CHAPTER 11: RADIOACTIVE WASTE MANAGEMENT

In September 1992, the NRC issued Amendment 87 to the Fermi 2 Operating License authorizing a change in the thermal power limit from 3293 MWt to 3430 MWt (References 1 and 2). The data provided in Chapter 11 for the original power level (3293 MWt) was calculated at 3430 MWt for source terms, activity releases, and doses to the public. As a result of the power uprate, source terms, activity releases, concentrations, and doses have been adjusted linearly to correspond to 102 percent of 3430 MWt or 3499 MWt. Flow rates, masses, and volumes are also scaled linearly for the uprated conditions. Table 11.1-1 provides the scale-up factors used in Sections 11.2, 11.3, 11.5, and Appendix 11A, Compliance with Appendix I. The Appendix I evaluation showed that the radiation doses associated with power uprate operation meet the Appendix I objectives.

The values in Table 11.1-2 have not been adjusted for power level because they are derived from the standard annual average design basis release rate of 0.1 Ci/sec at t=30 minutes. However, activities, concentrations, releases, and doses based on 11.1-2 are adjusted for power level. While the inconsistency in this approach is recognized, the calculations are reasonably conservative and the methodology is consistent with the General Electric Licensing Topical Report, NEDC-31897P-1 "Generic Guidelines for General Electric Boiling Water Reactor Power Uprate," June 1991.

On February 10, 2014, the NRC issued Amendment 196 to the Fermi 2 operating license authorizing a change in the thermal power limit from 3430 MWt to 3486 MWt, a 1.64 percent increase in thermal power. This Measurement Uncertainty Recapture (MUR) power uprate was performed in accordance with 10 CFR 50, Appendix K and the analyses performed at 102% of the pre-MUR licensed thermal power (3430 MWt) remain applicable at the MUR uprated thermal power (3486 MWt) because the 2% uncertainty is effectively reduced by the improvement in feedwater flow measurement. As such, the source terms, activity releases, concentrations, and doses were not adjusted as a result of the MUR power uprate.

11.1 SOURCE TERMS

The General Electric Company (GE) has evaluated radioactive material sources (activation products and fission product release from fuel) in operating BWRs over the past decade. These source terms are reviewed and periodically revised to incorporate up-to-date information. Release of radioactive material from operating BWRs has generally resulted in doses to offsite persons that have been only a small fraction of permissible doses or of natural background dose.

The information provided in this section defines the design-basis radioactive material levels in the reactor water, steam, and offgas. The various radioisotopes listed have been grouped as coolant activation products, noncoolant activation products, and fission products. The fission product levels are based on measurements of BWR water and offgas at several stations through mid-1971. Emphasis was placed on observations made at KRB and Dresden 2. The design-basis radioactive material levels do not necessarily include all the radioisotopes observed or theoretically predicted to be present. The radioisotopes included are considered significant to one or more of the following criteria:

a. Plant equipment design

b. Shielding design

c. Understanding system operation and performance

d. Measurement practicability

e. Evaluating radioactive material releases to the environment.

For halogens, radioisotopes with half-lives of less than 3 minutes were omitted. For other fission product radioisotopes in reactor water, radioisotopes with half-lives of less than 10 minutes were not considered.

11.1.1 Fission Products

11.1.1.1 Noble Radiogas Fission Products

The noble radiogas fission product source terms observed in operating BWRs are generally complex mixtures whose sources vary from minuscule defects in cladding to tramp uranium on external cladding surfaces. The relative leakage rate of amounts of noble radiogas isotopes can be described as follows:

a. Equilibrium: $R_g \approx k_1 Y$ (11.1-1)

b. Recoil: $R_g \approx k_2 Y \lambda$ (11.1-2)

The nomenclature in Subsection 11.1.1.4 defines the terms in these and succeeding equations. The constants k_1 and k_2 describe the fractions of the whole fission product that are involved in each of the releases.

The equilibrium and recoil mixtures are the two extremes of the mixture spectrum that are physically possible. The equilibrium mixture results when a sufficient time delay occurs, between the fission event and the time of release of the radiogases from the fuel to the coolant, for the radiogases to approach equilibrium levels in the fuel. When there is no delay or impedance between the fission event and the release of the radiogases, the recoil mixture is observed.

Prior to the Vallecitos BWR and Dresden 1 experience, it was assumed that noble radiogas leakage from the fuel would be the equilibrium mixture of the noble radiogases present in the fuel.

The Vallecitos BWR and early Dresden 1 experience indicated that the actual mixture most often observed approached a distribution that was intermediate in character to the two extremes. This intermediate decay mixture was termed the diffusion mixture. It must be emphasized that this diffusion mixture is merely one possible point on the mixture spectrum, ranging from the equilibrium to the recoil mixture, and does not have the absolute mathematical and mechanistic basis for the calculational methods possible for equilibrium and recoil mixtures. However, the diffusion distribution pattern that has been described is as follows (Reference 3):

Diffusion: $R_g \approx k_3 Y \lambda^{0.5}$ (11.1-3)

The constant k_3 describes the fraction of total fissions involved in the release. As can be seen, the value of the exponent of the decay constant λ is midway between that of equilibrium (0) and recoil (1). The diffusion pattern value of 0.5 was originally derived from diffusion theory, but the assumptions have become discredited.

Although the previously described diffusion mixture was used by GE as a basis for design since 1963, the design-basis release magnitude used has varied from 0.5 Ci/sec to 0.1 Ci/sec as measured after 30-minute decay (t = 30 minutes).*

Since about 1967, the design-basis release magnitude used, including the 1971 source terms, has been established at an annual average of 0.1 Ci/sec at t = 30 minutes. This design basis is considered as an annual average, with some time above and some time below this value.

This design value was selected on the basis of operating experience rather than predictive assumptions. Several judgment factors-including the significance of environmental release, reactor water radioisotope concentrations, liquid waste handling and effluent disposal criteria, building air contamination, shielding design, and turbine and other component contamination affecting maintenance-have been considered in establishing this level.

Experience in the operation of open-cycle BWRs has indicated that in-plant contamination and other operating restrictions may limit plant operation at levels well below emission rates that would correspond to the 10 CFR 20 dose limit of 500 mrem/yr to any offsite person.

Although noble radiogas source terms from fuel above 0.1 Ci/sec at t = 30 minutes can be tolerated for reasonable periods of time, long-term operation at such levels may be undesirable. Continual assessment of this value is made on the basis of actual operating experience in BWRs. There is no experimental or operational basis for changing this design-basis value because of increased reactor size or fuel power density, since limiting conditions are largely independent of these parameters.

While the noble radiogas source-term magnitude was established at 0.1 Ci/sec at t = 30 minutes, it was recognized that there may be a more statistically applicable distribution for the noble radiogas mixture. Sufficient data were available from KRB operations from 1967 to mid-1971 along with Dresden 2 data from operation in 1970 and several months in 1971 to more accurately characterize the noble radiogas mixture pattern for an operating BWR.

The basic equation for each radioisotope used to analyze the collected data is

$$R_g = K_g Y \lambda^m (1 - e^{-\lambda T}) (e^{-\lambda \tau}) \qquad (11.1\text{-}4)$$

With the exception of ^{85}Kr with a half-life of 10.74 years, the noble radiogas fission products in the fuel are essentially at an equilibrium condition after an irradiation period of several months (rate of formation is equal to rate of decay). Therefore, for practical purposes the term $(1 - e^{-\lambda T})$ approaches unity and can be neglected when the reactor has been operating at a steady state for long periods of time. The term $(e^{-\lambda t})$ is used to adjust the releases from the fuel at t = 0 to the decay time for which values are needed. Historically, t = 30 minutes has been used. When discussing long steady-state operation and leakage from the fuel, the

* The noble radiogas source-term rate after 30-minute decay has been used as a conventional measure of the design-basis fuel leakage rate, since it is conveniently measurable and was consistent with the nominal design-basis 30-minute offgas holdup system used on a number of plants.

following simplified form of Equation 11.1-4 can be used to describe the leakage of each noble radiogas isotope:

$$R_g = K_g Y \lambda^m \qquad (11.1\text{-}5)$$

The constant K_g describes the magnitude of leakage. The rate of noble radiogas leakage with respect to each other (composition) is expressed in terms of m, the exponent of the decay constant term λ.

Dividing both sides of Equation 11.1-5 by y and taking the logarithm of both sides results in the following equation:

$$\log(R_g/Y) = m \log(\lambda) + \log(K_g) \qquad (11.1\text{-}6)$$

Equation 11.1-6 represents a straight line when $\log(R_g/y)$ is plotted versus $\log(\lambda)$; m is the slope of the line. This straight line is obtained by plotting R_g/y versus λ on logarithmic graph paper. By fitting actual data from KRB and Dresden 2, using least squares techniques, to the equation, the slope m can be obtained. This can be estimated on the plotted graph. With radiogas leakage at KRB over the nearly 5-year period varying from 0.001 to 0.056 Ci/sec at t = 30 minutes, and with radiogas leakage at Dresden 2 varying from 0.001 to 0.169 Ci/sec at t = 30 minutes, the average value of m was determined. The value form is 0.4 with a standard deviation of ±0.07. This is illustrated in Figure 11.1-1 as a frequency histogram. As can be seen from this figure, variations in m were observed in the range m = 0.1 to m = 0.6.

After establishing the value of $\bar{m} = 0.4$, the value of K_g can be calculated by selecting a value for R_g or, as has been done historically, by setting the total design-basis source-term magnitude at t = 30 minutes. With ΣR_g at 30 minutes equal to 100,000 μCi/sec, K_g can be calculated as being 2.6×10^7. Equation 11.1-4 then becomes

$$R_g = 2.6 \times 10^7 \, Y\lambda^{0.4} (1 - e^{-\lambda t}) (e^{\lambda t}) \qquad (11.1\text{-}7)$$

This updated noble radiogas source-term mixture has been termed the 1971 mixture to differentiate it from the diffusion mixture. The noble gas source term for each radioisotope can be calculated from Equation 11.1-7. The resultant source terms are presented in Table 11.1-2 as leakage from fuel at t = 0, at t = 7 sec, and at t = 30 minutes. While ^{85}Kr can be calculated using Equation 11.1-7, the number of confirming experimental observations was limited by the difficulty of measuring the very low release rates of this isotope. Therefore, the table provides an estimated range for ^{85}Kr based on a few actual measurements.

11.1.1.2 Radiohalogen Fission Products

Historically, the radiohalogen design-basis source term was established by the same equation as that used for noble radiogases. In a fashion similar to that used with gases, a simplified equation can be shown to describe the release of each halogen radioisotopes:

$$R_h = K_h Y \lambda^n \qquad (11.1\text{-}8)$$

The constant K_h describes the magnitude of leakage from fuel. The rate of halogen radioisotope leakage with respect to each other (composition) is expressed in terms of n, the exponent of the decay constant λ. As was done with the noble radiogases, the average value was determined for n. The value for $\bar{n}$ is 0.5 with a standard deviation of ±0.19. This is illustrated in Figure 11.1-2 as a frequency histogram. As can be seen from this figure, variations in n were observed in the range of n = 0.1 to n = 0.9.

As mentioned above, it appeared that the use of the previous method of calculating radiohalogen leakage from fuel was overly conservative. Figure 11.1-3 relates KRB and Dresden 2 noble radiogas and ^{131}I leakage. It can be seen from Dresden 2 data, during the period August 1970 to January 1971, that there is a relationship between noble radiogas and ^{131}I leakage under one fuel condition. However, there was no simple relationship for all fuel conditions experienced. Also, it can be seen that during this period, high radiogas leakages were not accompanied by high radioiodine leakage from the fuel. Except for one KRB datum point, all steady-state ^{131}I leakages observed at KRB or Dresden 2 were equal to or less than 505 μCi/sec. Even at Dresden 1 in March 1965, when severe defects were experienced in stainless-steel-clad fuel, ^{131}I leakages greater than 500 μCi/sec were not experienced. Figure 11.1-3 shows that these higher radioiodine leakages from the fuel were related to noble radiogas source terms of less than the design-basis value of 0.1 Ci/sec at t = 30 minutes. This may be partially explained by inherent limitations due to internal plant operational problems that caused plant derating.

In general, one would not anticipate continued operation at full power for any significant time period with fuel-cladding defects. These defects would be indicated by ^{131}I leakage from the fuel in excess of 700 μCi/sec. When high radiohalogen leakages are observed, other fission products will be present in greater amounts. This may increase potential radiation exposure to operating and maintenance personnel during plant outages following such operation.

Using these judgment factors and experience to date, the design-basis radiohalogen source terms from fuel were established based on an ^{131}I leakage of 700 μCi/sec. This value, as seen in Figure 11.1-3, accommodates the experience data and the design-basis noble radiogas source term of 0.1 Ci/sec at t = 30 minutes. With the ^{131}I design-basis source term established, K_h can be calculated as being 2.4×10^7, and halogen radioisotope release can be expressed by the following equation:

$$R_h = 2.4 \times 10^7 \, Y\lambda^{0.5} \, (1 - e^{-\lambda T}) \, (e^{-\lambda t}) \qquad (11.1\text{-}9)$$

Concentrations of radiohalogens in reactor water can be calculated using the following equation:

$$C_h = \frac{R_h}{(\lambda + \beta + y)M} \qquad (11.1\text{-}10)$$

Although carryover of most soluble radioisotopes from reactor water to steam is observed to be <0.1 percent (<0.001 fraction), the observed carryover for radiohalogens has varied from 0.1 percent to about 2 percent in newer plants. The average of observed radiohalogen carryover measurements has been 1.2 percent by weight of reactor water in steam with a standard deviation of ±0.9. In our present source-term definition, we have used a radiohalogen carryover of 2 percent (0.02 fraction).

The halogen release rate from the fuel can be calculated from Equation 11.1-9. Concentrations in reactor water can be calculated from Equation 11.1-10. The resultant concentrations are presented in Table 11.1-3.

11.1.1.3 Other Fission Products

The observations of other fission products and transuranic nuclides, including ^{239}Np, in operating BWRs are not adequately correlated by simple equations. For these radioisotopes, design-basis concentrations in reactor water have been estimated conservatively from experience data and are presented in Table 11.1-4. Carryover of these radioisotopes from the reactor water to the steam is estimated to be <0.1 percent (<0.001 fraction). In addition to carryover, however, decay of noble radiogases in the steam leaving the reactor results in production of noble gas daughter radioisotopes in the steam and condensate systems.

Some daughter radioisotopes, such as yttrium and lanthanum, were not listed as being in reactor water. Their independent leakage to the coolant is negligible. However, these radioisotopes may be observed in some samples in equilibrium or approaching equilibrium with the parent radioisotope.

Except for ^{239}Np, trace concentrations of transuranic isotopes have been observed in only a few samples where extensive and complex analyses were carried out. The predominant alpha emitter present in reactor water is ^{242}Cm at an estimated concentration of 10^{-6} μCi/g or less, which is below the maximum permissible concentration in potable water applicable to continuous use by the general public. The concentration of alpha-emitting plutonium radioisotopes is more than one order of magnitude lower than that of ^{242}Cm. Plutonium-241, a beta emitter, may also be present in concentrations comparable to the ^{242}Cm level.

11.1.1.4 Nomenclature

The following nomenclature defines the terms used in equations for source-term calculations:

R_g = Leakage rate of noble gas radioisotope, μCi/sec

R_h = Leakage rate of halogen radioisotope, μCi/sec

y = Fission yield of radioisotope, atoms/fission

λ = Decay constant of radioisotope, per sec

T = Fuel irradiation time, sec

t = Decay time following leakage from fuel, sec

m = Noble radiogas decay constant exponent, dimensionless

n = Radiohalogen decay constant exponent, dimensionless

K_g = Constant establishing level of noble radiogas leakage from fuel

k_h = Constant establishing level of radiohalogen leakage from fuel

C_h = Concentration of halogen radioisotope in reactor water, μCi/g

M = Mass of water in operating reactor, g

β = Reactor water cleanup system removal constant, per sec

$$\beta = \frac{\text{Reactor water cleanup system flow rate, g/sec}}{\text{M,g}} \qquad (11.1\text{-}11)$$

$\gamma =$ Halogen steam carryover removal constant, per sec

$$\gamma = \frac{\left[\frac{\text{con.of halogen radiosotope in steam,}\mu\text{Ci/g}}{C_h}\right][\text{steam flow,g/sec}]}{M} \qquad (11.1\text{-}12)$$

11.1.2 Activation Products

11.1.2.1 Coolant Activation Products

The coolant activation products are not adequately correlated by simple equations. Design-basis concentrations in reactor water and steam have been estimated conservatively from experience data. The resultant concentrations are presented in Table 11.1-5. For plant operation with Hydrogen Water Chemistry, in-plant tests have shown that the N-16 steam activity values will increase by a maximum factor of six.

11.1.2.2 Noncoolant Activation Products

The activation products formed by activation of impurities in the coolant or by corrosion of irradiated system materials are not adequately correlated by simple equations. The design-basis source terms of noncoolant activation products have been estimated conservatively from experience data. The resultant concentrations are presented in Table 11.1-6. Carryover of these isotopes from the reactor water to the steam is estimated to be <0.1 percent (<0.001 fraction).

11.1.3 Tritium

The estimated amount of tritium released from Fermi 2 is calculated using the GALE code contained in NUREG-0016, Rev. 1. Actual amounts released are determined by sampling and included in the Annual Radioactive Effluent Release Report. The portions of this section discussing specific amounts of tritium released have been left in for historical reference.

In a BWR, tritium is produced by three principal methods:

a. Activation of naturally occurring deuterium in the primary coolant

b. Nuclear fission of UO_2 fuel

c. Neutron reactions with boron used in reactivity control rods.

With regard to tritium, which may be released from a BWR in liquid or gaseous effluents, the tritium formed in control rods which is released is believed to be negligible. A prime source of tritium available for release from a BWR is that produced from activation of deuterium in the primary coolant. Some fission product tritium may also transfer from fuel to primary coolant. This discussion is limited to the uncertainties associated with estimating the amounts of tritium generated in a BWR which are available for release.

All of the tritium produced by activation of deuterium in the primary coolant is available for release in liquid or gaseous effluents. The tritium formed in a BWR can be calculated using the equation

$$R_{act} = \frac{\Sigma\phi V\lambda}{3.7 \times 10^4 P} \qquad (11.1\text{-}13)$$

where

R_{act}	=	tritium formation rate by deuterium activation, μCi/sec/MWt
Σ	=	macroscopic thermal neutron cross section, cm^{-1}, for deuterium
ϕ	=	thermal neutron flux, neutrons/cm^2/sec
V	=	coolant volume in core, cm^3
λ	=	tritium radioactive decay constant, 1.78 x 10^{-9} sec^{-1}
P	=	reactor power level, MWt

For recent BWR designs, R_{act} is calculated to be 1.3 ± 0.4 x 10^{-4} μCi/sec/MWt. The uncertainty indicated is derived from the estimated errors in selecting values for the coolant volume in the core, coolant density in the core, abundance of deuterium in light water (some additional deuterium will be present because of the H(n,γ) D reaction), thermal neutron flux, and macroscopic cross section for deuterium.

The fraction of tritium produced by fission which may transfer from fuel to the coolant, and which will then be available for release in liquid and gaseous effluents, is much more difficult to estimate. However, since zircaloy-clad fuel rods are used in BWRs, essentially all fission product tritium remains in the fuel rods unless defects are present in the cladding material (Reference 4).

The study made at Dresden 1 in 1968 by the U.S. Public Health Service (USPHS) (Reference 5) suggests that essentially all of the tritium released from the plant could be accounted for by the deuterium activation source. For purposes of estimating the leakage of tritium from defective fuel, the assumption can be made that it leaks in a manner similar to the leakage of noble radiogases. Thus, the empirical relationship described as the diffusion mixture can be used for predicting the source term of individual noble gas radioisotopes as a function of total noble gas source term. The equation that describes this relationship is

$$R_{dif} = Ky\sqrt{1} \qquad (11.1\text{-}14)$$

where

R_{dif}	=	leakage rate of radioisotope, μCi/sec
y	=	fission yield fraction
λ	=	radioactive decay constant, sec^{-1}
K	=	constant related to total leakage rate

If the total noble radiogas source term is 10^5 μCi/sec after a 30-minute decay, leakage from fuel is calculated to be about 0.24 μCi/sec of tritium. To place this value in perspective in the USPHS study, the observed rate of ^{85}Kr, which has a half-life similar to that of tritium, was 0.06 to 0.4 times that calculated using the diffusion mixture relationship. This would suggest that the actual tritium leakage rate might range from 0.015 to 0.10 μCi/sec. Since the annual average noble radiogas leakage from a BWR is expected to be less than 0.1 Ci/sec at t = 30 minutes, the annual average tritium release rate from the fission source can be conservatively estimated at 0.12 ± 0.12 μCi/sec.

For a 3293-MWt reactor, the estimated total tritium appearance rate in reactor coolant and release rate in the effluent are about 17 Ci/yr.

Tritium formed in the reactor is generally present as tritiated oxide (HTO) and to a lesser degree as tritiated gas (HT). Tritium concentration in the steam formed in the reactor is the same as that in the reactor water at any given time. This tritium concentration is also present in condensate and feedwater. Since radioactive effluents generally originate from the reactor and power cycle equipment, radioactive effluents also have this tritium concentration. Condensate storage receives treated water from the radwaste system and rejects water from the condensate system. Thus, all plant process water should have a common tritium concentration.

Offgases released from the plant contain tritium, which is present as tritiated gas (HT) resulting from reactor water radiolysis as well as tritiated water vapor (HTO). In addition, a lesser amount present in ventilation air due to process steam leaks or evaporation from sumps, tanks, and spills on floors also contains tritium. The remainder of the tritium leaves the plant in liquid effluents.

Recombination of radiolysis gases in the offgas system forms water, which is condensed and returned to the main condenser. This tends to reduce the amount of tritium leaving in gaseous effluents. Reducing the gaseous tritium release results in a slightly higher tritium concentration in the plant process water. Reducing the amount of liquid effluent discharged also results in a higher process coolant equilibrium tritium concentration.

Essentially all tritium entering the primary coolant is eventually released to the environs, either as water vapor and gas to the atmosphere or as liquid effluent to the plant discharge. Reduction due to radioactive decay is negligible due to the 12-year half-life of tritium.

The USPHS study at Dresden 1 estimated that approximately 90 percent of the tritium release was observed in liquid effluent, with the remaining 10 percent leaving as gaseous effluent. Efforts to reduce the volume of liquid effluent discharges may change this distribution so that a greater amount of tritium leaves as gaseous effluent. The fraction of tritium leaving as liquid effluent may vary between 60 percent and 90 percent, with the remainder leaving in gaseous effluent.

11.1.4 Fuel Fission Product Inventory and Fuel Experience

11.1.4.1 Fuel Fission Product Inventory

Fuel rod and fuel plenum radioisotopic inventory, along with escape rate coefficients and release fractions, is not used in establishing BWR design-basis source-term coolant activities. Fuel fission product inventory information is used in establishing fission product source terms for accident analysis and is therefore discussed in Chapter 15.

11.1.4.2 Fuel Experience

A discussion of fuel experience gained for BWR fuel, including failure experience, burnup experience, and thermal conditions under which the experience was gained, is available in two GE topical reports (References 6 and 7).

11.1.5 Process Leakage Sources

The release of radioactive material from operating BWRs has generally resulted in doses to offsite persons which have been only a small fraction of permissible doses. With greater emphasis being placed on keeping doses from radioactive material in effluents as low as reasonably achievable, Edison utilizes augmented systems for further reduction of doses to offsite persons. Release paths such as process leaks into ventilation, which were previously negligible relative to normal effluents, become prominent although still negligible with respect to doses to offsite persons when augmented systems are provided on the principal process release pathways.

General Electric had a measurement program to identify and quantify these low-level release paths. Concurrently, analytical and mathematical model studies were performed to provide a description of the transport, residence, and release of various radionuclides in and from an operating BWR. This BWR Radiochemical Mode has been supplied in NEDO-10871 (Reference 8).

