT

5219	.463121E+03	.000000E+00	.463121E+03
5224	.510214E+03	.000000E+00	.510214E+03
5229	.560930E+03	.000000E+00	.560930E+03
5234	.615407E+03	.000000E+00	.615407E+03
5239	.673773E+03	.000000E+00	.673773E+03
5244	.736144E+03	.000000E+00	.736144E+03
5249	.802618E+03	.000000E+00	.802618E+03
5254	.873280E+03	.000000E+00	.873280E+03
5259	.948190E+03	.000000E+00	.948190E+03
5264	.102739E+04	.000000E+00	.102739E+04
5269	.111089E+04	.000000E+00	.111089E+04
5274	.119869E+04	.000000E+00	.119869E+04
5279	.129074E+04	.000000E+00	.129074E+04
5284	.138698E+04	.000000E+00	.138698E+04
5289	.148729E+04	.000000E+00	.148729E+04
5294	.159156E+04	.000000E+00	.159156E+04
5299	.169959E+04	.000000E+00	.169959E+04
5304	.181120E+04	.000000E+00	.181120E+04
5309	.192612E+04	.000000E+00	.192612E+04
5314	.204409E+04	.000000E+00	.204409E+04
5319	.216478E+04	.000000E+00	.216478E+04
5324	.228783E+04	.000000E+00	.228783E+04
5329	.241286E+04	.000000E+00	.241286E+04
5334	.253945E+04	.000000E+00	.253945E+04
5339	.266712E+04	.000000E+00	.266712E+04
5344	.279541E+04	.000000E+00	.279541E+04
5349	.292378E+04	.000000E+00	.292378E+04
5354	.305170E+04	.000000E+00	.305170E+04
5359	.317860E+04	.000000E+00	.317860E+04
5364	.330391E+04	.000000E+00	.330391E+04
5369	.342703E+04	.000000E+00	.342703E+04
5374	.354736E+04	.000000E+00	.354736E+04
5379	.366429E+04	.000000E+00	.366429E+04
5384	.377723E+04	.000000E+00	.377723E+04
5389	.388556E+04	.000000E+00	.388556E+04
5394	.398870E+04	.000000E+00	.398870E+04
5399	.408608E+04	.000000E+00	.408608E+04
5404	.417715E+04	.000000E+00	.417715E+04
5409	.426139E+04	.000000E+00	.426139E+04
5414	.433830E+04	.000000E+00	.433830E+04
5419	.440743E+04	.000000E+00	.440743E+04
5424	.446837E+04	.000000E+00	.446837E+04
5429	.452076E+04	.000000E+00	.452076E+04
5434	.456426E+04	.000000E+00	.456426E+04
5439	.459861E+04	.000000E+00	.459861E+04
5444	.462361E+04	.000000E+00	.462361E+04
5449	.463909E+04	.000000E+00	.463909E+04
5454	.464497E+04	.000000E+00	.464497E+04
5459	.464120E+04	.238939E+04	.703058E+04
5464	.462780E+04	.334996E+04	.797776E+04
5469	.460487E+04	.412466E+04	.872953E+04
5474	.457254E+04	.479905E+04	.937159E+04
5479	.453101E+04	.540819E+04	.993920E+04
5484	.448054E+04	.597052E+04	.104511E+05
5489	.442144E+04	.649714E+04	.109186E+05
5494	.435406E+04	.699537E+04	.113494E+05
5499	.427881E+04	.747032E+04	.117491E+05