Expected sources of liquid and gaseous radwaste releases are described in Sections 11.2 and 11.3, respectively.

Process leakage measurements and control methods are further discussed in Subsections 5.2.7 and 7.1.2.

11.1 SOURCE TERM

REFERENCES

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2. Nuclear Regulatory Commission, "Fermi 2 - Amendment 87 to Facility Operating License No. NPF-43" (TAC M82101), September 9, 1992.
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4. J. W. Ray, "Tritium in Power Reactors," Reactor and Fuel-Processing Technology, 12(1), pp. 19-26, Winter, 1968-1969.
5. B.Kahn et al., Radiological Surveillance Studies at a Boiling Water Nuclear Power Reactor, BRH/DER 70-1, U.S. Public Health Service, March 1970.
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7. H. E. Williamson and D. C. Ditamore, Experience With BWR Fuel Through September 1971, NEDO-10505, General Electric Company, May 1972.
8. General Electric Company, Technical Derivation of BWR 1971 Design Basis Radioactive Source Terms, NEDO-10871, March 1973.

TABLE 11.1-1 SCALE-UP FACTORS FOR RADIOACTIVE WASTE MANAGEMENT-EFFECT OF POWER UPRATE

	Scale-up Factor, F*				
	Source Terms	Liquid Effluents	Gaseous Effluents	Offgas Effluents	Solid Radwaste
Reactor Water Activity, F1	1.02				
Main Steam Activity Mass Concentration, F1	1.02				
Reactor Coolant Activity, F1		1.02			1.02
Reactor Coolant Mass Flow Rate, F2		1.02			1.02
Combined Release to Environment and Doses to Public F1 x F2		1.04			1.04
Mainstream Activity Mass Concentration, F1			1.02		
Mainsteam Flowrate, F2			1.02		
Combined Gasesous Release Rate, Released Activity, Resultant Dose, F1 x F2			1.04		
Reactor Steam Activity Mass Concentration, F1				1.02	
Reactor Steam Mass Flow Rate, F3				1.024	
Offgas System Activities, F1 x F3				1.044	

* Calculation of F1, F2, F3

Thermal Power Level, Original power, Uprated power, MWt	3430
102% of Uprated Power, MWt	3499
Scale-up Factor, F1 = 3499/3430	1.02
Scale-up Factor, F2 = 3499/3430	1.02
Scale-up Factor, F3 = Linear Extrapolation of Steamflow Rate	1.024

[14,156 lbm/hr @ 3293 MWt; 14,864 lbm/hr @ 3430; 15,220 lbm/hr @ 3499]

TABLE 11.1-2 NOBLE RADIOGAS SOURCE TERMS

Isotope	Half-Life	Release Rate at t = 0 (μCi/sec)	Release Rate[a] at t = 7 sec (μCi/sec)	Release Rate at t = 30 minutes (μCi/sec)
Kr-83m	1.86 hr	3.4(3)[b]	3.4(3)	2.9(3)
Kr-85m	4.4 hr	6.1(3)	6.1(3)	5.6(3)
Kr-85	10.74 years	10 to 20[c]	10 to 20[c]	10 to 20[c]
Kr-87	76 minutes	2.0(4)	2.0(4)	1.5(4)
Kr-88	2.79 hr	2.0(4)	2.0(4)	1.8(4)
Kr-89	3.18 minutes	1.3(5)	1.27(5)	1.8(2)
Kr-90	32.3 sec	2.8(5)	2.41(5)	
Kr-91	8.6 sec	3.3(5)	1.88(5)	
Kr-92	1.84 sec	3.3(5)	2.36(4)	
Kr-93	1.29 sec	9.9(4)	2.30(3)	
Kr-94	1.0 sec	2.3(4)	1.80(2)	
Kr-95	0.5 sec	2.1(3)	1.28(-1)	
Kr-97	1 sec	1.4(1)	1.09(-1)	
Xe-131m	11.96 days	1.5(1)	1.5(1)	1.5(1)
Xe-133m	2.26 days	2.9(2)	2.9(2)	2.8(2)
Xe-133	5.27 days	8.2(3)	8.2(3)	8.2(3)
Xe-135m	15.7 minutes	2.6(4)	2.59(4)	6.9(3)
Xe-135	9.16 hr	2.2(4)	2.2(4)	2.2(4)
Xe-137	3.82 minutes	1.5(5)	1.47(5)	6.7(2)
Xe-138	14.2 minutes	8.9(4)	8.85(4)	2.1(4)
Xe-139	40 sec	2.8(5)	2.48(5)	
Xe-140	13.6 sec	3.0(5)	2.1(5)	
Xe-141	1.72 sec	2.4(5)	1.43(4)	
Xe-142	1.22 sec	7.3(4)	1.37(3)	
Xe-143	0.96 sec	1.2(4)	7.66(1)	
Xe-144	9 sec	5.6(2)	3.27(2)	
	TOTAL	~2.5(6)	~1.40(6)	~1.0(5)

[a] Source term to steam-jet air ejector.

[b] $3.4(3) = 3.4 \times 10^3$.

[c] Estimated from experimental observations.

TABLE 11.1-3 HALOGEN ISOTOPES IN REACTOR WATER (3499 MWt)

Isotope	Half-Life	Concentration (μCi/g)
Br-83	2.40 hr	1.5(-2)[a]
Br-84	31.8 minutes	2.8(-2)
Br-85	3.0 minutes	1.7(-2)
I-131	8.065 days	1.3(-2)
I-132	2.284 hr	1.2(-1)
I-133	20.8 hr	9.1(-2)
I-134	52.3 minutes	2.4(-1)
I-135	6.7 hr	1.3(-1)

[a] 1.5(-2) = 1.5 x 10^{-2}.

TABLE 11.1-4 OTHER FISSION PRODUCT ISOTOPES IN REACTOR WATER (3499 MWt)

Isotope	Half-Life	Concentration (μCi/g)
Sr-89	50.8 days	3.2(-3)[a]
Sr-90	28.9 years	2.3(-4)
Sr-91	9.67 hr	7.0(-2)
Sr-92	2.69 hr	1.1(-1)
Zr-95	65.5 days	4.1(-5)
Zr-97	16.8 hr	3.3(-5)
Nb-95	35.1 days	4.3(-5)
Mo-99	66.6 hr	2.2(-2)
Tc-99m	6.007 hr	2.9(-1)
Tc-101	14.2 minutes	1.4(-1)
Ru-103	39.8 days	1.9(-5)
Ru-106	368 days	2.7(-6)
Te-129m	34.1 days	4.1(-5)
Te-132	78 hr	5.0(-2)
Cs-134	2.06 years	1.6(-4)
Cs-136	13 days	1.1(-4)
Cs-137	30.2 years	2.4(-4)
Cs-138	32.2 minutes	1.9(-1)
Ba-139	83.2 minutes	1.6(-1)
Ba-140	12.8 days	9.2(-3)
Ba-141	18.3 minutes	1.7(-1)
Ba-142	10.7 minutes	1.7(-1)
Ce-141	32.53 days	4.0(-5)
Ce-143	33.0 hr	3.6(-5)
Ce-144	284.4 days	3.6(-5)
Pr-143	13.58 days	3.9(-5)
Nd-147	11.06 days	1.4(-5)
Np-239	2.35 days	2.4(-1)

[a] 3.1(-3) = 3.1 x 10^{-3}.

TABLE 11.1-5 COOLANT ACTIVATION PRODUCTS IN REACTOR WATER AND STEAM (3499 MWt)

Isotope	Half-Life	Steam Concentration (µCi/g)	Reactor Water Concentration (µCi/g)
N-13	9.99 minutes	6.6(-3)[a]	4.1(-2)
N-16	7.13 sec	1.0(2)	6.2(1)
N-17	4.14 sec	1.6(-2)	6.4(-3)
O-19	26.8 sec	8.2(-1)	7.0(-1)
F-18	109.8 minutes	4.1(-3)	4.1(-3)

[a] 6.5(-3) = 6.5 x 10^{-3}.

Note: With Hydrogen Water Chemistry in operation, the N-16 steam concentration will increase by a maximum factor of six.

TABLE 11.1-6 NONCOOLANT ACTIVATION PRODUCTS IN REACTOR WATER (3499 MWt)

Isotope	Half-Life	Concentration (μCi/g)
Na-24	15 hr	2(-3)[a]
P-32	14.31 days	2(-5)
Cr-51	27.8 days	5(-4)
Mn-54	313 days	4(-5)
Mn-56	2.582 hr	5(-2)
Co-58	71.4 days	5(-3)
Co-60	5.258 years	5(-4)
Fe-59	45 days	8(-5)
Ni-65	2.55 hr	3(-4)
Zn-65	243.7 days	2(-6)
Zn-69m	13.7 hr	3(-5)
Ag-110m	253 days	6(-5)
W-187	23.9 hr	3(-3)

[a] 2(-3) = 2×10^{-3}.

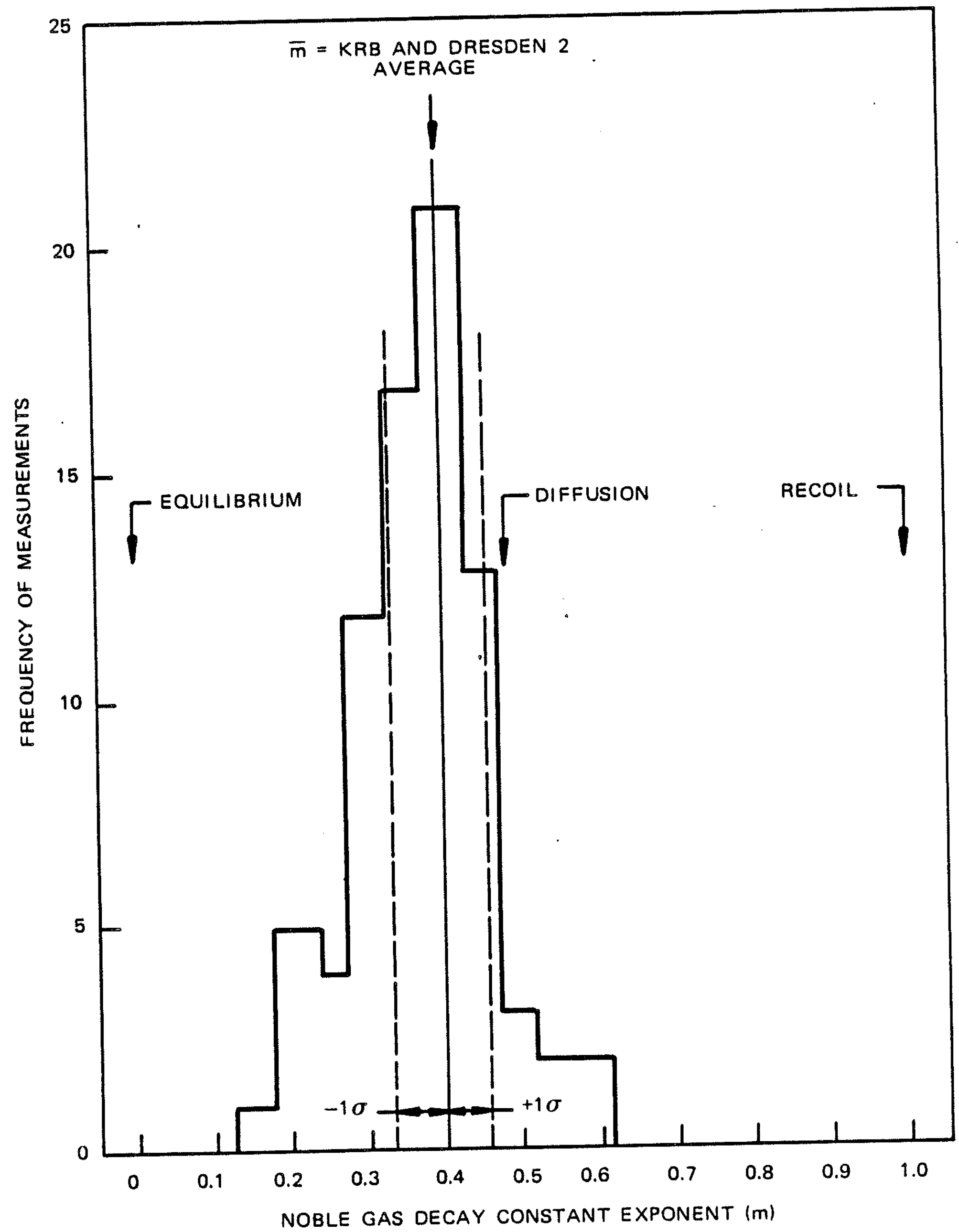

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FIGURE 11.1-1

NOBLE RADIOGAS DECAY CONSTANT EXPONENT FREQUENCY HISTOGRAM

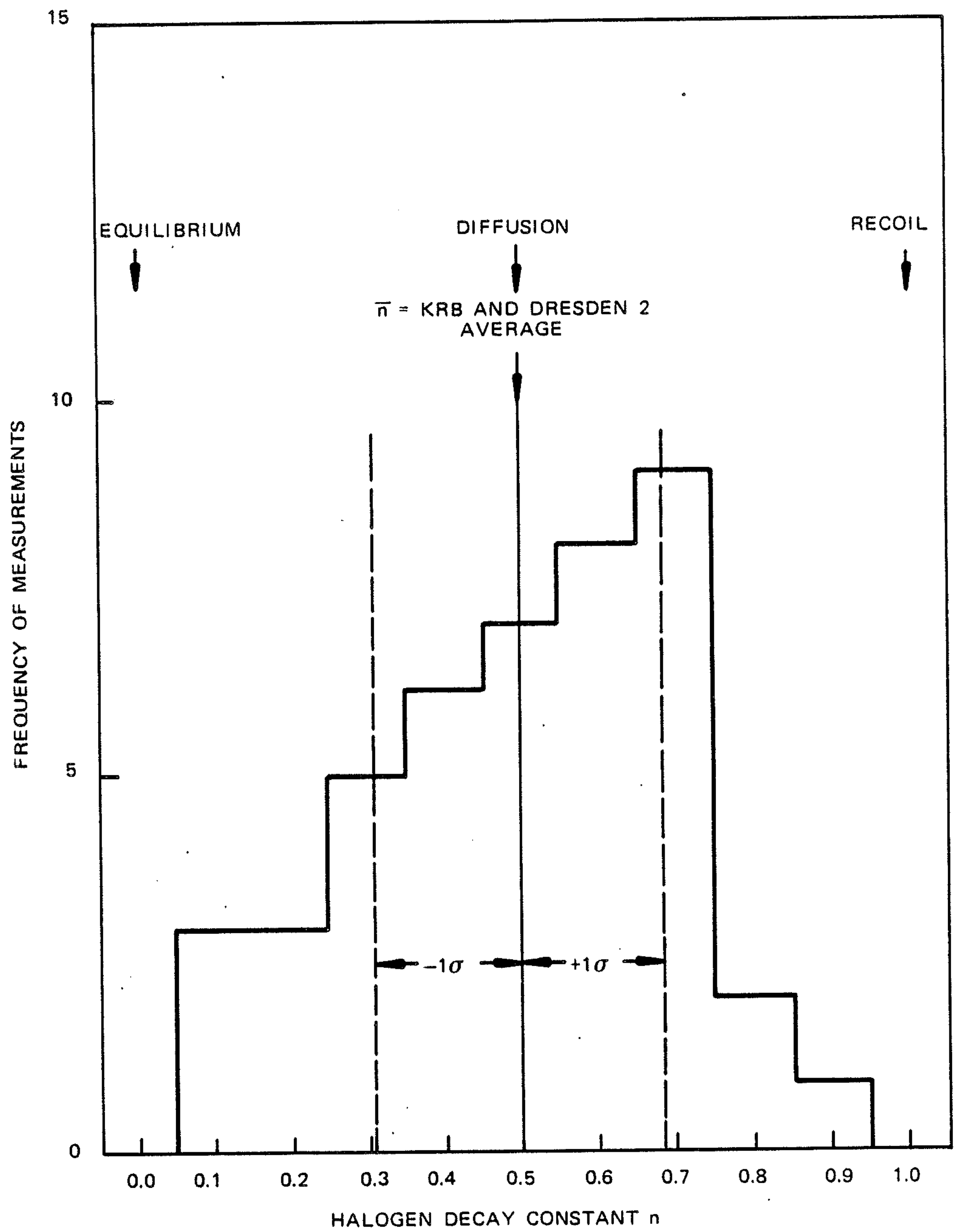

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FIGURE 11.1-2

RADIOHALOGEN DECAY CONSTANT EXPONENT FREQUENCY HISTOGRAM

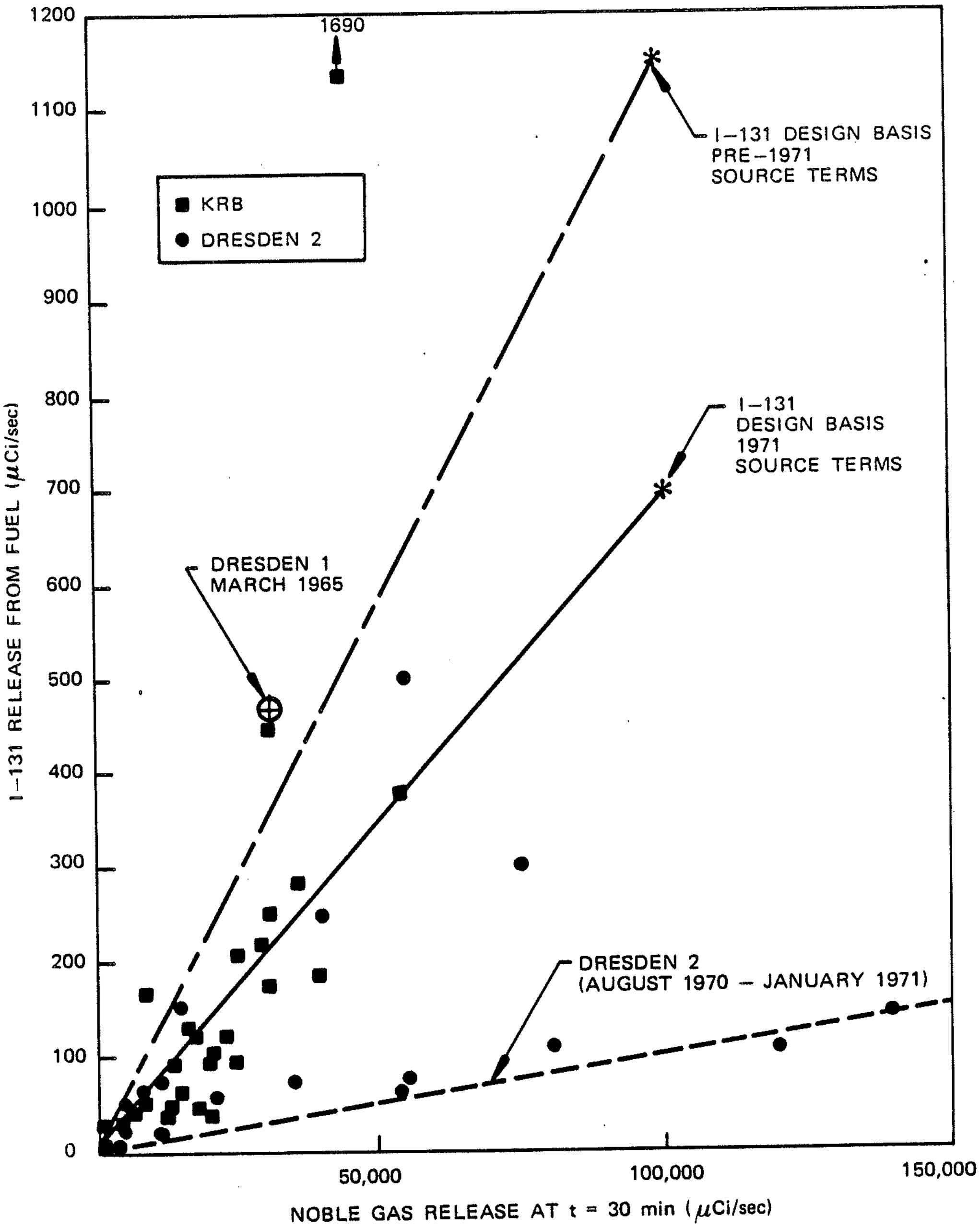

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FIGURE 11.1-3

NOBLE RADIOGAS VERSUS IODINE-131 LEAKAGE

11.2 LIQUID RADWASTE SYSTEM

The liquid radwaste system collects, monitors, processes, stores, and returns radioactive liquid wastes to the plant for reuse, or to the circulating-water reservoir blowdown line for controlled discharge. The collection and processing are done in a controlled, preplanned manner in compliance with established regulatory requirements. Any leakage or spillage due to equipment failure or malfunction will be contained and re-collected in the system. The system is capable of handling anticipated quantities of liquid radwaste without affecting the normal operation or availability of the plant.

11.2.1 Design Objectives

The liquid radwaste system is designed to function as follows:

a. Produce effluents that meet the limits of 10 CFR 20 and the design objectives of 10 CFR 50, Appendix I

b. Control and monitor releases of radioactive materials to the environment per the requirements of 10 CFR 50, Appendix A, General Design Criteria (GDC) 60 and 64

c. Produce treated waste of condensate quality for reuse within the plant

d. Provide the capacity to process liquid radioactive wastes produced in the plant during normal operation and during anticipated operational occurrences

e. Handle anticipated quantities of liquid radwaste without affecting the normal operation or availability of the plant

f. Segregate wastes into subsystems for more efficient processing

g. Provide alternative methods and redundancy of major items of equipment for processing radioactive liquids to ensure the flexibility of operation and maintenance

h. Use the plant drainage system to collect radioactive leakage or spillage due to equipment failure or malfunctions during normal plant operations

i. Provide for the transfer of liquid radwaste system processed waste by-products (evaporator bottoms, filter backwashes, tank sludge letdown, and spent resin) to the solid radwaste system

j. Protect plant personnel from radiation exposure and incorporate the basic as-low-as-reasonably-achievable (ALARA) objectives by the use of automated systems, shielding, and remotely operated instrumentation and controls.

Note: The following Section 11.2 description of the Liquid Radwaste System details the as-designed and as-installed design basis system. However, three of the described portions or subsystems are not presently being used, for various reasons. These subsystems remain in place and have not been isolated by any plant modifications, except as discussed in each section. They (and all components of them) have not officially been retired, or abandoned, and they could be made operational at some time in the future. Therefore, the full original design-basis description, usage, and tables for these items has been retained in Section 11.2 and all other pertinent sections of this UFSAR. These statements describing the system design are all technically correct; however, these items (and therefore their flow paths) are not considered operational at this time. These three subsystems or components are:

a. Radwaste Evaporator and supporting components

b. Two radwaste Etched-Disc Filters and supporting components

c. Two radwaste Oil Coalescers and supporting components

11.2.2 System Description

The liquid radwaste system is composed of two major subsystems--the floor drain collector (FDC) subsystem and the waste collector subsystem. The overall radwaste system's piping and instrumentation diagram is included as Figures 11.2-1 through 11.2-14, Figure 11.2-15 depicts the process flow diagram and Figure 11.2-16 (Sheets 1 through 3) depicts the sump pump diagrams.

Tables 11.2-1, 11.2-2, and 11.2-3 list the estimated design inputs to the liquid radwaste system along with the corresponding process flow diagram stream numbers (Figure 11.2-15).

At times the liquid radwaste system may produce water that may not be required for reuse in the station's water balance, in which case the system effluent could be discharged in a controlled manner to the circulating-water reservoir blowdown line. Processed liquid not meeting the criteria for either discharge or reuse is normally returned to the system for reprocessing.

The liquid and solid radwaste systems have a number of piping connections for use by portable waste-processing systems. (See Table 11.2-4 and Figure 11.2-15.) Vendor-contract services are available onsite for waste processing and solidification. These services meet applicable regulations and are more fully described in Subsections 11.2.10 and 11.5.6.

11.2.2.1 Floor Drain Collector Subsystem

The FDC subsystem will receive periodic and uncontrolled inputs from a variety of plant floor drain sources. The sources to this subsystem have been segregated from the waste collector subsystem because their water quality will probably be poor, will have high conductivity, and will normally contain higher contents of suspended and dissolved solids. The activity content will generally be lower than that of the waste collector subsystem. The estimated chemical characteristics of liquid radwaste input streams for this subsystem are listed in Table 11.2-5.

The chemical nature of the FDC subsystem inputs will also be highly variable. The effluent from the chemical waste tank will be particularly important to the overall stream process requirements because it is a source of high concentrations of dissolved solids. Periodic and variable quantities of oil and grease must also be accommodated by this subsystem. Most of this type of contaminant will be removed by the FDC oil coalescer when it is in service. Otherwise, but to a lesser extent, removal is accomplished by the precoat filters.

The FDC subsystem has an expected higher concentration of both dissolved and suspended solids, with a lower activity level and lower flow rate, than the waste collector subsystem.

Evaporators can be used to separate the FDC subsystem low-purity liquid by evaporation and condensation into a concentrated liquid that is fed to the solid radwaste system and a high-purity distillate that is fed to the FDC and waste collector demineralizers. Both the FDC and waste collector streams are normally passed through both demineralizers in series. Both subsystems offer independent etched-disk filters and oil coalescers to remove suspended solids and oil from the input liquids. In addition, precoat filters are provided for each stream but are not as volume-efficient because of the larger amount of solid radwaste they generate. The two streams are connected by a cross tie to allow the precoat filter or the etched-disk filter in the other stream to be used as a backup.

Each major input to the FDC subsystem is listed in Table 11.2-1 along with its corresponding stream number from Figure 11.2-15. Table 11.2-2 provides a summary of the design daily input to the chemical waste tank, which is in turn directed to the FDC tank for further processing.

The estimated design-basis daily volume inputs for the FDC subsystem total 15,219 gal, whereas the maximum daily volume input to this subsystem is calculated to be 42,284 gal. For the maximum volume input, it is assumed that the probability of the simultaneous occurrence of two or more volume input maximums is extremely low. Thus, the maximum is assumed to be the largest of the individual stream maximums plus the design daily inputs of the other streams. For this subsystem, the largest maximum daily volume input is estimated as 28,800 gal from the drywell floor drain sump. This amount, when added to the design daily volume inputs from the other FDC subsystem inputs, yields the maximum daily volume input value of 42,284 gal.

The normal collection point of the inputs to the FDC subsystem is the FDC tank, which has a working volume of about 20,000 gal. The design basis daily input of 15,219 gal can be accommodated for 1 day in the unlikely event of simultaneous failure of the redundant tank pumps. During the infrequent periods of anticipated maximum inputs, the waste surge tank will serve as an alternative collection point. This tank has a working volume of 65,700 gal and could contain the entire volumetric input (42,284 gal) to the FDC subsystem for 1 day during the maximum anticipated operational occurrence. Flow to the waste surge tank is accomplished by pumping from the FDC tank using the FDC pumps and the cross tie between the FDC subsystem and the waste collector subsystem.

Liquid radwaste system processing will normally be expected to be performed any time of day, 7 days a week; thus, for the design daily input case, an average FDC subsystem process rate of only 10.5 gpm would be required. For periods of maximum inputs, the FDC subsystem is capable of processing at a rate of at least 30 gpm. The processing rates account for periods of equipment unavailability during filter backwashes, resin replacement, and equipment maintenance. Generous liquid radwaste system subsystem interconnects, process equipment redundancy, and bypass capabilities provide maximum operational flexibility during periods of large input surges or unexpected equipment failures.

The FDC subsystem process equipment is discussed in Subsection 11.2.3.2.

11.2.2.2 Waste Collector Subsystem

The waste collector subsystem will receive periodic inputs from a variety of plant equipment drain sources. The equipment drain sources have been segregated from the FDC subsystem (and other sources) because the waste collector inputs will probably be of a higher purity (lower conductivity and suspended solids) than the FDC inputs. The activity concentration in the waste collector subsystem will tend to be higher than in the FDC subsystem. The estimated chemical characteristics of the liquid radwaste input streams for this subsystem are listed in Table 11.2-5.

Like the FDC subsystem, the chemical nature of the waste collector subsystem inputs will be variable, but should not be subject to the large fluctuations that may occur in the FDC subsystem. It is assumed that oil and grease will be present in the waste collector subsystem input, although this should occur much less frequently than in the FDC subsystem. Oil coalescers are included to provide for oil removal before ion exchange.

The waste collector subsystem process equipment is designed to also handle liquid input from the solid radwaste system. This consists of the discharge from the waste surge tank, whose primary function is to collect clarified liquid from the waste clarifier tank. Most of the clarified liquid is produced by the phase separator tank decant operation within the solid radwaste system. The solid radwaste system input to the waste collector subsystem enters downstream of the waste collector tank and, therefore, has no bearing on the size of the waste collector tank. Table 11.2-3 lists the design-basis daily volume input to the waste collector subsystem.

The combined result of all equipment drain inputs to the waste collector subsystem is represented by the waste collector tank effluent.

The estimated design-basis daily volume inputs for the waste collector subsystem total 28,805 gal. The maximum daily equipment drain volume input to this subsystem is calculated to be 48,846 gal. It is assumed that the probability of the simultaneous occurrence of two or more input maximums is extremely low; therefore, the maximum input is assumed to be the largest of the individual stream maximums plus the design daily volume inputs of the other streams. For this subsystem, the largest maximum daily equipment drain volume input will be 28,800 gal from the drywell equipment drain sump. This amount, when added to the design daily volume inputs from the other waste collector subsystem inputs, yields the maximum daily volume input value of 48,846 gal.

The collection point for the equipment drain volume input to the waste collector subsystem is the waste collector tank, which has a working volume of about 23,400 gal. The waste surge tank (which has a working volume of about 65,700 gal) will serve as the backup collection point for excessive equipment drain volume input to the waste collector subsystem.

The waste collector subsystem process equipment is discussed in Subsection 11.2.3.2.

11.2.2.3 Side Stream Liquid Radwaste Processing Subsystem

The Side Stream Liquid Radwaste Processing Subsystem (SSLRPS) processes primarily Chemical Waste Tank (CWT) contents prior to forwarding to the Floor Drain Collector Tank (FDCT). In addition, it processes liquids, such as: sludge from various building sumps, water collected in 55 gallon drums from the Standby Liquid Control System rinses during refueling outages and water from mopping of the building floors.

The SSLRPS includes two 45 kW evaporators, and two 20 gpm trains of Post Treatment System (PTS). Each train of PTS consists of a Granulated Active Charcoal Filter, an Ultra

Violet (UV) Total Organic Carbon (TOC) reducing System, and a Mixed Bed Filter, and associated Tanks, pumps and other system components as shown in Figure 11.2-18, Sheets 1, 2, and 3.

Each evaporator processes liquids in 55 gallons batches at a nominal rate of 0.2 gpm. The vapors from the evaporator will be condensed in a water-cooled condenser and collected in the Post Treatment Inlet Batch (PIB) Tank. The evaporator bottoms will be processed and shipped as solid radwaste. Liquids from the PIB Tank will be processed in one or both trains of the Post Treatment System, at a nominal rate of 20 gpm per train. PTS can process FDCT liquids at a nominal 40 gpm rate, when needed, using both streams of the system.

The Post Treatment System processes consist of carbon adsorption columns, photo-chemical oxidation of soluble organics using Ultraviolet (UV) light reactors and mixed bed filtration in succession. Particles above 5 microns in size and approximately, 90 percent of the Total Organic Carbon (TOC) will be removed by the Carbon filters. The effluents from the Carbon Bed Filters will flow through one or both of the UV Reactors. The UV reactors oxidize soluble organics into organic acids that can be more effectively removed by adsorption or ion exchange. The UV also kills bacteria, if present, in the liquid stream. The effluents from either of the UV reactors will flow through one or both mixed bed filters. The mixed bed filters remove the soluble organic acids generated by the UV reactors via adsorption and ion exchange.

The processed liquid will be collected in the Sample Batch Tank and returned to the FDCT via Radwaste Building basement floor drain system.

11.2.3 System Design

The liquid radwaste system is designed to ensure that system operation can be accomplished in a safe manner and to minimize the accumulated radiation exposure to system operators. Design practices that result in the achievement of the ALARA philosophy are used throughout. Where appropriate, redundant pump capacity is provided. Shielding is located to protect workers from operating equipment radiation.

The liquid radwaste system is designed to accommodate ease of maintenance in a radiation area, and, to the extent practicable, components are separated by shield walls to reduce radiation exposure to maintenance personnel. Clearance provisions are adequate for in-place maintenance activities and for the removal or replacement of components.

All normal liquid release pathways to the environment are continuously monitored to ensure that the dose to the general public will be well within the allowable limits of 10 CFR 20 and 10 CFR 50, Appendix I.

11.2.3.1 System Classifications

The following documents govern the codes, regulatory classifications, and regulatory requirements of the liquid radwaste system:

a. 10 CFR 20, Standards for Protection Against Radiation

b. 10 CFR 50, Appendix A, General Design Criteria for Nuclear Power Plants (GDC 60 and 64)

c. 10 CFR 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents

d. Regulatory Guide 1.143, Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants (Revision 1, October 1979)

e. Regulatory Guide 1.26, Quality Group Classifications and Standards for Water, Steam, and Radioactive Waste Components of Nuclear Power Plants

f. Regulatory Guide 8.8, Information Relevant to Ensuring That Occupational Radiation Exposure at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable.

The initial design classification of the liquid radwaste system was Quality Group D per Regulatory Guide 1.26. The current design, which is based on Regulatory Guide 1.143, retains the Quality Group D classification (Table 11.2-6).

Table 11.2-6 lists both ASTM and ASME Section II materials for use in atmospheric and 0- to 15-psig storage tanks rather than ASME Section II materials only. The reasons for this are as follows:

a. API-650 and AWWA-D100 specify materials conforming to ASTM specifications

b. ASTM material specifications and ASME Section II material specifications are essentially identical.

For the Fermi 2 radwaste modification, the materials employed for the fluid-retaining boundaries of new atmospheric tanks and modifications to existing atmospheric tanks conform to ASME Section II material specifications as listed, respectively, in Tables 11.2-7 and 11.5-2. The single exception to the conformance is the material for the new, conical bottom of the spent resin tank. ASTM A36 material is used rather than ASME SA-36. However, material specifications for ASTM A36 and ASME SA-36 are essentially identical.

Table 11.2-6 lists manufacturers' standards for welder qualification and procedures as well as ASME Section IX for welding employed in the manufacture of pumps. In this respect, Table 11.2-6 conforms to Table 4-1 of ANSI/ANS-55.1 and Table 2 of ANSI/ANS-55.6. The reason for not excluding manufacturers' standards in Table 11.2-6 is that the pumps used in radwaste systems are frequently of a standard commercial design, and welding that meets the requirements of ASME Section IX is not always available.

Regulatory Guide 1.143 also requires that foundations of walls and structures housing the liquid radwaste system be designed to specified seismic criteria to a height sufficient to contain the liquid inventory expected to be in the building. Seismic calculations previously performed by Edison show that the radwaste building satisfies Category I requirements; therefore, it meets the criteria of Regulatory Guide 1.143.

Regulatory Guide 1.143 and Standard Review Plan 15.7.3 require an analysis to assess the consequences of a hypothetical uncontrolled release of radioactive liquids and the effect of the release on the health and safety of the public. The initiating event for this accident sequence would be a seismically induced total failure of the liquid radwaste system. This assumption is conservative compared with the requirements in Regulatory Guide 1.29. Subsection 15.7.3 describes the basic method and results of this analysis. The results of the analysis indicate offsite radioactivity concentrations that are well within the NRC requirements stated in Appendix B of 10 CFR 20.

11.2.3.2 Process Equipment Description

The process equipment for the liquid radwaste system is capable of processing several combinations of chemical and/or radioactive inputs.

One component of the FDC system is the evaporator subsystem (two redundant low-pressure, single-shell, submerged-tube units). The use of the evaporators is optional (at the discretion of the plant, based upon such considerations as economics, ALARA, input-stream characteristics, offsite releases and doses, etc.), and the system design has provided evaporator bypasses directly to the radwaste demineralizers. The evaporators are preceded in the FDC system by either the precoat filter or the etched-disk filter and oil coalescer train. The etched-disk filter serves several functions: (1) it removes particulates larger than 5 μm in order to minimize plugging and changeout of the oil coalescer; (2) it removes particulates that would lead to fouling and scaling of the evaporators; and (3) if the evaporators are bypassed, the etched-disk filter will remove particulates that could affect the downstream demineralizers. The oil coalescer removes emulsified oil and grease that would foul the downstream demineralizers or cause foaming and carryover from the evaporators.

If the evaporators are in use, evaporator distillate is pumped through two mixed-bed demineralizers normally aligned in series. The demineralizers serve to polish the evaporator distillate in order to achieve condensate-quality effluent. Processed water qualifies as condensate-grade water and can be reused within the plant if it meets the specifications listed in Table 11.2-8.

Because the specific conductivity of input streams to the waste collector subsystem is normally expected to be low (less than 50 μmho/cm), demineralization was selected as the primary processing method. The demineralizers are also preceded by a 5-μm etched-disk filter and an oil coalescer to remove particulates, oil, and grease that could foul the demineralizer resin. The waste collector subsystem precoat filter, located in parallel with the etched-disk filter/oil coalescer train, can otherwise be placed in service. Two mixed-bed demineralizers, normally aligned in series, remove dissolved solids. Although one demineralizer is assigned to the FDC subsystem and the other to the waste collector subsystem, they are normally used in series and process the FDC or waste collector streams.

The principal design parameters for the major liquid radwaste system components are given in Table 11.2-7.

11.2.3.2.1 Floor Drain Collector Tank

The FDC tank collects drainage containing high concentrations of dissolved and suspended solids from the drywell, reactor building, turbine building, radwaste building, and onsite storage facility. The system is designed so that liquid can be normally processed through combinations of etched-disk filters, oil coalescers, precoat filters, evaporators, and demineralizers.

The expected normal design-basis volume input is 15,219 gal, as shown in Figure 11.2-15, stream number 23. The tank working volume is about 20,000 gal. The estimated normal processing rate from this tank is about 50 gpm.

The FDC tank is provided with a slant bottom and sludge well to enhance sludge blowdown. The sludge blowdown is augmented by spray nozzles at the tank bottom to direct settled solids to the sludge well. The tank is provided with a bottom sludge connection located in the tank floor at the sludge well and also a decant connection located in the vertical tank wall about 2 ft above the sludge connection. The lines from these two connections join into a three-way diverter valve whose position can be set to allow pump suction to be taken from either connection. During the bottoms mode of operation, the tank contents will be pumped out through the bottom sludge connection. The decant connection can be used either for normal operations or when large quantities of wastes containing high concentrations of suspended solids are input to the tank. In this case, suspended solids would be allowed to settle to the tank bottom, and liquid would be drawn off the top and out the decant connection for processing through the downstream filter. The settled solids (sludge) in the tank bottom can be directed to the sludge well and then pumped out through the bottom sludge connection to the condensate phase separators. The drain to the tank is blind flanged outside the cubicle. Tank overflow is directed to the radwaste building floor drain sump. The tank is vented to the building vent system through a 4-in. connection.

11.2.3.2.2 Floor Drain Collector Pumps

The purpose of the FDC pumps is to transfer liquid waste from the FDC tank through one of the following:

a. Floor drain etched-disk filter and oil coalescer to the evaporator feed tank

b. Floor drain precoat filter to the evaporator feed surge tank

c. Waste collector precoat filter or etched-disk filter and oil coalescer to the evaporator feed tank

d. Spray nozzles in the FDC tank (recirculation line)

e. Waste surge tank.

The pumps are also used on an infrequent basis to pump the FDC tank sludge letdown to the phase separator tanks in the solid radwaste system.

The capacity of these pumps is determined from the overall processing rate requirements of the FDC subsystem. For design daily inputs, the stream should be able to process at a minimum rate of 10.5 gpm and at a rate of 29.3 gpm during peak input surges. The actual pumps used for this service are sized to deliver flow in a range of 100 to 150 gpm. Two 100 percent-capacity pumps are provided for this purpose.

11.2.3.2.3 Floor Drain and Waste Collector Etched-Disk Filters

Floor drain and waste collector etched-disk filters are designed to remove suspended solids particles down to 5 μm in size. The particulate removal serves the following three purposes:

a. To prevent premature plugging of the downstream oil coalescers

b. To prevent large particulates from entering the evaporators

c. To remove particulates that could plug the downstream demineralizers.

The floor drain and waste collector etched-disk filters are estimated to remove most of the suspended solids that enter the liquid radwaste system via the FDC and waste collector subsystems. When the FDC tank effluent (stream 23) is processed, the flow rate will normally be about 50 gpm and the average suspended solids content is estimated to be about 129 ppm. Since the floor drain etched-disk filter was designed as a backup to the waste collector etched-disk filter, it should also be capable of processing the combined flows of the waste collector subsystem for streams 24 and 40. The average suspended solids input from the waste collector subsystem is estimated at 20 ppm.

The etched-disk filters for the floor drain and the waste collector are identical. Since the normal flow rate through the floor drain etched-disk filter is less than that through the waste collector etched-disk filter, it should have a higher dirt-holding capacity before reaching the automatic differential pressure cutoff prior to backwashing. When operated at 50 gpm, the etched-disk filter is calculated to hold 2.64 lb of suspended solids before reaching 75 psid across the filter. At 140 gpm, the etched-disk filter is calculated to hold 1 lb of suspended solids before reaching 75 psid. These values are based upon the assumed water/crud characteristics (5 percent suspended solids smaller than 5 μm).

The etched-disk filter was selected for this service because it was thought to require little or no filter-aid material that would otherwise add to the ultimate volume of the solid radwaste system. The filters require primarily air for backwashing; they add minimal backwash water for processing by the liquid radwaste system.

The etched-disk filter consists of stacks of hundreds of individual disks, each of which is chemically etched on the top surface. When the disks are stacked, the top surface of one disk against the bottom surface of another forms pores around the perimeter of the stack. The etching is controlled so that the pore size is equal to the minimum particle size to be removed. These stacks of disks are placed inside a vessel, and wastewater is pumped into the vessel, where it flows perpendicular to the stacks, through the pores into the center of the stacks, and out the top of the filter vessel. Suspended solids in the wastewater are trapped in the pores and retained on the exterior of the stacks.

The backwash sequence proceeds automatically after being initiated by a high differential pressure signal across the filter as sensed by a pressure element or by manual initiation. Backwashing takes about 2 minutes.

Filter backwash for both the waste collector and floor drain etched-disk filters is directed to the condensate phase separator tank A. The total backwash volume is about 21 gal.

11.2.3.2.4 Floor Drain and Waste Collector Oil Coalescers

The oil coalescers remove mechanically emulsified oil from the floor drain and waste collector subsystems to maintain the optimal performance of the downstream process equipment. If sufficient oil is present in the wastewater, the downstream demineralizer resins will be coated with oil, degrading the demineralizing capacity and necessitating more frequent resin-bed changeout. The upstream etched-disk filters should normally be in service at all times when the oil coalescers are operating.

Although it is not possible to quantify all experience with oil in radwaste systems, oil has historically presented serious operational problems. Some plants have instituted strict administrative controls to prevent oil from entering the radwaste system.

These controls have included careful surveillance for oil leaks, immediate isolation of leaks, and the isolation of any oil-contaminated sumps. These measures require the dedication of manpower and the collection of spilled or leaked oil by makeshift means. Oil may enter the radwaste collection tanks if the source is not discovered and isolated quickly.

Oil in the radwaste system could affect the performance of demineralizers and evaporators. Any goal of maximum recycle of processed water to the condensate system requires that oil be minimized or removed.

The assumed design oil concentrations in the collector tanks are somewhat subjective and actual values will depend on administrative control procedures and general housekeeping. A survey of floor and equipment drains at Fermi 2 showed that oil sources were fairly well segregated from the equipment drains that flow to the waste collector subsystem. Therefore, the higher concentrations of oil would be in the floor drain subsystem. In design work for oil-removal systems for coal-fired generating stations, the designer had considered 100 ppm of oil in the influent stream as the design basis. Sample data available to the designer for the FDC tank at another BWR averaged approximately 66 ppm over a 6-month period and almost 9 ppm for the waste collector tank. For Fermi 2, design-basis averages of 5 ppm and 20 ppm for the waste collector and FDC subsystems, respectively, were selected.

The option to use oil coalescers was based only on the assumed use of etched-disk prefilters. Otherwise, the oil coalescers would experience rapid pressure buildup and plugging, since they have a 3-μm rating for other suspended solids.

The floor drain oil coalescers will be used as backup for the waste collector subsystem coalescers and vice versa. Hence, both oil coalescers are designed to handle maximum flows of 150 gpm.

11.2.3.2.5 Waste Oil Tank

The waste oil tank collects the oily wastes from the two liquid radwaste system oil coalescers. Since the flow of oil to the tank is small, long-term oil storage is also provided by this tank.

The tank is sized to provide a minimum of 1 year of oil storage from the oil coalescers. The maximum expected oil flow is less than 300 gal per year; therefore, a tank size of 1000 gal provides both storage and a contingency for carryover from the coalescers and unexpected oil spills.

11.2.3.2.6 Waste Oil Pump

The waste oil pump transfers the waste oil from the waste oil tank to a portable disposal container.

The pump capacity (10 gpm) is based on emptying the waste oil tank (1000-gal capacity) in about 100 minutes. The pump differential pressure will be about 150 psi when the oil temperature is near 40°F. If the oil temperature is 60°F, the differential pressure is about 75 psi.

11.2.3.2.7 Evaporator Feed Surge Tank

This tank is for collection of the water from the FDC subsystem after filtration. Because the FDC subsystem is designed for a nominal 50 gpm processing rate and the evaporator system is designed for a nominal 30 gpm rate, the evaporator feed surge tank provides surge capacity.

The input to the tank contains minimal suspended solids, and the tank is therefore not provided with either a slant bottom or a sludge-drawoff line.

The tank is designed to be at least large enough to contain 15,219 gal, the design daily input from the FDC subsystem. The evaporator feed surge tank has a capacity of 25,000 gal, which will accommodate the design inputs for 1 day assuming the failure of the redundant tank discharge (evaporator feed) pumps. Downstream processing from this tank can normally occur 24 hr per day. It can be emptied of the design daily input in about 8 hr, assuming there are no further inputs to it.

11.2.3.2.8 Evaporator Feed Pumps

The evaporator feed pumps process water from the evaporator feed tank under different operating modes, as follows:

a. From the evaporator feed tank to the evaporator

b. From the evaporator feed tank through the floor drain and waste collector demineralizers to the waste sample tank when the evaporators are bypassed

c. Recycle or recirculation back to the evaporator feed tank through an eductor

d. From the evaporator feed tank to portable demineralization equipment in the onsite storage facility.

e. From evaporator feed tank to the Side Stream Liquid Radwaste Processing System distillation inlet batch tank

The capacity of the pumps is determined from the nominal evaporator-processing capacity of 30 gpm. The pump head is based on the head requirements for the above modes of operation. Two 100 percent-capacity pumps are provided.

11.2.3.2.9 Evaporators

The two redundant evaporators can process the prefiltered FDC subsystem low-purity waste by evaporation and condensation to produce concentrated liquid bottoms and a high-purity distillate.

The dissolved solids in the wastewater, including dissolved radioactive material, are concentrated in the evaporator bottoms. The evaporators provide the function of concentration or volume reduction of radioactive and nonradioactive material in the floor drain wastewater. The evaporators are sized to process floor drain water at a 30-gpm flow rate in each unit.

The concentrates (refuse liquid) are concentrated to an assumed practical density of less than 8 percent by weight and are normally discharged at a nominal temperature of 165°F.

Two 100 percent-capacity radwaste evaporators are provided. Normally, only one is used to process floor drain wastewater.