5504	.419613E+04	.792572E+04	.121218E+05
5509	.410650E+04	.836442E+04	.124709E+05
5514	.401045E+04	.878862E+04	.127991E+05
5519	.390852E+04	.920008E+04	.131086E+05
5524	.380127E+04	.960023E+04	.134015E+05
5529	.368929E+04	.999027E+04	.136796E+05
5534	.357318E+04	.103712E+05	.139443E+05
5539	.345354E+04	.107438E+05	.141973E+05
5544	.333097E+04	.111088E+05	.144398E+05
5549	.320609E+04	.114669E+05	.146729E+05
5554	.307948E+04	.118185E+05	.148980E+05
5559	.295174E+04	.120486E+05	.150003E+05
5564	.282342E+04	.118241E+05	.146475E+05
5569	.269507E+04	.116144E+05	.143094E+05
5574	.256722E+04	.114179E+05	.139851E+05
5579	.244036E+04	.112333E+05	.136737E+05
5584	.231495E+04	.110595E+05	.133745E+05
5589	.219143E+04	.108955E+05	.130869E+05
5594	.207019E+04	.107403E+05	.128105E+05
5599	.195161E+04	.105932E+05	.125448E+05
5604	.183599E+04	.104535E+05	.122895E+05
5609	.172364E+04	.103207E+05	.120443E+05
5614	.161481E+04	.101941E+05	.118089E+05
5619	.150971E+04	.100733E+05	.115830E+05
5624	.140852E+04	.995788E+04	.113664E+05
5629	.131138E+04	.984744E+04	.111588E+05
5634	.121841E+04	.974165E+04	.109601E+05
5639	.112968E+04	.964017E+04	.107698E+05
5644	.104524E+04	.954272E+04	.105880E+05
5649	.965099E+03	.944904E+04	.104141E+05
5654	.889256E+03	.935890E+04	.102482E+05
5659	.817673E+03	.927208E+04	.100898E+05
5664	.750291E+03	.918838E+04	.993867E+04
5669	.687033E+03	.910761E+04	.979465E+04
5674	.627803E+03	.902962E+04	.965742E+04
5679	.572488E+03	.895424E+04	.952672E+04
5684	.520963E+03	.888133E+04	.940229E+04
5689	.473092E+03	.881076E+04	.928385E+04
5714	.000000E+00	.848900E+04	.848900E+04
5739	.000000E+00	.821057E+04	.821057E+04
5764	.000000E+00	.796654E+04	.796654E+04
5789	.000000E+00	.775036E+04	.775036E+04
5814	.000000E+00	.755712E+04	.755712E+04
5839	.000000E+00	.738301E+04	.738301E+04
5864	.000000E+00	.722508E+04	.722508E+04
5889	.000000E+00	.708097E+04	.708097E+04
5914	.000000E+00	.694878E+04	.694878E+04
5939	.000000E+00	.682694E+04	.682694E+04

CR FLOW RATE(M**3/SEC)= 1.887

FREE VOL(M**3)= 4437.5

*** CR CONCENTRATIONS (PPM) ***

TIME (SEC)	INTAKE (PPM)	CONTROL ROOM (PPM)
5219	.463121E+03	.000000E+00

5224	.510214E+03	.102328E+01
5229	.560930E+03	.214749E+01
5234	.615407E+03	.338022E+01
5239	.673773E+03	.472935E+01
5244	.736144E+03	.620299E+01
5249	.802618E+03	.780948E+01
5254	.873280E+03	.955731E+01
5259	.948190E+03	.114552E+02
5264	.102739E+04	.135117E+02
5269	.111089E+04	.157359E+02
5274	.119869E+04	.181363E+02
5279	.129074E+04	.207218E+02
5284	.138698E+04	.235009E+02
5289	.148729E+04	.264821E+02
5294	.159156E+04	.296734E+02
5299	.169959E+04	.330827E+02
5304	.181120E+04	.367173E+02
5309	.192612E+04	.405841E+02
5314	.204409E+04	.446895E+02
5319	.216478E+04	.490392E+02
5324	.228783E+04	.536381E+02
5329	.241286E+04	.584904E+02
5334	.253945E+04	.635994E+02
5339	.266712E+04	.689674E+02
5344	.279541E+04	.745959E+02
5349	.292378E+04	.804851E+02
5354	.305170E+04	.866343E+02
5359	.317860E+04	.930413E+02
5364	.330391E+04	.997031E+02
5369	.342703E+04	.106615E+03
5374	.354736E+04	.113772E+03
5379	.366429E+04	.121166E+03
5384	.377723E+04	.128790E+03
5389	.388556E+04	.136633E+03
5394	.398870E+04	.144686E+03
5399	.408608E+04	.152936E+03
5404	.417715E+04	.161370E+03
5409	.426139E+04	.169974E+03
5414	.433830E+04	.178733E+03
5419	.440743E+04	.187629E+03
5424	.446837E+04	.196647E+03
5429	.452076E+04	.205768E+03
5434	.456426E+04	.214973E+03
5439	.459861E+04	.224243E+03
5444	.462361E+04	.233559E+03
5449	.463909E+04	.242900E+03
5454	.464497E+04	.252246E+03
5459	.703053E+04	.264526E+03
5464	.797776E+04	.279751E+03
5469	.872953E+04	.296767E+03
5474	.937159E+04	.315243E+03
5479	.993920E+04	.334975E+03
5484	.104511E+05	.355822E+03
5489	.109186E+05	.377672E+03
5494	.113494E+05	.400437E+03
5499	.117491E+05	.424042E+03
5504	.121218E+05	.448422E+03
5509	.124709E+05	.473521E+03
5514	.127991E+05	.499291E+03
5519	.131086E+05	.525686E+03

ENCLOSURE 2

**BROWNS FERRY NUCLEAR PLANT
FREQUENCY OF CHLORINE CONCENTRATION
IN THE CONTROL ROOM DUE TO A BARGE ACCIDENT**