The evaporators operate on a semibatch basis. Under this type of operation, feed and distillate production is a continuous process, but the removal of concentrates occurs only after the desired bottoms concentration is reached.

The evaporators are of the low-pressure, single-shell, submerged-tube type. The units are heated by steam supplied by the main plant auxiliary boilers (through pressure-reducing stations) to tube bundles. Each unit contains a distiller condenser cooled by general service water. The units operate under a partial vacuum (about 20-in. Hg vacuum). Vacuum is maintained by a liquid-ring type mechanical vacuum pump that removes noncondensibles from the shell. Each unit is provided with a single vacuum pump, distillate pump, and concentrates pump. Each unit is also fitted with a single distillate cooler (which is cooled by general service water) as well as the required valves and instrumentation. Internal baffles and demisters are provided for the removal of entrained water droplets from the vapor. The evaporators are skid mounted, with the vacuum pumps and the concentrates and distillate pumps located off the skids behind shield walls to minimize radiation exposure to maintenance and operations personnel. All equipment that is in contact with process fluid is constructed of stainless steel (except for the Incoloy tube bundles).

During steady-state operation, feed to the evaporator is continuous and is controlled automatically by the level in the shell. The concentrates pump operates automatically in the recirculation mode. A chemical metering pump pumps additives to continuously adjust the pH in the recirculation line of the concentrates pump so that frothing in the evaporator and scaling of heat transfer surfaces are avoided. The chemical metering pump is electrically interlocked to the concentrates pump; this permits the operation of the chemical injection system only when the concentrates pump is in operation recirculating bottoms. The vacuum pump is in continuous operation. The distillate pump also operates continuously and discharges to the distillate surge tank as long as distillate purity meets the conductivity limit (about 2 μmho/cm). Cavitation of the distillate pump is prevented by maintaining a minimum level in the pump suction pipe. Suction pipe level instrumentation ensures this level by throttling a flow control valve in the pump discharge line.

The distillate surge tank may be operated in the batch or continuous mode. In the batch mode, the tank is allowed to fill before the transfer of its contents is initiated. Once full, the evaporator distillate pump discharge is shifted to the standby evaporator's distillate surge tank by means of the distillate crossover piping. The contents of the full tank can then be sampled and, if within conductivity limits for further processing by the demineralizer train, can be pumped through the demineralizers. It is also possible to return the contents of the distillate surge tank to the evaporator feed surge tank for recycling if required. When the tank contents have been transferred and the standby evaporator's distillate surge tank has been filled, the distillate pump discharge can be shifted back to the operating evaporator's distillate surge tank. The surge tanks can continue to be alternated in this manner.

In the continuous mode of operation, the distillate may be transferred from the operating evaporator's distillate surge tank at the same rate that it is filling. The transfer rate is adjusted to match the fill rate by correctly selecting the flow setpoint of the distillate transfer flow control valve. In this mode of operation, primary reliance for distillate purity must be placed on the evaporator distillate conductivity instrumentation. Periodic grab samples may be obtained from the sample tap on the distillate transfer pump recirculation line or directly from the tank. The continuous mode of distillate transfer is also possible using the standby evaporator's distillate surge tank and distillate transfer pump in case the operating evaporator's distillate transfer pump is out of service.

System analysis indicates that about 8 days of operation would be required to reach 6 percent to 10 percent by weight dissolved solids in the concentrates. The evaporator is not required to be completely shut down if there are short time periods (within a long-term evaporator run) when the unit is not processing FDC subsystem water; rather, the evaporator can be kept in standby. In the standby mode, the evaporator concentrates are kept at the approximate operating temperature by a submersible heater in the evaporator shell. The heater is thermostatically controlled and has a low-level cutout.

Once the desired concentration of the evaporator bottoms has been reached, the bottoms are transferred to the concentrates feed tank either directly from the evaporator shell or indirectly via the evaporator drains holdup tank. From the concentrates feed tank, the bottoms are transferred to the extruder/evaporator for solidification in the solid radwaste system. The evaporator drains holdup tank and concentrates feed tank and associated piping are electrically heated to maintain the temperature of the concentrates and to prevent possible crystallization of the dissolved material.

11.2.3.2.10 Concentrates Pumps

The concentrates pumps transfer concentrates from the evaporator shell to the evaporator drains tank or the concentrates feed tank. They also circulate evaporator concentrates through the evaporator shell during normal operation to prevent solution precipitation.

These pumps are capable of emptying the full evaporator shell of concentrates (800 gal) within about 1 hr. The pumps are conservatively sized to have a capacity of about 50 gpm. One pump is provided for each evaporator subsystem.

11.2.3.2.11 Evaporator Drains Holdup Tank

This tank serves as an emergency backup tank to the concentrates feed tank (described in Subsection 11.5.3.2.16). During normal evaporator operation this tank is bypassed. The tank can be used when it is necessary to drain the evaporator and the concentrates feed tank is unavailable.

The tank is designed to hold the volume of one evaporator batch (about 800 gal) in the event that draining is necessary. During normal evaporator operation, the evaporator drains discharge directly to the concentrates feed tank.

11.2.3.2.12 Evaporator Drains Pump

The evaporator drains pump mixes and maintains a uniform temperature of the contents in the evaporator drains holdup tank.

The pump capacity is determined by the tank-mixing requirements. The evaporator drains tank has a capacity of about 1500 gal and should be completely recycled at least once per hour; thus, a pump capacity of 30 gpm is adequate.

11.2.3.2.13 Distillate Pumps

The purpose of these pumps is to deliver distillate from the evaporator to the distillate surge tank through the seal water/ distillate cooler.

The capacity of the pumps is determined from the evaporator capacity plus reflux (about 35 gpm). The head requirement for the pump is based on the system resistance for the above operating mode.

11.2.3.2.14 Distillate Surge Tanks

The two distillate surge tanks provide a surge capacity between the evaporators and the floor drain and waste collector demineralizers. Provision is made for sampling the distillate collected in these tanks. After sampling, the distillate can be pumped through the demineralizers or returned to the evaporator feed tank through a recycle line.

The evaporators are designed to operate at a nominal flow rate of 30 gpm. Each tank has a volume of 5100 gal which would provide an operating time of over 2.5 hr before the distillate has to be transferred. This is enough time to sample the distillate and to pump to either of the demineralizers for polishing or back to the evaporator feed tank for reprocessing.

11.2.3.2.15 Distillate Transfer Pumps

The distillate transfer pumps transfer liquid from the evaporator distillate surge tank to one of the following:

a. A waste sample tank through the floor drain and waste collector demineralizers

b. The waste surge tank (or waste collector or floor drain collector tanks) through the floor drain and waste collector demineralizers (recycle mode)

c. Directly to the evaporator feed tank (recycle mode).

This pump also provides recirculation to mix the evaporator distillate surge tank liquid to acquire a representative sample.

These pumps are capable of discharging the evaporator distillate surge tank contents at a rate that ensures that one surge tank can be sampled and emptied while the other surge tank is being filled. Since the nominal evaporator system capacity is 30 gpm, the pumps are conservatively sized to have a nominal capacity of 50 gpm. Two 100 percent-capacity pumps are provided. The distillate surge tanks are provided with crossover inlet connections that allow one tank to fill while the other is being sampled and discharged.

11.2.3.2.16 Floor Drain and Waste Collector Demineralizers

The demineralizers remove, by ion exchange, the dissolved solids contained in the floor drain collector subsystem and the waste collector subsystem. The goal of demineralization is to produce water of sufficient quality to be recycled to the plant via the condensate storage tank or the condensate return tank.

The nominal combined simultaneous flow rate from the waste collector subsystem and the floor drain system through the demineralizers should be about 140 gpm.

The demineralizers are designed to reduce the dissolved solids concentrations such that the conductivity is less than 1 μmho/cm. It is calculated that on the average, a resin bed will require replacement about every 8 days for the design daily inputs.

The floor drain demineralizer holds approximately 49 ft^3, and the waste demineralizer approximately 49 ft^3 of mixed cation and anion resin and activated carbon. Each vessel has type 304 stainless steel internals, including an inlet distributor and a wire-wrapped underdrain collector that prevents the escape of resins. During service, water enters the demineralizers through the inlet distributor, is distributed over and passes down through the resin bed, and discharges through the underdrain collector. When resin exhaustion is indicated by high conductivity in the effluent, the spent resins are dumped by manual initiation to the spent resin tank, and new resins are added to the demineralizers.

Under normal conditions, these two demineralizers will operate in series to process combined wastes from the FDC and waste collector subsystems. If required, the demineralizers can be used individually for either subsystem to process liquid wastes. Each demineralizer is sized to operate at a flow rate of about 140 gpm, if necessary. Using the demineralizers in series provides maximum loading of the ion exchange resins before they have to be replaced with new resins. The piping system is designed such that either demineralizer can be used as the lead or follow unit. As the liquid wastes are processed through the demineralizers, the effluent is continuously monitored. If the conductivity out of the second demineralizer is below a preset value, then the processed liquid is directed to the waste sample tanks. If the conductivity of the processed liquid exceeds the preset value, then the flow is automatically diverted and returned to a selected subsystem (normally to the waste surge tank) for reprocessing.

11.2.3.2.17 Waste Sample Tanks

The purposes of the waste sample tanks are the following:

a. To collect treated water processed by the demineralizers from the floor drain and waste collector subsystems

b. To allow analysis of the tank contents for radioactivity and conductivity after the tank contents have been mixed

c. To discharge the water to either the condensate storage tank, to the blowdown discharge, or to the waste collector or waste surge tanks for recycling, depending on the radiochemical analysis of the water.

The calculated design daily input from the FDC subsystem is 15,219 gal. The calculated design daily input from the waste collector subsystem is about 34,173 gal. The three waste sample tanks have a capacity of about 24,300, 24,300, and 21,000 gal, respectively. The treated water will be sampled before discharge to the condensate storage tank, the blowdown line, or the waste collector or waste surge tank. At any given time, one sample tank will be receiving a batch while the second one can be in the sample mode and the third can be in the discharge mode. Therefore, the three tanks together meet the design requirements. During periods of maximum operational occurrences, one of these three tanks can provide surge capacity.

11.2.3.2.18 Waste Sample Pumps

Three waste sample pumps are provided. Two are normally associated with sample tanks G1101-A004 A and B. The third is normally associated with sample tank G1101-A009. One pump is provided for each tank, but a manual valve alignment will allow pumping from the A tank with the B pump or C pump and vice versa.

These pumps transfer water from the waste sample tanks to the following:

a. Condensate storage tank

b. Waste surge tank (off-standard water quality)

c. Blowdown discharge line

d. Waste sample tank (recirculation line).

The capacity of the waste sample pumps is determined by providing a reasonable rate for the tank to empty to accommodate overall system inputs. Since the waste sample tanks can be filled at a rate of about 140 gpm via the waste collector subsystem, the waste sample pumps should be capable of discharging to the condensate storage, waste surge, or waste collector tanks at a similar rate.

Flow to the blowdown discharge line will be throttled back to a level of 5 to 50 gpm. Excess pump flow while discharging through throttling valves will be recycled to the waste sample tank.

11.2.3.2.19 Chemical Waste Tank

The chemical waste tank collects wastewater, including decontamination solutions and laboratory drains that may require pH or other suitable adjustment before processing. Provisions exist for the addition of an acid or base to the tank to adjust the pH, and the wastes are then sent to the floor drain collector tank for further processing.

The design-basis maximum daily input to this tank is from the periodic evaporator cleaning rinse operation (stream 13, Figure 11.2-15). This is assumed to produce about 3350 gal of solution twice a year.

11.2.3.2.20 Chemical Waste Pumps

The purpose of these pumps is to mix the contents of the chemical waste tank and to transfer neutralized waste to the FDC tank. These pumps also transfer the Chemical Waste Tank Contents to the Side Stream Liquid Radwaste Processing System Distillation Inlet Batch Tank. The capacity of the pumps is based on the mixing requirement of the chemical waste tank, which has a 5200-gal capacity, and the capability to empty a full tank within one shift. The selected size of 60 gpm would allow one complete turnover of the tank contents followed by tank emptying, within one 8-hr shift. Two 100 percent-capacity pumps are provided.

11.2.3.2.21 Precoat Filters

The floor drain precoat filter and the waste-collector precoat filter provide processing paths that are in parallel with the etched-disk filter/oil coalescer trains. The removal efficiency for particulate is based on the amount of filter aid used and is generally found to be 0.1 lb of crud removed for each pound of filter aid. The floor drain precoat filter is designed to handle 50 gpm with a 64-ft^2 filter area and a 210-gal filter vessel volume. The waste collector precoat filter is designed to handle 125 gpm with a 115-ft^2 filter area and a 460-gal filter vessel volume.

Precoating is accomplished by recirculating a powdered resin/ fiber mixture through the vessel where it collects and forms a layer on filter elements. A holding pump provides minimum flow through the filter to prevent the material from falling off after precoating or when the filter is taken out of service upon the completion of a batch. During service, wastes flow into the filter, suspended solids and oil are retained on the filter resin layer, and liquid passes through the layer out of the vessel. As the filter cycle continues, solids build up on the surface of the filter elements and cause the differential pressure across the filter to increase. The filter can be left in service until the differential pressure reaches about 30 psi, at which time it will automatically be taken out of service and put into a hold condition. It must then be backwashed before it can be put back into service. If the differential pressure cutoff is not reached but the filter is no longer required for service, it can be manually put into a hold condition. During service, a filter aid solution can be injected into the incoming wastes as body feed to prevent the filter cake from blinding, which would cause the filter to rapidly reach differential pressure cutoff. This body feed is particularly important with oily wastes. When differential pressure is reached or the filter is no longer required for filtration, it is removed from service and backwashed by using an air bump method. After backwashing, it is left cleaned and full of water, ready for the next precoating and service cycles.

11.2.3.2.22 Waste Precoat Tank

The waste precoat tank mixes the powdered resin/fiber into a uniform slurry before precoating the precoat filters. The tank services both the floor drain and waste collector precoat filters.

The precoat tank is designed to contain enough powdered resin/ fiber solution to allow the precoating of one filter before refilling the tank.

11.2.3.2.23 Filter Aid Tank

The filter aid tank mixes the filter aid into a slurry before feeding it to the floor drain or waste collector precoat filters along with the incoming wastes.

The filter aid tank supplies filter aid to both the floor drain and waste collector precoat filters. The tank is sized to feed sufficient filter aid to each filter for one batch run before refilling is necessary.

11.2.3.2.24 Waste Collector Tank

This tank collects waste from different sources, which include the reactor water cleanup system, drywell and reactor building equipment drain sumps, waste and floor drain demineralizer drains, distillate surge tank drain and overflow, the turbine building equipment drain sump, and the radwaste building equipment drain sump. These inputs are periodic in nature. The wastewater collected in the tank can be pumped from either the bottom-sludge well connection or from the decant nozzle (2 ft above the bottom suction). Any sludge collected over time can be let down via the bottom-sludge well connection to the phase separator tanks. The volume to overflow of the waste collector tank is approximately 23,400 gal. This capacity, combined with the processing rate through the filters, will be adequate to handle the flows to the waste collector tank. Excessive inputs during surge periods will be pumped to the waste surge tank.

The waste collector tank is modified to provide a sludge well with a slant bottom. Spray nozzles are provided at the bottom of the tank to direct solids to the sludge well. The tank is vented to the building vent system, and the tank overflow is directed to the radwaste building floor drain sump. The tank drain is blind flanged outside the cubicle.

11.2.3.2.25 Waste Collector Pumps

The purpose of these pumps is to pump water from the waste collector tank through one of the following:

a. Waste collector etched-disk filter, oil coalescer, and floor drain and waste collector demineralizers to waste sample tank

b. Waste collector precoat filter and floor drain and waste collector demineralizers to waste sample tank

c. Floor drain precoat filter or etched-disk filter and oil coalescer, and floor drain and waste collector demineralizers to waste sample tank

d. Recirculation lines back to the waste collector tank.

The pumps are also used infrequently to pump, through a system-balancing valve, the waste collector tank sludge letdown to the phase separator tanks in the solid radwaste system.

The capacity of these pumps is determined by the overall processing rate requirements for the waste collector subsystem. Waste collector tank contents should normally be processed at a minimum rate of 100 gpm in order to accommodate the design daily inputs. The actual pumps used in this service are sized to deliver a flow range of 100 to 160 gpm. Two 100 percent-capacity pumps are provided. These pumps are vertical, in-line, centrifugal pumps capable of operating under several modes of operation.

11.2.3.2.26 Waste Surge Tank Pumps

These pumps pump water from the waste surge tank through one of the following:

a. Waste collector etched-disk filter, oil coalescer, and floor drain and waste collector demineralizers to the waste sample tank

b. Waste collector precoat filter and floor drain and waste collector demineralizers to the waste sample tank

c. Floor drain precoat filter or etched-disk filter, oil coalescer, and floor drain and waste collector demineralizers to the waste sample tank

d. System-balancing valve to the condensate phase separator tanks (sludge letdown)

e. Spray nozzles to the waste surge tank (recirculating line).

The capacity of these pumps is based on the overall processing rate requirements dictated by the inputs to the waste surge tank. The waste surge tank contents should normally be processed at a minimum rate of 100 gpm in order to accommodate the design daily input.

Two 100 percent-capacity pumps are provided. The pumps are vertical, in-line, centrifugal pumps capable of operating under different operating modes. During the sludge blowdown mode, a system-balancing valve is utilized to generate the necessary pressure drop.

The waste surge tank is described in Subsection 11.5.3.2.4 as a solid radwaste system component.

11.2.3.2.27 Ultraviolet (UV) Total Organic Carbon Reduction System

Organically contaminated water produced by plant operation is drained into the liquid radwaste system for treatment. Total organic carbon (TOC) can be treated using UV radiation. Certain wavelength UV radiation has the capability to destroy TOC by breaking bonds and oxidizing the organic compounds. The process passes the waste stream past UV radiation emitting lamps. The effluent from the unit can then be demineralized to remove the products of the TOC breakdown.

To treat various liquid radwaste streams, a portable UV water treatment unit will be used as necessary to reduce organics from the liquid radwaste process waste streams.

11.2.3.3 Side Stream Liquid Radwaste Processing System Equipment Description

The Side Stream Liquid Radwaste processing System is depicted in Figure 11.2-18. Major components are briefly described below and their design capabilities are summarized in Table 11.2-7.

11.2.3.3.1 Distillation Inlet Batch (DIB) Tank

The DIB tank stores liquids forwarded from the Chemical Waste Tank and from 55 drums that collect water from building floor mopping operations. The Tank's working volume is 800 gallons. Water from the Fermi 2 Condensate System is provided to clean the tank, when needed. The tank level is monitored and controlled from the local control panel. The over flow line is routed to the Radwaste Building Floor Drain. The tank vent is hard piped to the Radwaste Building Ventilation system.

11.2.3.3.2 High and Low Radwaste Evaporators

The high and low Radwaste Evaporators are both capable of processing liquid radwaste in 55 gallon batches at a nominal rate of 0.2 gpm. The vapor from the evaporators is conveyed to the condenser using Station Air stream. Return air is discharged to the Radwaste Building Ventilation System. Solids will remain in the 55 gallon drum. When sufficient amount of solid is collected or when the radiation level reaches a predetermined level, the drum is released for offsite shipment.

11.2.3.3.3 High and Low Radwaste Condensers

Each evaporator is provided with a water cooled condenser. The station air drives the vapors across the condenser tubes carrying General Service Water. The condenser liquids are collected in the Condensate Receiver. The condensate thus collected is forwarded Post treatment Inlet Batch Tank via the condensate forwarding pump.

11.2.3.3.4 Post Treatment Inlet Batch (PIB) Tank

The PIB Tank collects the condensate from the high and low Radwaste Evaporators for processing via the Post Treatment System. The tank's working volume is about 800 gallons. The tank level is monitored and controlled from the local control panel. The over flow line is routed to the Radwaste Building Floor Drain. The tank vent is hard piped to the Radwaste Building Ventilation system.

11.2.3.3.5 PIB Tank Forwarding Pump

The contents of the PIB Tank are forwarded to the Post Treatment System using a 10 gpm pump. This pump can also be aligned for tank recirculation.

11.2.3.3.6 Granular Activated Carbon Bed Filters

Two adsorption columns each capable of holding over 20 cubic feet of Granular Activated Carbon (GAC) are designed to remove particles above 5 microns in size from the liquid streams flowing at or below 20 gpm. The tank vent is hard piped to the Radwaste Building Ventilation system.

11.2.3.3.7 Ultraviolet (UV) Light Reactors

Two 1.5 kW medium pressure UV Reactors are provided to oxidize the effluents from the Carbon Bed Filters. The UV rays also kill bacteria, if present in the effluent stream. Each UV reactor is capable of handling up to 20 gpm effluent flow.

11.2.3.3.8 Mixed Bed Filters

Two mixed bed filters each capable of holding 20 cubic feet of Cation and anion resin beads. The mixed Bed Filter removes the organic acids produced by the UV reactor by oxidizing soluble organics in the effluent stream. Each Mix Bed Filter can handle flows up to 20 gpm. The tank vent is hard piped to the Radwaste Building Ventilation system.

11.2.3.3.9 Sample Batch (SB) Tank

The effluents from the mixed bed filters are collected in the Sample Batch Tank. The tank's working volume is 1000 gallons. The tank level is monitored and controlled from the control panel. The over flow line is routed to the Radwaste Building Floor Drain. The tank vent is hard piped to the Radwaste Building Ventilation system.

11.2.3.4 Pipe Routing

To aid the routing of piping normally carrying radioactive fluids, a shielded pipe tunnel runs along the north, south, and west walls of the radwaste building at an elevation of 564 ft. Whenever possible, pipes carrying radioactive fluids are routed through this tunnel and exit at the tunnel when required to connect to a piece of process equipment. When a pipe cannot be routed via the tunnel, proper care, including the installation of shielding material, is taken to reduce the radiation levels to acceptable values.

11.2.4 Operating Procedure

The liquid radwaste system is basically a manual-start/automatic-stop processing system that does not require continuous on-line operation. The system is designed around large collecting tanks that accept inputs from a variety of sources. As tank levels increase, an operator selects the appropriate system lineup and manually initiates treatment by manipulating control panel switches. Upon completion of system lineup, the operator starts the appropriate pump to draw down the collecting tank. The pump will stop automatically on low tank level and will remain de-energized unless manually restarted.

If radioactive liquid must be discharged from the site, it is treated by the liquid radwaste system and transferred to a waste sample tank for sampling. The treated water is sampled before discharge to verify compliance with discharge criteria; if the criteria are not satisfied, the water is recycled through the liquid radwaste system. Liquid radwaste discharge monitoring is further described in Section 11.4.

11.2.5 Performance Tests

Since the liquid radwaste system is operated as required during the operation of the power plant, its ongoing operability is demonstrated without recourse to special testing. Operating logs, records, and sample results reflect the day-to-day performance of the system. Conditions such as high-volume processing, short filter or demineralizer runs, or high wastewater conductivity or activity are evaluated when they occur.

11.2.6 Estimated Releases

The liquid radwaste system is designed so that, with proper water management techniques, minimal or zero discharge of liquid waste should be needed. It is recognized that during some operating conditions, such as startup, the discharge of excess water may be desirable or even necessary.

The total design-basis liquid releases (excluding tritium) are estimated to be about 0.14 Ci per year. Tritium releases are estimated to be about 52.5 Ci per year. The radwaste system is designed to effectively capture the majority of incoming radionuclides (and ultimately process them as solid wastes) and to so reduce the radioactivity levels in the radwaste sample tanks to minimal values (for discharge). Therefore, the exact configuration of the radwaste equipment/trains utilized or in use is not so important as long as the end-point (discharge) isotopic-concentration criteria are maintained. This is illustrated by the results shown in Tables 11.2-9 and 11.2-10, where estimated design-basis releases have been calculated for two different modes of operating the radwaste equipment. It is seen that the resultant release quantities are virtually the same.

All releases to the environment from the liquid radwaste system are discharged past a radiation monitor that isolates the discharge line if high radioactive concentrations in the discharged liquid should occur. This monitor and the isolation valve are located so that, if a high radiation level is detected, the line is isolated before any liquid can be discharged. The flow is rerouted back to the system for reprocessing. The monitor and discharge lines would then be decontaminated by flushing.

11.2.7 Release Points

Any release of liquid radwaste is directed to the circulating water reservoir blowdown line. This discharge is from the Fermi 2 circulating water pump house and is directed to Lake Erie. The discharge path is shown in Figure 2.1-5.

11.2.8 Dilution Factors

If small amounts of liquid radwaste are to be released from Fermi 2, they will be released to Lake Erie via the circulating water reservoir blowdown line. The minimum dilution flow will be about 10,000 gpm. Further dilution of the blowdown is provided by the natural mixing characteristics of Lake Erie in the vicinity of the discharge. Section III of Appendix 11A provides an evaluation of dilution factors to the nearest individual receptors both northeast and south of Fermi 2 and at the Monroe and Toledo potable water intakes. These dilution factors are as follows:

a. 45 at nearest shoreline northeast of Fermi 2 (1770 m)

b. 67 at nearest shoreline south of Fermi 2 (1530 m)

c. 77 at 3200 m south of Fermi 2 (Monroe potable water intake)

d. 100 at distances greater than 3200 m.

11.2.9 Estimated Doses From Liquid Effluents

The possible pathways for radiation exposure to Man from plant effluents are presented in Figure 11.2-17. The following general pathways have been evaluated for liquid effluents:

a. Drinking water

b. Aquatic food chains

c. Direct radiation from water and shores.

These pathways can be divided into internal exposures resulting from pathways a. and b. and external exposures resulting from pathway c.

The radiation doses described in this section are predicated upon design-basis source terms, radwaste throughput values, and annual releases into Lake Erie. They were updated for power uprate conditions, and are considered to be conservative upper-limit values, and are being retained as such in the UFSAR for “historical” purposes. It is understood that the actual releases, source terms, and offsite dose values will be different than these UFSAR values, will be estimated via the Offsite Dose Calculation Manual, and will be periodically reported to the NRC.

A detailed design-basis evaluation of the potential doses from liquid effluents to an individual is presented in Appendix 11A, Section III. The maximum exposure from liquid effluents to an individual was assumed to be located, as discussed in Subsection 11.2.8 above, at 1770 m northeast of Fermi 2 and 1530 m south of Fermi 2. The resident south was assumed to drink potable water obtained from the Monroe water intake located 3200 m south of Fermi 2. The resident north was assumed to obtain his potable water from the Detroit municipal water system, which will be unaffected by Fermi 2 operation. Table III-1 of Appendix A presents conservative usage factors for liquid exposures. The activities usage factors represent 2 hr/day for boating, swimming, and shoreline use, each for a period of 90 days/yr for the teenager and child, while the adult will participate 1 hr/day in each activity. The ingestion rates are those recommended by Regulatory Guide 1.109 (Reference 2). The individual doses are summarized in Table 11.2-11 for the mode of radwaste operation with evaporators and the etched-disk filters in service.

Doses to the maximum exposed individual were calculated based on Mode One Operation (i.e., normal operation with the evaporators and etched disk filters in use). These doses are tabulated in Table 11.2-11. A comparison of Mode One annual liquid effluent releases with those corresponding to Mode Two operation (i.e., normal operation without the radwaste evaporators and with the precoat filters in use) shows that both sets of releases are almost identical. Therefore, it is reasonable to expect that doses to the maximum individual based on Mode Two operation, if they were to be calculated, would be approximately equal to those tabulated in Table 11.2-11. The total body doses tabulated in Table 11.2-11 are within the guidelines established by Appendix I and 10CFR20, and are less than the value calculated by the NRC (1.6 mrem/year total body, as reported in the Safety Evaluation Report, Table 11-5, NUREG-0798, July 1981).

The population exposures from both internal and external pathways were evaluated using the guidance provided in Regulatory Guide 1.109, Revision 1 (Reference 3). The exposures were calculated using the LADTAP II computer code (Reference 4). LADTAP II is a computer code received from the Radiation Shielding Information Center at Oak Ridge National Laboratory, which implements the models in Reference 3.

The population exposures from internal and external pathways were reviewed for the mode of operation without the evaporators and etched disk filters. As shown in Tables 11.2-9 and 11.2-10, there is no significant difference in the source terms between operation in mode one and mode two. It can be expected that the population exposure from internal and external pathways would not change significantly and that any differences would be due to changes in the assumptions in Subsections 11.2.9.1 and 11.2.9.2 used to evaluate the doses rather than from the radiological source term.

11.2.9.1 Internal Population Exposure

Internal population exposure will arise from the ingestion of potable water and from the ingestion of fish.

The locations of all municipal potable water intakes within 50 miles of Fermi 2 are presented in Table 2.1-12. The population data of each municipality were extrapolated to represent the population in the year 2000. The growth rates used for the U.S. locations were based on the assumption that the country growth rate established from 1970 to 1980 (Reference 5) would be maintained and would be applicable to the appropriate municipality. For the Canadian locations, a provincial growth rate from 1976 to 1980 (Reference 6) was assumed to be maintained until the year 2000. The dilution factors presented in Subsection 11.2.8 were assumed to be applicable. Table 11.2-12 presents the data on the municipal potable water intake locations, populations, and dilution factors.

For the expected population exposure from fish ingestion, an upper limit was estimated from the following assumptions:

a. The commercial fish catch from Lake Erie landed in Michigan is assumed to be affected by plant releases (Reference 7). The 1980 catch amounted to 280,000 kg

b. The sport fish catch described in Reference 7 is affected by plant activity releases. It was assumed to consist of 70 percent yellow perch and 30 percent walleye and amounts to 1,837,000 kg

c. The applicable dilution factor is conservatively taken to be 100 in all cases

d. The edible portion of the fish was assumed to be 60 percent

e. The population doses for fish ingestion are based on the estimated 50-mile population for the year 2000 (Reference 8).

Table 11.2-13 provides the internal population exposure by pathway and various organs.

11.2.9.2 External Population Exposure

External population exposure resulting from liquid effluents can arise from swimming, boating, and other shoreline activities.

The population of concern in the evaluation of the dose due to external exposure is residents of the nearby communities along the Lake Erie beachfront. It is estimated that 50 percent of the persons living in beachfront communities in Monroe County, Michigan, and the Toledo area use the beach for recreational purposes (Reference 5). The communities of interest, 50 percent of their year 2000 populations, their distances from the plant, and dilution factors are given in Table 11.2-14. The estimated year 2000 populations were calculated by extrapolating the 1980 population (Reference 8) to the year 2000, assuming that the country growth rates established from the year 1970 to the year 1980 will be maintained.

Other communities are either at greater distances from the plant or have beachfronts that are generally unsuitable for recreational activity. For the purpose of estimating population doses, it was assumed that a resident using the beach would spend 200 hr per year engaging in beach activities. Of this total time, it was assumed that 50 hr would be spent for swimming, 50 hr for water-surface activities (fishing, boating, waterskiing, and sailing), and 100 hr for shoreline activities such as sunbathing or walking along the shore (listed as shoreline in Table 11.2-14, which presents the external population doses from the liquid effluents by pathway and various organs).

11.2.10 Vendor-Supplied Liquid Processing System

If the permanent Fermi 2 liquid processing system is not available due to system malfunction, or if needed for any other reason, a vendor-supplied portable system can be utilized. The system normally will be operated by the vendor and will be closely monitored by Edison personnel. The types and quantities of waste to be processed are the same as for the permanent radwaste systems (as described in Subsection 11.2.2). Fermi 2 specific operating procedures or approved vendor procedures will be used for operating the portable system interfaced with the Fermi liquid radwaste system.

This vendor-supplied portable system would normally be installed in the areas immediately adjacent to the truck bay in the onsite storage facility. These areas of the onsite storage facility were specifically designed and constructed to contain and handle mobile process systems (see Subsection 11.7.2.2.11). Concrete floors and walls in this region are coated, and all drains are routed back to the liquid radwaste system. The remote-operated overhead crane is available to move the process equipment. The design of these onsite storage facility areas and the methods of operation have incorporated features to maintain personnel exposures ALARA. Permanent piping installed in the shielded onsite storage facility pipe tunnel will transport the radioactive process fluid to the vendor's equipment.

The interface connections between the mobile system and the Fermi 2 system are shown in Figure 11.2-15 and described in Table 11.2-4. A typical portable radwaste system operates by passing the contaminated water through a series of pressure vessels, as necessary, containing filtration media or ion-exchange resins. When these vessels are removed from service, the media are sluiced to a disposal container and processed further or dewatered or solidified in situ and then shipped to an approved burial site for disposal. In both cases, the resulting end products comply with all federal and state disposal regulations. The processed water is, in turn, routed to the waste sample tanks when established conductivity limits are met.

11.2 LIQUID RADWASTE SYSTEM

REFERENCES

1. U.S. Nuclear Regulatory Commission, Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents for Boiling Water Reactors, BWR-GALE Code, NUREG-0016, Rev. 1, January 1979.

2. U.S. Nuclear Regulatory Commission, Calculation of Annual Doses to Man From Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I, Regulatory Guide 1.109, U.S. Nuclear Regulatory Commission, March 1976.

3. U.S. Nuclear Regulatory Commission, Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I, Regulatory Guide 1.109, Rev. 1, October 1977.

4. Oak Ridge National Laboratory, Users Manual for LADTAP II - A Computer Program for Calculating Radiation Exposure of Nuclear Reactor Laboratory Effluents, NUREG/CR-1276, May 1980.

5. 1980 Census of Population and Housing, Preliminary Reports, for Ohio - PHC 80-P-37, February 1981; for Michigan - PHC 80-P-24, February 1981.

6. The World Almanac and Book of Facts, 1981.

7. U.S. Nuclear Regulatory Commission, Draft Environmental Impact Statement Related to the Operation of the Enrico Fermi Atomic Power Plant, Unit 2 - Docket 50-341, NUREG-0769, April 1981.

8. U.S. Department of Commerce, Bureau of the Census, 1980 Census data by tract for Monroe County, Michigan (unpublished data).

TABLE 11.2-1 DESIGN DAILY INPUT VOLUMES FOR THE FLOOR DRAIN COLLECTOR SUBSYSTEM

Stream No.[a]	Description	Fermi 2 Design Daily Volume (gpd)
1	Turbine building, oil separator effluent	3,060
2	Drywell floor drain sump	1,785
3	Reactor building floor drain sump	5,100
4	Turbine building floor drain sump	2,040
5	Loadout building drains	200
7	Personnel decontamination drains	100
8	Cask-cleaning drains	14
9	CRD and fourth-floor drains	Infrequent
10	Radwaste building drains	2,550
26	Chemical waste tank[b]	370
23	Total floor drain collector tank effluent	15,219

a Refer to Figure 11.2-15.
b Refer to Table 11.2-2.

TABLE 11.2-2 DESIGN DAILY VOLUMES FOR CHEMICAL WASTE TANK INPUT TO THE FLOOR DRAIN COLLECTOR SUBSYSTEM

Stream No.[a]	Description	Fermi 2 Design Daily Volume (gpd)
6	Regulated shop drains	50
11	Laboratory drains	200
12	Decontamination solutions	100
13	Evaporator cleaning solutions	17
81	Neutralization chemicals	3
26	Total chemical waste tank effluent	370

[a] Refer to Figure 11.2-15.

TABLE 11.2-3 DESIGN DAILY VOLUMES FOR MAJOR INPUTS TO THE WASTE COLLECTOR SUBSYSTEM

Stream No.[a]	Description	Fermi 2 Design Daily Volume (gpd)
14	Drywell equipment drain sump	8,738
15	Reactor building equipment drains	9,509
16	Radwaste building equipment drains	2,827
17	Turbine building equipment drains	7,710
24	Total waste collector tank effluent	28,784
40	Waste surge tank liquid effluent[b]	6,000
	Total input to waste collector filter	34,784

[a] Refer to Figure 11.2-15.

[b] Stream 40 joins stream 24 downstream of the waste collector pumps.

TABLE 11.2-4 VENDOR PROCESSING CONNECTIONS

Connection	Size (in.)	Material	Design Pressure (psig)	Design Temperature (°F)
Demineralization, floor drains	2	Carbon steel	150	150
Demineralization, waste collector	3	Carbon steel	150	150
Wet slurries to solidification	2	Stainless steel	150	150
Decant water from solidification process	2	Stainless steel	150	150
Purified water from demineralization process	3	Stainless steel	150	150

TABLE 11.2-5 ESTIMATED CHEMICAL CHARACTERISTICS OF LIQUID RADWASTE INPUT STREAMS

Input	Suspended Solids (ppm)	Dissolved Solids (ppm)	Oil and Grease (ppm)	pH
FDC subsystem	120	165	20	6-8
Chemical waste tank inputs to FDC	500	15,700	<1	7-9
Waste collector subsystem	20	35	5	6-8

TABLE 11.2-6 RADWASTE EQUIPMENT DESIGN REQUIREMENTS

Equipment	Codes: Design and Fabrication	Materials[a]	Welder Qualification and Procedure	Inspection and Testing
Pressure vessels	ASME Code Section VIII, Division 1	ASME Code Section II	ASME Code Section IX	ASME Code Section VIII, Division 1
Atmospheric or 0-15 psig tanks	ASME Code[b] Section III, Class 3, or API 620 or 650, or AWWA D-100[c]	ASME Code Section II or ASTM	ASME Code Section IX	ASME Code[b] Section III, Class 3, or API 620 or 650, or AWWA D-100[c]
Heat Exchangers	ASME Code Section VIII, Division 1, and TEMA	ASME Code Section II	ASME Code Section IX	ASME Code Section VIII, Division 1
Piping and valves	ANSI B31.1	ASTM or ASME Code Section II	ASME Code Section IX	ANSI B31.1
Pumps	Manufacturer's Standards[d]	ASME Code Section II or Manufacturer's Standards	ASME Code Section IX or Manufacturer's Standards	ASME Code[b] Section III, Class 3 or Hydraulic Institute

[a] Material manufacturer's certified test reports should be obtained whenever possible.

[b] ASME Code stamp and material traceability are not required.

[c] API-650 and AWWA D-100 apply to atmospheric tanks, whereas API-620 applies to 0- to 15-psig tanks. ASME Section III, Class 3, has rules .pertaining to both atmospheric (Subarticle ND-3800) and 0- to 15-psig (Subarticle ND-3900) tanks.

[d] Manufacturer's standard for the intended service. Hydrotesting should be 1.5 times the design pressure.

TABLE 11.2-7 LIQUID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Component	Number	Capacity (gal)	Material	Design Pressure (psig)	Design Temperature (°F)	Design Code
Floor drain collector tank	1	20,000	Carbon steel[a]	Atmospheric	150	API-650[b]
Evaporator feed surge tank	1	25,000	Carbon steel (SA-285, Grade C)	Atmospheric	150	ASME III, Class 3
Waste oil tank	1	1,000	Carbon steel (SA-285, Grade C)	Atmospheric	150	ASME III. Class 3
Waste precoat tank	1	180	Carbon steel	Atmospheric	150	Manufacturer's Standard
Waste clarifier tank	1	16,500	Carbon steel Plasite 7155	Atmospheric	150	API-650[b]
Filter aid tank	1	400	Carbon steel	Atmospheric	150	Manufacturer's Standard
Distillate surge tank	2	5,100	Aluminum	Atmospheric	150	ASME III
Chemical waste tank	1	5,200	Stainless steal	Atmospheric	150	API-650
Evaporator drains holdup tank	1	1,500	Carbon steel	Atmospheric	150	ASME III
Waste collector tank	1	23,400	Carbon steel[a]	Atmospheric	150	API-650[b]
Waste sample tank	2	24,300	Aluminum	Atmospheric	150	ANSI B96.1-1967
Waste sample tank	1	21,000	Aluminum	Atmospheric	150	ANSI B96.1-1967
Waste surge tank	1	65,700	Carbon steel[a]	Atmospheric	150	API-650[b]

[a] Except for a new SA-240-304/stainless steel bottom.
[b] Design code for tank modifications is ASME III, Class 3

Component	Number	Liquid Pumped	Flow Rating (gpm)	Total Dynamic Head (ft)	Materials (Casing/ Shaft/ Impeller)	Type	Design Code
Floor drain collector pump A	1	Wastewater	150	264	SS SS SS	Single stage, vertical, in-line	Manufacturer's Standard
Floor drain collector pump B	1	Wastewater	150	264	SS SS SS	Single-stage, vertical, in-line	Manufacturer's Standard
Evaporator feed pump	2	Evaporator surge tank effluent	40	126	316 SS/ 316 SS/ 316 SS	Single-stage, vertical, in-line	Manufacturer's Standard
Distillate pump	2	Evaporator distillate	35	92	SS CF-3/ CS/ SS CF-3	Single stage, centrifugal	Manufacturer's Standard

TABLE 11.2-7 LIQUID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Component	Number	Liquid Pumped	Flow Rating (gpm)	Total Dynamic Head (ft)	Materials (Casing/ Shaft/ Impeller)	Type	Design Code
Distillate transfer pump	2	Evaporator distillate	50	80	316 SS/ 316 SS/ 316 SS	Single stage, horizontal	Manufacturer's Standard
Evaporator drains pump	1	Evaporator drainage	30	35	316 SS/CS 316 SS	Single stage, horizontal	Manufacturer's Standard
Concentrates pump	2	Wastewater	50	90	CS/ 304 L SS/ SS CF-3	Single stage, horizontal,	Manufacturer's Standard
Chemical waste pump	2	Wastewater	60	90	316 SS/ 316 SS/ 316 SS	Single stage, one vertical, in-line and one horizontal	Manufacturer's Standard
Chloride waste pump	1	Chloride wastewater	35	40	Monel/ Monel/ Monel	Single stage, vertical, in-line	Manufacturer's Standard
Waste oil pump	1	Waste oil	10	352	CS/ CS/ CS	Rotary gear	Manufacturer's Standard
Waste collector pump A	1	Wastewater	150	350	Cast iron/ stainless steel/ bronze	Single stage, vertical, in-line	Manufacturer's Standard
Waste collector pump B	1	Wastewater	150	350	Cast iron/ stainless steel/ bronze	Single stage, vertical, in-line	Manufacturer's Standard
Waste surge pump A	1	Wastewater	150	326	316 SS/ 316 SS/ 316 SS	Single stage, vertical, in-line	Manufacturer's Standard
Waste surge pump B	1	Wastewater	150	326	316 SS/ 316 SS/ 316 SS	Single stage, vertical, in-line	Manufacturer's Standard
Waste sample pump	2	Radwaste	150	97	316 SS/ 316 SS/ 316 SS	Single stage, in-line	Manufacturer's Standard
Waste sample pumps	1	Radwaste	150	190	316 SS/ 316 SS/ 316 SS	Single stage, vertical, in-line	Manufacturer's Standard
Floor drain sump pumps	2	Wastewater	55	35	Cast iron/ stainless steel/ bronze	Horizontal, self-priming	Manufacturer's Standard
Equipment drains sump pumps	2	Wastewater	55	35	Cast iron/ stainless steel/ bronze	Horizontal, self-priming	Manufacturer's Standard
Evaporator Condensate Forwarding Pumps	2	Condensate	10	100	Cast iron/ stainless steel/ bronze	Horizontal	Manufacturer's Standard

TABLE 11.2-7 LIQUID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Component	Number	Liquid Pumped	Flow Rating (gpm)	Total Dynamic Head (ft)	Materials (Casing/ Shaft/ Impeller)	Type	Design Code
PIB Tank Forwarding Pump	1	Condensate	10	170	316 SS	Horizontal 4-Stage Centrifugal	Manufacturer's Standard
Sample Batch Tank Forwarding Pump	1	Water	40	170	316SS	Horizontal 4-Stage Centrifugal	Manufacturer's Standard

Floor Drain Demineralizer

Type - Mixed-bed, anion and cation resin, nuclear grade, nonregenerative, with stainless steel wire mesh underdrain

Capacity - 140 gpm, batch process

Resin bed - 49 ft^3

Vessel size - 4 ft 6 in. O.D. by 4 ft 9 in. vertical shell and ASME heads

Design temperature - 150°F

Design pressure - 150 psig

Pressure drop - 7 psid

Design code - ASME Section VIII, Division I, 2010

Material – Shell, heads, nozzle pipes, flanges and internals – stainless steel

Waste Demineralizer

Type - Mixed-bed, anion and cation resin, with stainless steel wire mesh underdrain

Capacity - 140 gpm, batch process

Resin bed - 49 ft^3, resin depth 3 ft minimum, 5 ft maximum

Vessel size - 4 ft 6 in. O.D. by 9 ft 6 in. shell height

Design temperature - 150°F

Design pressure - 150 psig

Material - Shell, heads, flanges, and nozzle pipes - carbon steel

Internals - 304 stainless steel

Tank lining - 1/4-in. EPDM (ethylene propylene)

Pressure drop - 10 psid

Design code - Demineralizer Vessel - ASME Section III, Class C, 1968

TABLE 11.2-7 LIQUID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Post Treatment System Mixed Bed Demineralizer

Type – Mixed-bed, anion and cation resin, nuclear grade, nonregenerative, with stainless steel wire mesh underdrain

Number of Demineralizers - 2

Capacity - 20 gpm, batch process

Resin bed - 20 ft^3

Vessel size – 30 in. O.D. by 5 ft 8 in. vertical shell and ASME heads

Design Temperature - 150°F

Design Pressure - 150 psig

Pressure drop - 5 psid

Material - Shell, heads, flanges, and nozzle pipes - 316 SS

Internals - 304 Stainless steel

Design Code - ASME Section VIII, Division I, 2001

Post Treatment System Granulated Activated Charcoal Bed Filter

Type - Granular Activated Carbon Bed Filter

Number of Filters - 2

Capacity - 20 gpm, batch process

GAC bed – 24 ft^3

Vessel size - 30 in. O.D. by 5 ft 8 in. shell height

Design Temperature - 150°F

Design Pressure - 150 psig

Material - Shell, heads, flanges, and nozzle pipes - 316 SS

Internals - 304 Stainless steel

Pressure drop - 10 psid

Design Code - ASME Section VIII, Division I, 2001

Floor Drain and Waste Collector Etched-Disk Filters (two)

Type - Etched disk

Capacity - 190 gpm maximum

Materials - Shell and heads - 304 stainless steel

Internals - 316L stainless steel

Design pressure - 350 psig

Design temperature - 150°F

Design code - ASME Section VIII, Division I

TABLE 11.2-7 LIQUID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Floor Drain and Waste Collector Oil Coalescers (two)

Type - Oil separator vessel with oil-coalescing cartridges

Capacity - 150 gpm design

Material - 316 stainless steel

Design pressure - 150 psig

Design temperature - 150°F

Design code - ASME Section VIII, Division 1

Process Evaporators (two)

Type - Low-pressure, horizontal batch type with submerged U-tube heating bundle - single shell, with continuous spray demister

Capacity - 30 gpm of distillate

Steam pressure to tube bundle - 10 psig

Cooling water pressure - 100 psig

Overpressure protection - 3 in. rupture disk to discharge

Condensing space vacuum - 20 in. Hg

Distillate temperature - 190°F

Operating temperature - 160°F (evaporator and condenser)

Distillate temperature at cooler discharge - 125°F

Shell size - 8 ft 6 in. diameter by 11 ft 4 in. long over elliptical heads

Material and thickness - 304 stainless steel, 1/2-in.-thick plate

Tubes and tube sheets - Incoloy-825, 3/4 in., 17-gage tubes; 2-1/16-in.-thick tube sheets

Decontamination factor - 3 x 10^5 bottoms to distillate (gross activity basis)

Max. activity of concentrated waste liquid - 5 x 10^{-2} μCi/ml

Volume of concentrated waste liquid - 800 gal

Design codes - Evaporator shell - ASME Section III, Class C, 1968

Evaporator tube bundles - ASME Section VIII, Division 1, 1980

Channel sections of tube bundles - ASME Section VIII, Division 1, 1968

Process piping - ANSI B31.7, 1969 Class III for stainless steel

Pumps and valves - ASME Draft Code for Pumps and Valves for Nuclear Power, Class III, 1968, and March 1970 Addenda

Distillate cooler - ASME Section VIII, Division 1, 1968, and TEMA Class C

Piping for steam and cooling water - Carbon steel ANSI B31.1

TABLE 11.2-7 LIQUID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Precoat Filters (two)

Surface area - Waste collector filter: 115 ft^2

- Floor drain filter: 64 ft^2

Max. differential pressure - Waste collector filter: 30 psid

- Floor drain filter: 30 psid

Amount of precoat - 0.2 lb/ft^2 (each filter)

Filter vessel volume - Waste collector filter: 460 gal

-Floor drain filter: 210 gal

Total backwash air required - Waste collector filter: 61 scf

- Floor drain filter: 28 scf

Materials - Vessel - carbon steel

- Internals - 304 stainless steel

- Lining – Plasite

[a] Except SA-240-304/stainless steel bottom.

[b] Design code for tank modifications is ASME III, Class 3.

TABLE 11.2-8 ESTIMATED CONDENSATE STORAGE WATER QUALITY

Parameter	Value
Specific conductivity at 25 °C	≤ 1µmho/cm
pH at 25 °C	6 to 8
Silica (as SiO_2)	≤50 ppb
Chloride (as Cl^-)	≤25 ppb
Boron (as BO_3)	≤0.1 ppm
Total Organic Carbon (TOC)	≤500 ppb

Note: pH and conductivity apply after correction is made for dissolved carbon dioxide.

TABLE 11.2-9 ESTIMATED ANNUAL RELEASES FROM LIQUID EFFLUENT FOR MODE ONE[a,b,c] (3499 MWt)

Nuclide	Total (Ci/yr)[d]
Corrosion and Activation	
Na-24	0.00460
P-32	0.00011
Cr-51	0.00345
Mn-54	0.00004
Mn-56	0.01007
Fe-55	0.00058
Fe-59	0.00002
Co-58	0.00011
Co-60	0.00023
Ni-65	0.00006
Cu-64	0.01329
Zn-65	0.00011
Zn-69m	0.00091
Zn-69	0.00076
W-187	0.00015
Np-239	0.00380
Fission Products	
Br-83	0.00120
Br-84	0.00030
Br-85	0.00001
Rb-89	0.00098
Sr-89	0.00006
Sr-91	0.00163
Y-91m	0.00084
Y-91	0.00002
Sr-92	0.00209
Y-92	0.00278

TABLE 11.2-9 ESTIMATED ANNUAL RELEASES FROM LIQUID EFFLUENT FOR MODE ONE[a,b,c](3499 MWt)

Nuclide	Total (Ci/yr)[d]
Y-93	0.00167
Nb-98	0.00028
Mo-99	0.00109
Tc-99m	0.00715
Tc-101	0.00161
Ru-103	0.00001
Tc-104	0.00185
Ru-105	0.00058
Rh-105m	0.00058
Rh-105	0.00005
Te-129m	0.00002
Te-129	0.00001
Te-131m	0.00005
I-131	0.00226
I-132	0.01152
I-133	0.02621
I-134	0.00736
Cs-134	0.00018
I-135	0.01903
Cs-136	0.00046
Cs-137	0.00011
Cs-138	0.00421
Ba-139	0.00114
Ba-140	0.00023
La-140	0.00001
Ba-141	0.00023
La-141	0.00018
Ce-141	0.00002
Ba-142	0.00008

TABLE 11.2-9 ESTIMATED ANNUAL RELEASES FROM LIQUID EFFLUENT FOR MODE ONE[a,b,c] (3499 MWt)

Nuclide	Total (Ci/yr)[d]
La-142	0.00072
Ce-143	0.00001
Pr-143	0.00002
Total (except tritium)	0.13718
Tritium release	52.5

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a Nuclides having an annual release of less than 10^{-5} Ci/yr have been excluded.
b Calculated according to NUREG-0016, Revision 1.
c Mode one represents normal operation with both the radwaste evaporator and the etched-disk-filter/oil coalescer trains in use.
d See Table 5 of Annex A of Appendix 11A.

TABLE 11.2-10 ESTIMATED ANNUAL RELEASES FROM LIQUID EFFLUENTS FOR MODE TWO[a,b,c] (3499 MWt)

Nuclide	Total (Ci/yr)[d]
Corrosion and Activation	
Na-24	0.00460
P-32	0.00011
Cr-51	0.00345
Mn-54	0.00004
Mn-56	0.01008
Fe-55	0.00058
Fe-59	0.00002
Co-58	0.00011
Co-60	0.00023
Ni-65	0.00006
Cu-64	0.01330
Zn-65	0.00011
Zn-69m	0.00091
Zn-69	0.00076
W-187	0.00015
Np-239	0.00380
Fission Products	
Br-83	0.00120
Br-84	0.00030
Br-85	0.00001
Rb-89	0.00098
Sr-89	0.00006
Sr-91	0.00163
Y-91m	0.00084
Y-91	0.00002
Sr-92	0.00209
Y-92	0.00278
Y-93	0.00167
Nb-98	0.00028
Mo-99	0.00109
Tc-99m	0.00715
Tc-101	0.00161
Ru-103	0.00001
Tc-104	0.00185
Ru-105	0.00058
Rh-105m	0.00058

TABLE 11.2-10 ESTIMATED ANNUAL RELEASES FROM LIQUID EFFLUENTS FOR MODE TWO[a,b,c] (3499 MWt)

Nuclide	Total (Ci/yr)[d]
Rh-105	0.00005
Te-129m	0.00002
Te-129	0.00001
Te-131m	0.00005
I-131	0.00226
I-132	0.01153
I-133	0.02622
I-134	0.00736
Cs-134	0.00018
I-135	0.01904
Cs-136	0.00046
Cs-137	0.00011
Cs-138	0.00421
Ba-139	0.00114
Ba-140	0.00023
La-140	0.00001
Ba-141	0.00023
La-141	0.00018
Ce-141	0.00002
Ba-142	0.00008
La-142	0.00072
Ce-143	0.00001
Pr-143	0.00002
Total (except tritium)	0.13723
Tritium release	52.5

---

a Nuclides having an annual release of less than 10^{-5} Ci/yr have been excluded.
b Calculated according to NUREG-0016, Revision 1.
c Mode one represents normal operation with both the radwaste evaporator and the etched-disk-filter/oil coalescer trains in use.
d See Table 5 of Annex A of Appendix 11A.

TABLE 11.2-11 ESTIMATED MAXIMUM DOSES TO AN INDIVIDUAL RESULTING FROM FERMI 2 LIQUID EFFLUENT FOR MODE ONE OPERATION[a] (3499 MWt)

Pathway	Dose to a Child (mrem/year) Total Body	Bone (Maximum Organ)
	Resident 1770 meters NE	
Fish ingestion	0.00343	0.07305
Invertebrate ingestion	0.00029	0.00385
Shoreline	0.00006	0.00006
Swimming	0.00004	0.00004
Boating	0.00003	0.00002
Total	0.00386	0.07703
	Resident 1530 meters S	
Fish ingestion	0.00229	0.04912
Invertebrate ingestion	0.0002	0.0026
Drinking water	0.00223	0.00019
Shoreline	0.00004	0.00004
Swimming	0.00002	0.00002
Boating	0.00001	0.00001
Total	0.00480	0.05198

[a] See Table 11.2-9 for definition of mode one.

TABLE 11.2-12 MUNICIPAL POTABLE WATER INTAKES

Municipality	Year 2000 Population	Dilution Factor
Monroe	56,000	77
Toledo	466,200	100
Kingsville	1,800	100
Leamington	12,600	100
Port Clinton	14,900	100
Wheatley	1,300	100
Sandusky	53,400	100

TABLE 11.2-13 ESTIMATED POPULATION DOSES WITHIN A 50-MILE RADIUS RESULTING FROM FERMI 2 LIQUID EFFLUENTS FOR THE YEAR 2000 (Internal and External) (3499 MWt)

Pathway	Dose (man-rem/yr) Total Body	Thyroid
Internal		
Sport fish ingestion	0.08533	0.02602
Commercial fish ingestion	0.00066	0.00017
Drinking water	0.35798	1.61299
External		
Shoreline	0.00291	0.00291
Swimming	0.00094	0.00094
Boating	0.00047	0.00047
Total	0.45	1.64

TABLE 11.2-14 LAKE ERIE SHORELINE COMMUNITIES

Community	Year 2000 Population[a]	Approximate Distance From Plant (miles)	Dilution Factor
Monroe County			
Estral Beach	294	2.5	45
Stony Point	936	1.5	45
Woodland Beach	1,514	3	77
Detroit Beach	1,327	4	77
Avalon Beach	495	9	77
Toledo Beach	79	11	77
Luna Pier	3,828	14	77
Toledo area	168,645	26	100

[a] Numbers in this column represent 50 percent of the projected population for the year 2000.

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Refer to Plant Drawing M-2033

FIGURE 11.2-1

WASTE COLLECTOR P&ID

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Refer to Plant Drawing M-2040

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-2

FLOOR DRAIN COLLECTOR P&ID

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Refer to Plant Drawing M-4797

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-3
DEMINERALIZERS P&ID

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Refer to Plant Drawing M-4798

Fermi 2

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FIGURE 11.2-4

EVAPORATOR FEED "B" P&ID

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UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-5

EVAPORATOR FEED "A" P&ID

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Refer to Plant Drawing M-2215

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UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-6

CHEMICAL WASTE
P&ID

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Refer to Plant Drawing M-2222

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UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-7

WASTE SLUDGE P&ID

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Refer to Plant Drawing M-4941

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FIGURE 11.2-8

CENTRIFUGE FEED P&ID

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Refer to Plant Drawing M-4942

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FIGURE 11.2-9

SPENT RESIN SLURRY P&ID

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Refer to Plant Drawing M-4943

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FIGURE 11.2-10

ASPHALT FEED P&ID

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Refer to Plant Drawing M-4944

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FIGURE 11.2-11

EXTRUDER/EVAPORATOR
P&ID

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Refer to Plant Drawing M-4945

Fermi 2

UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-12

FILL STATION AUXILIARIES AND COOLING WATER BOOSTER PUMPS P&ID

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Refer to Plant Drawing M-5094

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FIGURE 11.2-13

CAUSTIC FEED SYSTEM ISOLOK SAMPLING SYSTEMS
AND MISCELLANEOUS SERVICE PIPING

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Refer to Plant Drawing M-5122

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FIGURE 11.2-14

WASTE COLLECTION P&ID

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Refer to Plant Drawing M-2028

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FIGURE 11.2-15, SHEET 1

RADWASTE SYSTEM PROCESS FLOW DIAGRAM

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Refer to Plant Drawing M-2029

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FIGURE 11.2-15, SHEET 2

RADWASTE SYSTEM PROCESS FLOW DIAGRAM

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Refer to Plant Drawing M-2030

Fermi 2

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FIGURE 11.2-15, SHEET 3

RADWASTE SYSTEM PROCESS FLOW DIAGRAM

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Refer to Plant Drawing M-2032

Fermi 2

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FIGURE 11.2-16, SHEET 1

RADWASTE SYSTEM
SUMP PUMP DIAGRAM

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Refer to Plant Drawing M-2032-1

Fermi 2

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FIGURE 11.2-16, SHEET 2

RADWASTE SYSTEM SUMP PUMP DIAGRAM

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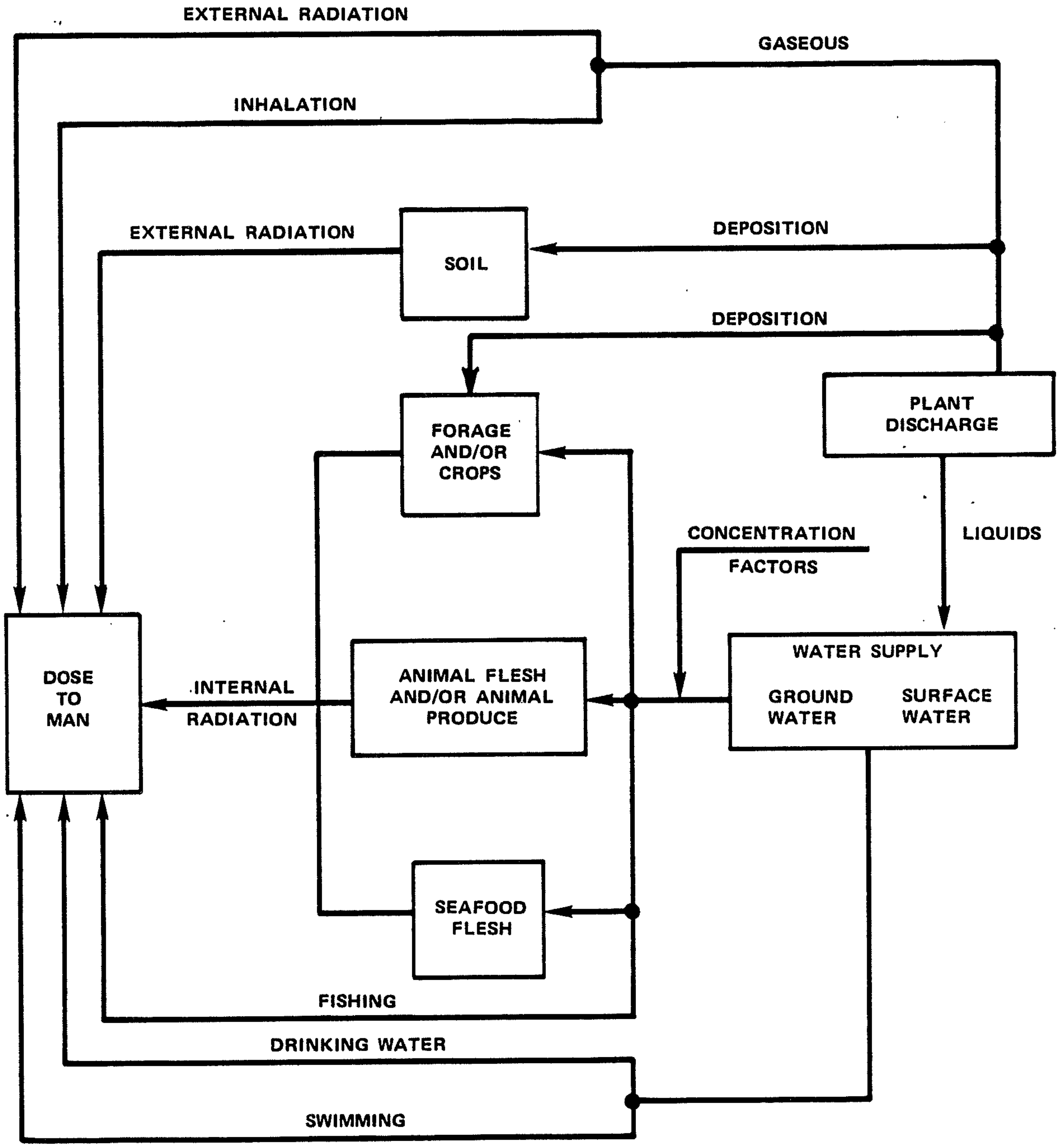
Refer to Plant Drawing M-2031

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-16, SHEET 3
RADWASTE SYSTEM SUMP PUMP DIAGRAM



Fermi 2

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FIGURE 11.2-17

EXPOSURE PATHWAYS TO MAN

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Refer to Plant Drawing M-2511

Fermi 2

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FIGURE 11.2-18, SHEET 1

SIDE STREAM LRWP SYSTEM P&ID

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Refer to Plant Drawing M-2512

Fermi 2

UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.2-18, SHEET 2

SIDE STREAM LRWP SYSTEM P&ID

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Refer to Plant Drawing M-2513

11.3 GASEOUS RADWASTE SYSTEM

11.3.1 Design Objectives

The design objectives of the gaseous radwaste system are to process and control the release of gaseous radioactive effluents to the site environs so that the releases are a small fraction of the concentration limits as defined in 10 CFR 20, Appendix B, and are as low as reasonably achievable, as required by 10 CFR 50, Appendix I; to keep iodine releases within the total yearly release limit of Regulatory Guide 1.42;* and to operate within the emission rates established in the Offsite Dose Calculation Manual radiological effluent controls.

Subsections 11.3.6 and 11.3.9 establish that the gaseous radwaste system adequately meets the above design objectives.

11.3.2 System Description

The largest single source of gaseous radwaste from the Fermi 2 plant is the offgas removed from the main condenser. For the treatment of this source of gaseous radwaste, the gaseous waste processing system, referred to as the offgas system, has been incorporated in the plant design. This system is discussed in Subsection 11.3.2.7.

Other sources of gaseous radwaste include releases from the turbine gland seal steam condenser and releases to the various plant ventilation systems from potential leakage of main steam and primary coolant. Although attempts are made to limit leakage to a minimum, small leaks at rates which make their detection difficult are expected. These other sources of gaseous waste are discussed in Subsections 11.3.2.1 through 11.3.2.6.

11.3.2.1 Turbine Gland Seal Steam

Steam is provided to the turbine gland seal to prevent air inleakage to the condenser during operation. Steam to the gland seal is provided from the main steam line or from the auxiliary boiler during startup and from the high-pressure turbine inner steam seal leakoffs during operation. The steam from the turbine gland seal and air inleakage is exhausted to the gland steam condenser where the steam is condensed. The condensate is returned to the main condenser. Subsection 10.4.3 provides a detailed description of the turbine gland sealing system.

The noncondensibles from the gland steam condenser contain a source of radioactive gaseous effluents from Fermi 2. Estimated sources from the gland steam condenser were based upon the parameters given in Appendix A of Regulatory Guide 1.42.

In order to reduce the concentration of short-lived radionuclides in offgas from the gland seal condenser, additional piping has been incorporated in the gland seal condenser exhaust system to provide a minimum 2-minute delay. Estimated releases from the turbine gland seal condenser are given in Table 11.3-1.

---

* Regulatory Guide 1.42 was withdrawn March 18, 1976, with the adoption of Appendix I to 10 CFR 50 and the development of a series of implementing guides.

11.3.2.2 Sources to Turbine Building Ventilation System

The source of radionuclides to the turbine building atmosphere is small potential leaks from valves in piping systems carrying main steam. Although attempts are made to limit this potential leakage to a minimum, small leaks are expected to occur. For calculational purposes, the total steam leakage into the turbine building is assumed to be 1700 lb/hr consistent with Regulatory Guide 1.42, Revision 1. Noble gas concentrations in the steam are presented in Table 11.1-2. Assumptions for iodine releases are the same as those provided in Appendix A of Regulatory Guide 1.42, Revision 1. The total main steam line flow is 15,221,000 lbm/hr for the design basis of 102 percent of uprated reactor power.

Due to the extremely high turbine building ventilation exhaust flow rates, treatment of this release path is not practicable. Within the turbine building area, ventilation flow is controlled by maintaining pressure differentials between the various turbine building areas. This ensures proper ventilation flow patterns and also prevents releases of radioactive gases to areas of the turbine building normally accessible during plant operation. In evaluating the ventilation system in the steam piping area (that is, the valve area and east and west reheater bays at Elevation 641 ft 6 in.), it was conservatively determined that a minimum 10-minute holdup is provided by the ventilation system. This allows adequate decay for short-lived isotopes. Monitoring of the turbine building ventilation exhaust is performed, and if the radioactivity concentration exceeds the monitor setting as described in Section 11.4, turbine building ventilation is terminated. The turbine building ventilation system is described in Subsection 9.4.4. The expected releases from the turbine building are listed in Table 11.3-1.

11.3.2.3 Sources to Reactor Building Ventilation System

Since the noble gas concentrations are negligible in the primary coolant liquid present in fluid systems located in the reactor building, only the release of radiohalogens from primary coolant leakage into the reactor building represents a source of radioactivity to the reactor building ventilation. A primary coolant leakage rate of 500 lb/hr was used in estimating a conservative radiohalogen source term. This value is the total of a number of minor leaks assumed to exist. The assumptions used in determining the quantity of radiohalogen releases are those presented in Appendix A of Regulatory Guide l.42, Revision 1. The estimated releases from the reactor building are given in Table 11.3-l.

Normally, ventilation of the reactor building is performed by the reactor/auxiliary building ventilation system, which does not process the ventilation effluent. However, if the radioactivity concentration in the release exceeds the associated exhaust radiation monitor setpoint (Section 11.4), ventilation by the reactor/auxiliary building ventilation system is terminated and the reactor building is ventilated and maintained under negative pressure with respect to outside atmosphere by the standby gas treatment system (SGTS). The reactor/auxiliary building ventilation system is described in Subsection 9.4.2.

11.3.2.4 Sources to Drywell Purge System

Neutron activation of air around the reactor pressure vessel (RPV) and potential small system leaks could provide sources of radioactive gases to the drywell atmosphere. Since the drywell is a closed system and is not normally vented, most isotopes will have decayed out prior to initiation of ventilation of the drywell. The atmosphere can be sampled prior to purging and is also monitored during purging. If high radiation levels are detected, the purge can be terminated or processed by the SGTS. Therefore, any release from the Fermi 2 drywell is expected to be negligible. The drywell purge system is described in Subsection 6.2.3.

11.3.2.5 Sources to Radwaste Building Ventilation System

The source of radioactive gases in the radwaste building could be from evaporation of leakage from equipment, from valves, or from the ventilation of atmospheric storage tanks. The iodine concentration in the liquid radwaste system is significantly lower than that in the primary coolant due to removal by processing and to dilution of the iodine by noncontaminated water entering the system from sumps. Assuming an average reduction of 100 for iodine in the liquid radwaste system, the radiohalogen release to the radwaste building atmosphere has been determined to be negligible.

11.3.2.6 Other Potential Sources of Radioactive Gaseous Waste

It will be necessary to vent certain tanks and discharge gases from specific laboratories and building service areas to a reactor building, turbine building, or radwaste building ventilation exhaust system. These additions are of a low level and add insignificant increments to the total radioactive gas releases.

11.3.2.7 Offgas System

The noncondensibles removed from the main condenser are the largest source of radioactive gaseous waste from the plant. In order to reduce the releases from this source, the offgas system has been incorporated in the plant. The offgas system consists of two effluent streams, one from the mechanical vacuum pump and the second from the steam-jet air ejectors. The offgas system is described in Figure 11.3-1 and shown schematically in Figure 11.3-2.

11.3.2.7.1 Mechanical Vacuum Pump Offgas

The mechanical vacuum pump is used before startup to reduce the condenser pressure to approximately 4 in. Hg abs, at which point the mechanical vacuum pumps stop and the steam-jet air ejectors are started manually.

The mechanical vacuum pump is also used for normal shutdowns, SCRAM related shutdowns, and during periods of low power operations when the Offgas system is not available. The expected quantity of gaseous radwaste released from these operations of the mechanical vacuum pump are also small. Controls for the release path contained in the Offsite Dose Calculation Manual (ODCM) are designed to prevent exceeding ODCM limits. An active mechanical vacuum pump trip on high radiation in the main steam lines will ensure that 10 CFR 50.67 limits are not exceeded on transient or “puff” releases. These controls prevent the release limits from being exceeded.

Since the mechanical vacuum pump is normally used only under the conditions stated above, it is an infrequent source of gaseous releases. The expected quantity of gaseous radwaste released from this source is dependent upon the chronology of events from initiation of shutdown to startup.

An estimate of the expected concentrations of gaseous radwaste from the mechanical vacuum pump during a startup can be made assuming that:

a. The plant operates with an 80 percent plant capacity factor

b. The average duration per shutdown is 18 days, assuming four shutdowns per year and a total of 20 percent downtime per year

c. The volume of the condenser is estimated to be 1.8 x 10^5 ft^3

d. For noble gases, offgas from the reactor is assumed to be carried to the condenser, at the full power rate, for 2 hr following shutdown of the steam-jet air ejectors

e. For iodine, the partition coefficient within the turbine condenser is taken as 10^{-4} $\frac{mCi/cm^3 \text{ noncondensible}}{mCi/cm^3 \text{ water}}$

Other parameters for iodine are as given in Appendix A to Regulatory Guide 1.42.

During startups, the rate of air removal by the mechanical vacuum pump is greater than the offgas flow rate through the steam-jet air ejector during normal operation. As a result, the offgas from the mechanical vacuum pump does not permit processing through the portion of the offgas system designed to process air ejector effluents. Also, since startup using the mechanical vacuum pump follows an outage period that is long enough to allow significant decay of most gaseous isotopes in the condenser, no processing is provided other than a 2-minute delay of the mechanical vacuum pump offgas. Estimated releases from this effluent stream are given in Table 11.3-1.

During mechanical vacuum pump operation for normal shutdowns, SCRAM related shutdowns, and operations during periods of low power operations when the Offgas system is not available, the release rate of the mechanical vacuum pump offgas is expected to be low. The controls applied to this release path will ensure that ODCM limits on instantaneous release, quarterly dose and annual dose due to untreated release are met. These limits are significantly below the levels originally estimated in Table 11.3-1. This allows mechanical vacuum pump operations for normal shutdowns, SCRAM related shutdowns, and during periods of low power operations when the Offgas system is not available.

11.3.2.7.2 Steam-Jet Air Ejector Offgas

In order to reduce backpressure on the turbine and to maintain turbine efficiency, noncondensible gases must be continuously exhausted from the condenser during plant operation. This is accomplished by the main condenser steam-jet air ejectors. The condenser offgas, which is the major source of the gaseous radwaste, contains hydrogen and oxygen generated by the radiolysis of water, air that leaks into the condenser, and radioactive gases consisting of activation and fission gases. About 98.5 percent of the radioactive gases that exit the RPV with the steam are very short-lived activation gases that have less than a 30-sec half-life, such as ^{16}N and ^{19}O. Additional activation gases are present in much smaller amounts, with half-lives of 10 minutes (^{13}N) and 110 minutes (^{18}F). The remaining radioactive gases, krypton and xenon, are noble gases and result from fissioning. The concentration of these noble gases depends on the amount of tramp uranium in the coolant and on the cladding surfaces, which is usually extremely small, and on the number and size of fuel-cladding leaks. Estimated concentrations of radioactive gases exiting the RPV and entering the offgas system are provided in Table 11.1-1.

In addition to the radiogases removed from the condenser, there are also radioiodines and radioactive particulate daughters due to the decay of krypton and xenon isotopes.

11.3.2.7.3 Radionuclide Inventories in the Offgas System

The calculated design-basis radionuclide inventories in components within the offgas system are presented in Table 11.3-2. Components identified in Table 11.3-2 are shown schematically in Figure 11.3-2.

11.3.2.7.3.1 Noble Gas Inventories

Noble gas inventories have been calculated by using equipment volume, condenser offgas release rate as listed in Table 11.1-2, and decay during residence in the equipment. Decay during transit between equipment was not considered. Residence time in equipment other than the charcoal beds was determined by:

$$T = \frac{V}{F} \qquad (11.3\text{-}1)$$

where

T = residence time

V = equipment volume

F = flow rate (see Subsection 11.3.3.1)

The residence times for the various equipment in the offgas system are:

a. Preheater - 0.2 sec

b. Recombiner - 0.5 sec

c. Condenser - 18 sec

d. Aftercooler - 30 sec

e. Precooler - 15 sec

f. Holdup pipe - 130 sec

g. Sand filter - 30 sec

h. Chiller - 18 sec

i. First charcoal bed - 2.66 days (Xe); 4 hr (Kr)

j. All charcoal beds - 16 days(Xe); 24 hr (Kr)

k. Afterfilter - 60 sec

The residence time for the noble gases in the charcoal delay beds was determined by

$$T = \frac{K_D M}{F} \qquad (11.3\text{-}2)$$

where

K_D = dynamic adsorption coefficient, cm^3/g

M = mass of adsorbing material (charcoal), g

F = volumetric flow rate, cm^3/sec (see Subsection 11.3.3.1)

The values of K_D were determined experimentally for the installed Fermi system at the following conditions:

a. Percent moisture of charcoal - approximately 1.4 percent

b. Temperature of charcoal - 70°F

c. Gas pressure - 12.5 psia.

These are the nominal operating conditions in the charcoal delay portion of the offgas system. The derived test data obtained per design calculation were:

Gas	K_D Measure as cm^3/g	Residence Time
Kr	37.6	24.8 hours
Xe	629 – 688	17.3 – 18.9 days

These test results showed charcoal residence times longer than the design basis values of 24 hours and 16 days.

11.3.2.7.3.2 Daughter Product Inventory

Unlike noble gases, the daughter products are either washed out of the free volume in equipment such as condensers and directed to the liquid radwaste system, washed out and trapped on frost in equipment such as the chiller where they are later directed to the liquid radwaste system after the chiller is defrosted, or trapped in equipment such as the sand filter and charcoal beds. A daughter product removal of 100 percent was assumed for the following components:

a. Offgas condenser

b. Aftercooler

c. Precooler

d. Holdup pipe

e. Chiller

f. Sand filter

g. Charcoal beds

h. Afterfilter.

Daughter product activities in each piece of equipment were determined by calculating the quantity produced by decay of the parent during residence in the component, and then calculating the amount removed by decay. For equipment that removes these radionuclides by washout or retention, the concentration in the equipment effluent discharge was assumed to be zero. The equation used to calculate the daughter product inventories was the modified Bateman Equation for decay chain activity computation:

$$N_i(t) = P(\lambda_1 . \lambda_2 \ldots \lambda_{i-1}) . \sum_{j=1}^{i} \frac{\left(1-e^{-\lambda_j T}\right)}{\lambda_{j} \prod_{k \neq j} (\lambda_k - \lambda_j)} \qquad (11.3\text{-}3)$$

where

$N_i(t)$	=	activity of ith isotope after time (t), lCi
T	=	equipment residence time, sec
P	=	continuous release rate, lCi/sec

In equipment that retains these daughter products, the concentrations increase until an equilibrium is reached or until the retention material is changed. The operating times assumed for equipment that retains these products are

a. Chiller (assumed to require defrosting after 6 hr of operation) - 6 hr

b. Charcoal beds - 10 years

c. Afterfilter - 10 years.

The inventories in such components were calculated using the following equation:

$$N_i(t) = P(1 - e^{-\lambda_1 T}) \left[(\lambda_1 . \lambda_2 \ldots . \lambda_{i-1}) \sum_{j=1}^{i} \frac{\left(1-e^{-\lambda_j t}\right)}{\lambda_j \prod_{k \neq j} (\lambda_k - \lambda_j)} \right] \qquad (11.3\text{-}4)$$

where

$N_i(t)$	=	activity of ith daughter isotope after time t in microcuries
t	=	operation or accumulation time, sec
T	=	equipment residence time, sec

11.3.2.7.3.3 Radioiodine Inventory

Major components in the offgas system were provided by Kraftwerk Union. Data on similar process streams of offgas systems provided by Kraftwerk Union and operating in West Germany have been obtained. These data show no detectable iodine entering the charcoal adsorbers. The iodine removal is not assumed to occur due to washout in the recombiner condenser, but rather is assumed to result from iodine reacting with the recombiner catalyst. The iodine inventory in the offgas system given in Table 11.3-2 reflects the data available through Kraftwerk Union and assumes that all iodine is removed in the recombiner.

11.3.2.7.4 Design Bases of the Offgas System

The design bases for the offgas system are

a. To process an annual average offgas rate equivalent to 100,000 μCi/sec after a 30-minute delay (See subsection 11.3.6)

b. To maintain the concentration of hydrogen in the gases from the air ejectors below its flammable limit

c. To provide protection against inadvertent release of significant quantities of gaseous and particulate radioactive material to the environs

d. To ensure that in-plant occupational radiation exposures due to operation of the offgas system are as low as practicable.

11.3.2.7.5 Process Description

Basically, the offgas system processes the condenser offgas by delaying the offgas so that significant decay of radionuclides is allowed before it is released from the plant. The delay is provided by charcoal, which impedes the flow of all gases; however, heavy gases such as krypton and xenon are affected more than are lighter gases. The charcoal provides about a 1-day delay for krypton and about a 16-day delay for xenon.

During plant operation, offgas discharged from the steam-jet air ejector is diluted with steam to keep hydrogen concentrations below 4.0 percent. The gas is heated by steam in the preheater, and enters the recombiner, where the hydrogen and oxygen are recombined catalytically into water. Diluting the gas with steam controls the hydrogen concentration and also provides control over temperature rise during the recombination. After recombination, the gases are cooled and dehumidified. The gas then enters a 2.2 minute (nominal) delay pipe which is followed by a sand filter. The gas is further cooled and enters the ambient temperature charcoal adsorbers. Chilling and drying the air improves the charcoal adsorbers' performance. The discharge from the adsorber system is filtered mainly to remove any charcoal fines that may have been carried out of the last charcoal bed. The gas is then pumped into the offgas discharge piping. The system vacuum pump is used to maintain a slightly negative pressure throughout the system, thus ensuring that any leakage would be into the system. The effluent from the offgas system is discharged from the plant after dilution in the reactor building ventilation system exhaust.

The condenser offgas system removes most of the activity from activation gases and reduces the activity due to fission gases by a factor of at least 90 (when compared to the 30-minute mixture). Essentially all of the hydrogen is removed from the offgas.

The ability to continuously process condenser offgas in the case of equipment failure is ensured by providing redundant standby equipment for each component in the offgas system, except for the six charcoal beds. Since the charcoal beds are passive equipment at ambient temperature and are at a slightly negative pressure, failure of a charcoal bed is unlikely.

The hydrogen concentration in the system is controlled by the addition of dilution steam upstream of the recombiner. Oxygen is injected into the 18” offgas manifold to ensure that hydrogen injected into the feedwater system via the Hydrogen Water Chemistry (HWC) System is recombined. Free hydrogen is essentially nonexistent at the outlet of the recombiner. Increased hydrogen concentration, which is measured in the 2.2-minute delay pipe, and the lack of a ΔT across the recombiner would provide indication of a recombiner failure. A switchover to the redundant hydrogen recombiner subsystem would be made.

Protection against inadvertent release of significant quantities of gaseous waste during system operation is accomplished by the following measures:

a. The system is maintained at a negative pressure, which ensures that air leakage is into the system

b. The system is designed to withstand the maximum pressure transient which would result from an instantaneous combination of a stoichiometric hydrogen-oxygen mixture

c. Radiation monitors on the delay line from the mechanical vacuum pumps would alarm should high radioactivity concentrations occur while these pumps are in use. Following an alarm, the plant operator can take proper action to correct/mitigate the situation. The mechanical vacuum pumps are also automatically tripped on main steam line high radiation.

d. The Reactor Building Exhaust Plenum Radiation Monitoring System measures the radioactivity in the Reactor Building exhaust plenum prior to discharge from the Reactor Building vent stack. This monitor will alarm in the main control room should high radioactivity concentrations be present in the Reactor Building or Offgas System exhausts. Following a high-radiation alarm, the plant operator can take proper action to correct the situation.

In-plant occupational radiation exposures due to system operation are maintained as low as practicable as follows:

a. Shielded rooms and a pipe tunnel are provided for the routing of piping, including field-routed piping carrying radioactive fluids

b. Adequate shielding is provided around the offgas system

c. The redundant equipment trains are completely isolated from each other so that if equipment servicing is required, offgas processing can be switched to the standby equipment, and maintenance can be performed on the off-line equipment.

11.3.2.7.6 System Availability

The offgas system operation is required during the operation of the plant. There are two independent 100 percent-capacity trains of equipment consisting of water separators, preheaters, recombiners, condensers, aftercoolers, and precoolers; there is also redundancy in the number of sand filters, chillers, mechanical filters, and water ring pumps. Upon failure of any component in one subsystem, a switchover is made to the redundant subsystem. Although the charcoal adsorbers are not redundant, system availability is protected since charcoal adsorber tanks can be bypassed individually. This arrangement ensures the operation of the offgas system at all times during the operation of the plant.

While there are redundant trains of the Offgas System equipment, the steam jet air ejector line, 2.2 minute delay piping, and the Offgas vent pipe are not redundant and are not required to be redundant. The limiting failure is that of the delay piping and this abnormal operating occurrence is addressed in the analysis in UFSAR Section 15.7.1.

11.3.2.7.7 Decontamination Factors

11.3.2.7.7.1 Particulate Removal

Since, in processing, the offgas is first passed through a sand filter followed by six activated charcoal adsorber beds, none of the particulate activity entering the system is expected to be discharged. Particulate daughter products of noble gas decaying within the charcoal beds are entrapped there. To further prevent particulate releases, charcoal fines in particular, the charcoal beds are followed with a high-efficiency particulate air (HEPA) filter rated at 99.9 percent efficient for all particles 0.3 μm and larger.

11.3.2.7.7.2 Radiogas Removal

Since radiogases are removed by decay, the decontamination factor will vary from isotope to isotope. Table 11.3-3 presents the estimated decontamination factor for each radiogas isotope, assuming a 24-hr holdup for krypton isotopes and a 16-day holdup for xenon isotopes.

11.3.3 System Design

The offgas system shown in Figure 11.3-1 is considered to consist of four subsystems: (1) the recombiner subsystem; (2) the air drying subsystem; (3) the charcoal adsorption subsystem; and (4) the water ring exhaust pump subsystem.

11.3.3.1 Design Parameters

Design parameters of the offgas system are:

a. Hydrogen - 186 cfm nominal at 14.7 psia and 130°F

b. Oxygen - 93 cfm nominal at 14.7 psia and 130°F

c. Air - 40 cfm nominal at 14.7 psia and 70°F

d. Steam - sufficient to reduce hydrogen concentration to ≤4.0 percent by volume at preheater inlet.

Carrier gas is the air inleakage from the main condenser after the radiolytic hydrogen and oxygen are removed by the recombiner. The sixth edition of Heat Exchange Institute Standards for Steam Surface Condensers, Paragraph S-16 c(2), indicates that, with certain conditions of stable operation and suitable construction, noncondensibles (not including radiolytic dissociation and trace gases) should not exceed 6 scfm for large condensers. The air inleakage for Fermi 2 has been considered as 40 scfm (nominal). However the plant can operate at an air inleakage flow higher than 40 scfm as long as the offsite dose rates do not exceed the applicable limits specified in the Technical specifications, and the offgas equipment does not exceed its capacity.

11.3.3.2 Design Pressure Transients

The most severe pressure transient that the system is postulated to experience would proceed as follows. The system is functioning normally; however, condenser air inleakage is so low as to be nondetectable. A recombiner failure occurs, but system switchover to the standby hydrogen removal train is not complete until a considerable quantity of H_2-0_2 gas, in stoichiometric proportions, has entered the vessels downstream of the condenser. Combustion cannot occur upstream of the condenser due to the presence of dilution steam and noncondensed air ejector steam. An ignition source that causes an instantaneous constant-volume combustion of gases is alleged to exist. The calculated pressure is postulated to exist everywhere in the offgas system exhaust pipe. The maximum pressure transient is 3l8 psig. To withstand this pressure transient, the offgas system (except for the water ring exhaust pumps) is designed for an upset pressure of 375 psia.

The recombiner is provided with a rupture disk for overpressure protection of the water separator, the tube side of the preheater, the recombiner, the shell side of the condenser, and the aftercooler. There are no isolating valves between these components and interconnecting piping. This is in accordance with the code requirement for overpressure protection in Article UG 125, ASME Boiler and Pressure Vessel Code Section VIII, Division 1.

In addition, safety valves are provided at the shell side of the preheater and relief valves are provided for the tube side of the condenser, aftercooler, and water ring cooler, for protection of the system piping and components against overpressurization.

11.3.3.3 Component Description

Each major component of the offgas system is described in the following subsections. Design parameters of offgas system components are listed in Table 11.3-4.

11.3.3.3.1 Water Separator

There is one water separator provided per train. The water separator is a vertical tank-shaped vessel. Gas enters near the bottom by way of a tangential nozzle. Water is removed by utilizing the cyclone principle. The gas passes through a stainless steel mesh demister before exiting through the top of the vessel. Detained water is drained to the condensate receiver tank by way of the loop seal.

11.3.3.3.2 Offgas Preheater

There is one offgas preheater provided per train. The purpose of the offgas preheater is to superheat the offgas. This is conducive to more efficient and dependable recombiner performance. The preheaters are flanged-head straight tube-type vessels. The shell side receives main steam which has been throttled to 160 psia. The steam condenses, giving up heat to the offgas that flows through the tubes. The shell-side water level is sensed and controlled, and the shell side is drained directly to the condenser. The tube side drains to the condensate receiver through the loop seal. A shell-side safety valve is provided that discharges into the offgas stream at the preheater inlet.

11.3.3.3.3 Catalytic Recombiner

There is one catalytic recombiner provided per train. The recombiners are vertical tank-shaped vessels. Offgas enters through the side of the vessel near the top. The gas passes down through a bed of homogeneous palladium catalyst that is supported on an aluminum oxide carrier material (pellet). The catalyst causes an exothermic reaction when the free hydrogen and oxygen in the offgas are being recombined into water. Normally, hydrogen concentration in the recombiner outlet will not exceed 20 ppm by volume. Hydrogen concentrations may exceed this value during system transients. The gas is discharged through a nozzle located in the bottom of the vessel. Each recombiner is equipped with thermocouples located at different depths in the catalyst so that a temperature profile for the bed can be continuously observed during operation. This allows the operator to monitor continuously for catalyst attrition.

Each recombiner is equipped with thermostatically controlled electric heaters located in the catalyst bed. These are used to maintain catalyst temperature in the standby recombiner so that system switchover can be accomplished without loss of recombination efficiency. Each recombiner is equipped with a rupture disk rated at 345 psig.

11.3.3.3.4 Offgas Condenser

There is one offgas condenser provided per train. The offgas condensers are horizontal U-tube flanged-head vessels. The tubes are free riding to minimize thermal stresses. Offgas entering the shell side is cooled and some of the moisture is condensed. The condensate drains into the condensate receiver tank through the four-inch loop seal manifold. Condensate from the condensate system is supplied to the tube side. Condensate flow is maintained only in the operating condenser.

11.3.3.3.5 Offgas Aftercooler

There is one offgas aftercooler provided per train. The offgas aftercoolers are straight-tube horizontal flanged-head heat exchangers. Turbine building closed cooling water (TBCCW) flows through the tubes. Offgas from the offgas condenser flows through the shell side, where additional moisture is condensed. The aftercooler drains, by way of the four-inch loop seal manifold, into the condensate receiver tank. Aftercooler discharge is essentially humid air. A demister is provided on the aftercooler outlet.

11.3.3.3.6 Precooler

There is one precooler provided per train. The precooler is a vertical vessel with a removable shell. The tubing design is serpentine with baffle plates. Throttled freon gas from a refrigeration system flows on the tube side. Offgas passes through the shell side and is cooled. The precooler discharges through a demister. Since the precoolers are the last vessels in the recombiner trains (hydrogen removal trains), they are followed by an isolation valve. Offgas passes from the operating precooler through the 2.2 minute delay pipe into the sand filter.

11.3.3.3.7 Sand Filters

There is one sand filter provided per train. Discharge from the delay pipe flows into a sand filter. The sand filters are vertical tanks. The offgas flows up through the sand. The purposes of the sand filters are to remove the nongaseous decay daughters and to attenuate a transient pressure wave, thus providing protection for the vessels downstream.

11.3.3.3.8 Chillers

There are three chillers shared between two trains. The chillers are vertical heat exchangers, flanged with a removable shell. The tubing is serpentine in design. Throttled freon gas from a refrigeration system circulates through the tubes. Offgas circulates through the shell side and is cooled. The tubing will become covered with frost during operation. Switchover to another chiller occurs automatically on a timed cycle, and the first chiller is automatically defrosted by heated freon circulating through the chiller coils. A third chiller is available as a standby unit. Each chiller is equipped with its own refrigeration subsystem. In the event of higher air-inleakage flows, chillers may be operated in manual mode (operating them in parallel) to lower the temperature of the offgas at the chiller outlet.

11.3.3.3.9 Charcoal Adsorbers

There are six charcoal adsorbers provided. The charcoal adsorbers are vertical tanks, each containing approximately 20,000 lb of activated charcoal adsorbent. All molecules, such as those of chemically inert krypton and xenon, and molecules, such as N_2 and O_2 gases, interact mechanically with the charcoal, the net result of which is that the flow of heavy gases is delayed. The delay of the radionuclides of krypton and xenon in the charcoal beds allows a significant portion of these gases to decay, thus reducing the activity of the offgas. Offgas flows up through the charcoal beds. All six adsorbers are piped together in a series arrangement. Because of their size and building space requirements, as well as the passive nature of these vessels, no standby adsorbers are provided. Bypass piping around each adsorber along with isolation valves are provided so that any adsorber can be isolated without inhibiting the use of the other adsorbers. Administrative controls preclude the possibility of bypassing the entire adsorber chain.

Each of the six bypass valves has a keylock switch in the main control room. The keys cannot be removed when bypass has been initiated. The keys are under the administrative control of the Shift Manager or his delegate. Administrative control ensures that no more than one charcoal adsorber can be bypassed at any one time when reactor power is greater than 5 percent.

11.3.3.3.10 Absolute Filter

There is one absolute filter provided per train. Two trains are provided, one of which is standby. The filters are housed in tank-type vessels. The filters are HEPA type, rated at 99.9 percent efficiency for all particles 0.3 μm and larger. The filters are replaceable cartridge-type units, with three cartridges in parallel per absolute filter.

11.3.3.3.11 Water Ring Exhaust Pumps

There is one water ring exhaust pump provided per train. The water ring pumps are used to maintain the system at a slightly negative gage pressure. Thus, should leaks occur, they would leak into the system. One water ring pump operates; the other is a standby unit. Associated with each water ring pump is a ring water buffer tank and a ring water cooler. In operation, a two- phase air/water mixture is discharged by the pumps. This mixture enters the buffer tank where the water is separated and the air is discharged to the reactor building vent. Water drains from the buffer tank through the cooler and returns to the pump.

A water ring pump of proven reliability is used here to hold a slight negative pressure in the offgas system. In the event of higher air inleakage flows, the two water ring exhaust pumps may be operated in parallel to maintain the vacuum in the main condenser.

11.3.3.3.12 Component Drains

The water separators, preheaters (tube side), condensers, and aftercoolers drain into a drain receiver tank by way of a loop seal manifold. Each vessel drain is routed individually to the four-inch loop seal manifold and is equipped with a hand-operated shutoff valve. The receiver tank is vented to the offgas condenser gas outlet. Each vent has a motor-operated shutoff valve. The drain receiver tank is drained, by means of a level controller, into the condensate receiver tank. The condensate tank is vented to the main turbine condenser, and is drained by means of pumps that transport the condensate back to the main turbine condenser.

The steam-jet air ejector intercondensers are drained by means of a manifold and loop seal that are connected directly to the condensate receiver tank. Condensate in the steam-jet air ejector exhaust manifold is drained directly into a collector tank. Condensate in the delay pipes is drained into collector tanks that are drained via level controllers into the condensate receiver tank.

Condensate in the vacuum manifold is drained into a collector tank. When the tank is full, the pipe connecting the tank and manifold is valved shut. The tank is vented to the steam-jet air ejector exhaust manifold and then drained into the condensate receiver tank. After draining, the vent is closed and the valve in the connecting pipe is opened.

Condensate does not form in the sand filter, absolute filter, or adsorbers.

11.3.3.3.13 Component Isolation

Each of the two hydrogen removal trains (i.e., those components from the water separator up to and including the precooler) is located in a separate cell. The trains are completely isolated from each other. One system operates continuously and the other serves as a standby. Because of the high activity of the offgas, it is impossible to perform any service on the operating train. Thus, upon malfunction, operation can be shifted to the standby train without interrupting plant operation. Because either train may be isolated, service can be performed on one train while the other operates.

11.3.3.4 Quality Group Classification

A detailed discussion of equipment Quality Group classification is presented in Subsection 3.2.2. This classification meets the criterion of Regulatory Guide 1.26 since the single failure of any component does not result in an offsite dose in excess of 0.5 rem. This is demonstrated in Subsection 15.11 where the analysis of the offgas system failure is presented.

11.3.3.5 Seismic Classification

Since an assumed seismically induced total failure of the offgas system would not result in an offsite dose in excess of 0.5 rem as specified in Regulatory Guide 1.29, the offgas system does not require Category I design. The analysis of the offgas system failure is provided in Section 15.11.

11.3.3.6 Offgas System Instrumentation and Control

The offgas system is monitored for radiation level at two locations: at the discharge of the 2.2 minute delay pipe and in the reactor building exhaust plenum. The radiation monitor at the discharge of the 2.2 minute delay pipe continuously monitors radioactivity release from the reactor and therefore continuously monitors the degree of fuel leakage. This radiation monitor is used to provide an alarm on high radiation in the offgas. The monitor has no control function.

The radiation monitor for the reactor building exhaust plenum continuously monitors the effluents released from the charcoal beds. If high radiation levels should occur in the discharge of the offgas system, this monitor would alarm in the main control room. Upon receipt of a high radiation alarm, the plant operator can evaluate the situation and initiate the proper action.

The discharge from the mechanical vacuum pump downstream of the 2-minute delay pipe is also monitored as discussed in Subsection 11.4.3.8.2.13.

Offgas system process radiation monitors are discussed further in Subsection 11.4.3.8.2.2.

This system is also monitored by flow, temperature, and pressure instrumentation. In addition, it is monitored by a hydrogen analyzer to ensure correct operation and control and to ensure that hydrogen concentration is maintained below the flammable limit. Oxygen concentration is monitored at the inlet to the delay piping. The Hydrogen Water Chemistry System is tripped on high or low oxygen concentrations. Process monitors are shown in Figure 11.3-1. The offgas system is normally operated automatically; upon operator initiative, however, the equipment can be operated from the main control room. The operator is thus in control of the system at all times, regardless of system operating mode.

System monitors are discussed in Subsection 7.7.2.6. The principal system instrumentation for significant monitored process parameters is listed in Table 11.3-5.

11.3.4 Operating Procedures

11.3.4.1 Startup

As the reactor is pressurized, steam is supplied to the preheater. The recombiner is preheated by means of electric heaters. With the recombiners preheated, charcoal adsorbers are valved in, or initially bypassed to prevent moisture damage below 5 percent power and the main condenser at approximately 4 in. Hg abs, the steam-jet air ejectors are started. As the condenser is pumped down and the reactor power is increased, the recombiner inlet stream is diluted to less than 4.0 percent H_2 (by volume) by a regulated steam supply and the recombiner outlet is maintained at less than 20 ppm hydrogen.

11.3.4.2 Normal Operation

After startup, the noncondensibles pumped by the steam-jet air ejector stabilize. Recombiner performance is closely followed by means of the recorded temperature profile of the recombiner catalyst bed. The hydrogen effluent concentration is measured by a hydrogen analyzer. Below 5 percent power as an option to the above stated method, the mechanical vacuum pumps may be used.

Normal operation is terminated when steam pressure to the steam jet air ejectors is insufficient for operation by closing off steam to the steam-jet air ejectors and preheaters.

11.3.4.3 Charcoal Bypass Mode

There is a charcoal adsorber bypass line that can be used to bypass any single charcoal adsorber. The activity is monitored by a process radiation monitor upstream of the reactor building vent that produces a high radiation alarm. The alarm setting is covered in Subsection 11.4.3.8.2.2.

11.3.5 Performance Tests

This system is in continuous operation during normal plant operation and does not require specific testing to ensure operability. Process equipment is continuously monitored to determine if process parameters are within design limits, as shown in Figure 11.3-1. Monitor equipment is calibrated and maintained according to a specific schedule and upon indication of monitor malfunction.

Process radiation monitors located downstream of the 2.2-minute delay line and downstream of the charcoal beds in the reactor building exhaust plenum provide adequate indication of the system's ability to reduce the radiogas concentration in this effluent.

To ensure that the hydrogen concentration is within design limits, the recombiner performance is continuously monitored by catalyst bed thermocouples monitoring bed temperature profiles and by a hydrogen analyzer measuring the hydrogen concentration of the recombiner effluent.

11.3.6 Estimated Releases

The potential sources of gaseous radwaste releases have been discussed in Subsections 11.3.2.1 through 11.3.2.7. Calculated releases from these potential sources are tabulated in Table 11.3-1. Anticipated operational occurrences would not signifi-cantly vary the total yearly release value because the 100,000 μCi/sec offgas rate after 30 minutes decay is an annual average value. The value of 100,000 μCi/sec is a conservative annual average, and offgas rate is expected to be above this value only for short periods of time.

Table 11.3-6 provides the calculated yearly average radionuclide concentrations at the restricted boundary of the site using the maximum yearly average χ/Q. The information in this table demonstrates that the design objectives of the gaseous radwaste system are met.

11.3.7 Release Points

The two release points for normal gaseous radwaste effluents from Fermi 2 are the reactor building vent and the turbine building vent. These release points are indicated in Appendix 11A Figure III-1.

The reactor building vent is cylindrical in shape, extends 22.5 ft above the top of the reactor building and is 7 ft 2 in. in diameter. The vent centerline is 8 ft 6 in. from the east wall of the reactor building and 9 ft 3 in. from the south wall of the reactor building. The top of the vent is at Elevation 761 ft (New York Mean Tide, l935) and the grade is 583 ft. The exhaust from this vent is approximately 101,940 cfm at a velocity of 2529 fpm.

The turbine building vent is rectangular in shape, extends 4 ft above the upper roof over the turbine building and has a cross-sectional area of approximately 416 ft^2. The top of the vent is at Elevation 714.5 ft (New York Mean Tide, 1935). The exhaust from the vent is approximately 315,900 cfm at a velocity of 759 fpm.

The greatest fraction of the gaseous activity released from the plant will be from the offgas system and the turbine gland seal exhaust. Both of these releases are mixed with the reactor building ventilation exhaust before they leave the plant. Assuming the zero enthalpy for air is fixed at 32°F, the normal heat value of the gland seal exhaust is 248,000 Btu/hr and the normal heat value for the offgas system exhaust is 1650 Btu/hr.

The radwaste building vent is a third ventilation release point (see Figure 9.4-5). The radwaste building ventilation system exhaust is discharged via the radwaste building vent under normal operating conditions through HEPA filters to remove particulate radioactive material.

The radwaste building vent is rectangular in shape, extends 54 ft above the lower roof of the turbine building, and has a cross-sectional area of approximately 16.65 ft^2. The vent centerline is approximately 383 ft from the south wall and 78 ft from the east wall of the turbine building. The top of the vent is at Elevation 729 ft (New York Mean Tide, 1935). The exhaust from the vent is approximately 38,519 cfm at a velocity of 2313 fpm.

11.3.8 Dilution Factors

Estimates of annual average offsite atmospheric dilution factors are presented in Section 2.3. Calculations are provided of the estimated values of χ/Q for 16 radial sectors to a distance of 50 miles from the plant for ground-level releases. The maximum annual average site boundary χ/Q value has been determined to be to the NNW site boundary and is 1.15×10^{-6} sec/m^3.

11.3.9 Estimated Doses

From Table 11.3-1, it can be observed that the calculated radioactive gaseous releases are composed mostly of noble gases with halogens contributing only a small fraction. Since the noble gases do not react chemically with other substances under normal conditions, there is no physical basis for their transport through food chains or reconcentration within the human body. Thus, the most significant exposure pathway for released noble gases is direct external radiation to the skin and whole body.

The opposite is true of the released radioiodines for which inhalation and food chain transport are the critical pathways.

External radiation from iodine is generally insignificant in comparison with the internal dose derived through inhalation and ingestion.

11.3.9.1 External Dose From Gaseous Cloud Immersion

The determination of the external dose from gaseous cloud immer-sion for the "maximum-exposed individual" and the population can be performed using the International Commission on Radiological Protection (ICRP) recommended semi-infinite sphere model (Reference 1). The following relationship was used to determine the dose rate from this source:

$$D(rem/yr) = (0.259)(\chi/Q) \begin{cases} \sum_i \overline{E}_{\gamma,i} Q_i & \text{(for whole body dose)} \\ \text{or} & \\ \sum_i \left(\overline{E}_{\gamma,i} + \overline{E}_{\beta,i}\right) Q_i & \text{(for skin dose)} \end{cases} \quad (11.3\text{-}4)$$

where

χ/Q = applicable annual average effluent concentration normalized by source strength, sec/m^3

$E_{\gamma,i}$ = average energy of gamma disintegration of i^{th} radionuclide, MeV

$E_{\beta,i}$ = average energy of beta disintegration of i^{th} radionuclide, MeV

Q_i = annual average activity release for i^{th} radio- nuclide, Ci/yr

0.259 = constant necessary to yield dose rate rems/yr

The normalization constant 0.259 is developed from the following equation:

$$0.259 = (0.5)\left(1.6 \times 10^{-6}\,\frac{\text{ergs}}{\text{MeV}}\right)\left(10^{-2}\,\frac{\text{g-rads}}{\text{erg}}\left(1\,\frac{\text{rem}}{\text{rad}}\right)\right)(1.13)\left(3.7 \times 10^{10}\,{}^{\text{dis}}\!/_{\text{sec}-\text{Ci}}\right)\left(\frac{1}{1.29\times10^{3}\text{gair/m}^3}\right) \quad (11.3\text{-}5)$$

where

0.5 = geometry factor accounting for the fact that receptor is irradiated from half the whole available solid angle

1.13 = factor to account for increased stopping power of tissue relative to air for β's and secondary electrons produced by x- and δ- radiation (Section 11.2 and Reference 1)

The basic assumption of this model is that the energy absorption at any point inside an infinite medium of homogeneous material of uniform radioactivity concentration is equal to the energy source from that point. Use of the infinite sphere model provides conservative results because:

a. The surrounding cloud of radioactivity is not infinite in dimension

b. The concentration is not uniform, but is a maximum at the centerline

c. The spatial flux depression caused by the presence of the source-free body in the infinite medium is not accounted for.

Direct exposure to a cloud of radioactivity results in a dose to the skin or to the whole body depending upon the type of radiation emitted. The radiation of interest in this report consists of beta and gamma components. Beta particles and gamma rays are assumed to contribute to the skin dose; however, only gamma rays are assumed to contribute to the total-body dose.

11.3.9.1.1 Maximum Individual External Exposure From Cloud Immersion

For the purpose of estimating the potential annual dose, a hypothetical maximum-exposed individual is assumed to reside at the NNW site boundary continuously over a period of 1 full year, unshielded by housing and clothing. These conservative assumptions resulted in a maximum individual whole-body dose rate of 4.6 mrem/yr and an external skin dose rate of 8.9 mrem/yr.

11.3.9.1.2 Population Exposure From Cloud Immersion

The general relationship presented earlier for the skin dose and external whole-body dose was employed to determine the population dose. The estimated population distributions within 50 miles of the plant, for the years 1980, 2000, and 2020, as defined in Figures 2.1-7, 2.1-9, and 2.1-11, were used for this purpose. The annual segment population exposures, the product of the segment populations and the sector average dose rates, are summed over all 160 segments to evaluate the total population exposure within 50 miles.

The results are summarized as follows:

Year	Population Within 50 Miles of the Site	Annual Man-Rem Within 50 Miles of the Site	
		Whole Body	Skin

1980	6,100,000	1.5×10^2	3.1×10^2
2000	8,200,000	2.2×10^2	4.2×10^2
2020	12,000,000	3.0×10^2	5.8×10^2

11.3.9.2 External Dose From Contaminated Land Surface

An individual downwind from the plant can receive external radiation from material deposited on the ground by a passing radioactive cloud. Airborne radioactive material can be deposited on the ground by dry deposition, rainout and washout, and can consist of any material in the cloud except for the noble gases and tritium (Reference 2).

The whole-body dose from deposited activity was calculated using the equation:

$$D(\text{mrem/yr}) = \sum Q_i(\chi/Q)(V_{gi})(T_i/0.693)(DCF)_i \ldots \left(10^6 \frac{\mu\text{Ci}}{\text{Ci}}\right)\left(10^{-4} \frac{\text{m}^2}{\text{cm}^2}\right)\left(10^3 \frac{\text{mrem}}{\text{rem}}\right) \quad (11.3\text{-}6)$$

where

Q_i = release rate of isotope i, Ci/yr

χ/Q = annual average effluent concentration normalized by source strength, sec/m^3

V_{gi} = deposition velocity of radionuclide is 0.01 m/sec (Reference 3)

T_i = radiological half-life of radionuclide i, years

$(DCF)_i$ = dose conversion factor of radionuclide i, rem/yr per $\mu Ci/cm^2$

The dose conversion factors for gamma and beta radiation were obtained from Reference 4. The calculated beta exposure rates were reduced by a factor of two to account for the self-shielding of the human body against fission product beta radiation.

The whole-body dose to the maximum-exposed hypothetical individual at the NNW site boundary was calculated using an effective deposition velocity of 0.015 m/sec for the iodines, the only significant contributors. It was calculated that an annual whole-body dose of 0.08 mrem from gamma radiation would result. Including the beta contribution, a body surface dose of 0.23 mrem/yr was calculated.

11.3.9.3 Internal Exposure From Gaseous Effluents

Release radionuclides must be either inhaled or ingested in order to yield internal radiation exposure. Ingestion requires that the physical transport of the radioactivity be through some form of food chain. This is possible for the radioactive halogen isotopes. Inhalation is a significant pathway for the radioactive halogens and tritium.

11.3.9.3.1 Internal Exposure From Released Noble Gases

Since the noble gases do not react chemically with other substances, there is no physical basis for their transport through food chains or reconcentration within the human body.

In terms of continued inhalation and absorption in the body, both krypton and xenon may develop in physical solution, chiefly in the body water and fat (Reference 5). Several human exposure experiments revealed that inhalation of relatively large amounts of radioactive noble gases resulted in very low tissue exposures (References 6 and 7). In general, it may be estimated that the internal dose from radioactive noble gases dissolved in body tissue following inhalation from a cloud is negligible (i.e., less than 1 percent of the associated external whole-body dose) (Reference 8).

11.3.9.3.2 Internal Exposure From Released Radioactive Halogens

In addition to the noble gases, small amounts of radioactive halogens are anticipated to be released as gaseous effluent from Fermi 2. Iodine is an insignificant contributor to the external whole-body dose, but may produce potentially significant internal doses due to the preferential concentration of iodine in the human thyroid gland. Iodine may enter the body either through inhalation or by ingestion. The most critical pathway for environmental transport of the routine release of radioiodine is the pasture-cow-milk-Man pathway.

11.3.9.3.2.1 Iodine Inhalation Thyroid Dose

Exposure rates have been computed for the inhalation of iodine. The dose rate has been estimated using Regulatory Guide 1.42 (Reference 9). For the infant, the inhalation dose is given by the following formula:

$$D(\text{mrem/yr}) = [4.8 \times 10^5\, Q_{131} + 1.2 \times 10^5\, Q_{133}]\, (\chi/Q)R \qquad (11.3\text{-}7)$$

where

Q_{131}, Q_{133} = release rate of ^{131}I and ^{133}I, Ci/yr

χ/Q = applicable annual average effluent concentration normalized by source strength, sec/m^3

R = dimensionless iodine cloud depletion factor, assumed to equal 1

4.8×10^5, 1.2×10^5 = constant terms that take intoaccount breathing rate of infant and dose conversion factor $\frac{\text{mrem} - \text{m}^3}{\text{Ci} - \text{sec}}$

For the adult, the dose due to inhalation is determined from the equation

$$D(\text{mrem/yr}) = [4.0 \times 10^5\, Q_{133} + 9.8 \times 10^4\, Q_{133}]\, (\chi/Q)R \qquad (11.3\text{-}8)$$

The constant terms in this equation take into account the breathing rate of the adult and dose conversion factor for each isotope. The cloud depletion factor is assumed equal to 1. The maximum annual iodine-induced thyroid inhalation exposure to an adult was calculated to be 0.37 mrem/yr. For the child, the corresponding exposure is 0.46 mrem/yr.

11.3.9.3.2.2 Thyroid Milk Ingestion Dose

Although the radioiodines will be released initially in gaseous forms, they may be deposited on grass, ingested by a grazing cow, and subsequently secreted in milk. Various mathematical models have been devised to estimate the dose to the thyroid via this route. In all cases, the exposure is inversely proportional to the mass of the thyroid gland. The most sensitive receptor in the population, in terms of whole thyroid dose per unit intake, is therefore a young child or infant who would have a very small thyroid. Also, the relative radiosensitivity of the thyroid decreases markedly with age. Since the rate of milk ingestion is important in determining the dose, the most critical receptor is not a newborn infant but is more likely to be a child 6 months to 1 year in age.

For the child, the dose was calculated using Regulatory Guide 1.42 (Reference 9). The following formula gives the child dose:

$$D(\text{mrem/yr}) = [1.15 \times 10^8 Q_{131} + 2.12 \times 10^6 Q_{133}] (\chi/Q)R \qquad (11.3\text{-}9)$$

where

R = dimensionless iodine cloud depletion factor, assumed equal to 1

Q_{131}, Q_{133} = release rate of iodine ^{131}I and ^{133}I, Ci/yr

χ/Q = applicable annual average effluent concentration normalized by source strength at location of nearest cow (sec/m^3)

1.15×10^8, 2.12×10^6 = constant terms that take into account milk ingestion rate of the child, fractional thyroid deposition value from human ingestion, and dose conversion factor $\frac{\text{mrem} - \text{m}^3}{\text{Ci} - \text{sec}}$

The site nearest Fermi 2 at which milk is known to be produced from grazing cows is located about 3 miles to the north-northwest. The applicable χ/Q value for this location has been determined to be 1.27×10^{-7} sec/m^3. It was assumed that the cows graze 5 months per year. The maximum potential thyroid dose to a child from this milk source was calculated to be 2.2mrem/yr.

11.3.9.3.2.3 Adult Thyroid Milk Ingestion Dose

The following model (References 10 and 11) was employed to compute the adult thyroid milk dose from the release of radioiodines:

$$D(\text{rem/yr}) = (\chi/Q)\frac{V_{g_i}K_c I_d}{\lambda_{g_i}} A_i Q_i (2.74 \times 10^3) \qquad (11.3\text{-}10)$$

where

2.74×10^3 = conversion factor changing Ci/yr to µCi/day

V_{gi} = deposition velocity of radionuclide onto pasture 0.015 m/sec; (Reference 3)

K_c = (µCi/l)/(µCi/m^2); milk/grass activity ratio

I_d = adult milk ingestion rate, 1.0 1/day

A_i = dose conversion factor for adult, $\frac{rem}{yr}/\frac{\mu C_i}{day}$

λ_{gi} = mean lifetime for i^{th} isotope on the ground, $days^{-1}$

The maximum potential thyroid dose to an adult was calculated to be 0.44 mrem/year.

11.3.9.3.2.4 Adult Human Thyroid Dose Via Leafy Vegetables

The model for calculation of doses due to ingestion of leafy vegetables having radioiodine deposited on them is taken from Reference 9 with the exception that no cloud depletion is assumed. The model assumes the consumption of 18 kg of fresh leafy vegetables over a period of 3 months. The resulting equation for dose rate due to ingestion of leafy vegetables is:

$$D(mrem/yr) = [2.1 \times 10^6\, Q_{131} + 8.3 \times 10^4\, Q_{133}]\, (\chi/Q)(R) \qquad (11.3\text{-}11)$$

where

R = dimensionless iodine cloud depletion factor, assumed equal to 1

χ/Q = applicable annual average effluent concentration normalized by source strength, sec/m^3

2.1×10^6, 8.3×10^4 = constant term which takes into account amount of leafy vegetables ingested, fractional thyroid deposition dose from human ingestion, and dose concentration factor, $\frac{mrem - m^3}{Ci - sec}$

For Fermi 2, it was assumed that the nearest garden was located at the site boundary in the direction with the highest χ/Q value, north-northwest. The total dose via the ingestion of leafy vegetables is 0.95 mrem/yr.

11.3.9.3.3 Internal Exposure From Released Tritium (Released As Vapor)

It is anticipated that approximately 52.5 Ci/yr of tritium will be released from Fermi 2. For tritium, the inhalation dose has been estimated using the following equation:

$$D(rem/yr) = \sum/Q_i\, (\chi/Q)\, (BR)(DCF)_i \left(10^6 \frac{\mu Ci}{Ci}\right)\left(\frac{1\ yr}{365\ days}\right) \qquad (11.3\text{-}12)$$

where

Q_i = release rate of tritium, Ci/yr

BR = breathing rate, m^3/sec

$(DCF)_i$ = dose conversion factor for tritium, $\frac{rem}{yr}/\frac{\mu Ci}{day}$

Since the tritium can rapidly be taken into the body by skin absorption (Reference 12), the total tritium uptake by the body was assumed to be twice the rate due to inhalation alone as recommended by the ICRP (Reference 1). The conversion factor was assumed to be 4.627 x 10^{-2} rem/yr per μCi/day, as derived from Reference 5.

The resultant whole-body dose is 3.6×10^{-3} mrem/yr.

11.3.9.4 Summary of Estimated Doses

Table 11.3-7 presents a summary of the doses to the hypothetical maximum-exposed individual by release pathway.

11.3 GASEOUS RADWASTE SYSTEM

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TABLE 11.3-1 EXPECTED GASEOUS RELEASES FROM FERMI 2 (ACTIVITY RELEASE RATES BASED ON 3499 MWt)

		SOURCE OF RELEASE						SOURCE OF RELEASE				
		Reactor Building Ventilation (R.B. Vent)		Turbine Building* Ventilation (R.B. Vent)		Mechanical Vacuum Pump (R.B. Vent)		Turbine Gland Seal Condenser (R.B. Vent)		Offgas System (R.B. Vent)		
Isotope	Half-Life	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	Total Curies/Year
Kr-83m	1.86 hr			4.04E-01	9.68E+00			3.12E+00	7.91E+01	4.62E-01	1.14E+01	1.0E+02
Kr-85m	4.4 hr			7.09E-01	1.77E+01			6.24E+00	1.56E+02	1.45E+02	3.64E+03	3.8E+03
Kr-85	10.74 year			2.33E-02	6.04E-02	1.04E+01	6.35E-01	1.04E-02	2.60E-01	2.08E+01	5.20E+02	5.2E+02
Kr-87	76 minutes			2.31E+00	5.52E+01			2.08E+01	5.20E+02	4.12E-02	1.04E+00	5.8E+02
Kr-88	2.79 hr			2.24E+00	5.83E+01			2.08E+01	5.20E+02	5.36E+01	1.35E+03	1.9E+03
Kr-89	3.18 minutes			1.77E+00	4.47E+01			8.74E+01	2.19E+03			2.2E+03
Kr-90	32.3 sec			8.44E-05	2.08E-03			2.29E+01	5.72E+02			5.7E+02
Kr-91	8.6 sec							2.19E-02	5.52E-01			5.0E-01
Xe-131m	11.96 days			1.80E-05	4.47E-02	2.91E+00	1.67E-01	1.56E-02	3.95E-02	6.17E+00	1.56E+02	1.6E+02
Xe-133m	2.26 days			3.47E-02	2.50E-01	6.56E-01	3.75E-02	3.02E-01	7.60E+00	2.23E+00	5.62E+01	6.4E+01
Xe-133	5.27 days			9.67E-01	2.50E-01	4.27E+02	2.39E+01	8.53E+00	2.19E+02	1.04E+03	2.60E+04	2.6E+04
Xe-135m	15.7 minutes			2.00E+00	5.00E+01			2.50E+01	6.24E+02			6.7E+02
Xe-135	9.16 hr			2.36E+00	6.56E+01			2.29E+01	5.72E+02			6.4E+02
Xe-137	3.8 minutes			2.95E+00	7.39E+01			1.04E+02	2.60E+03			2.7E+03
Xe-138	14.2 minutes			6.54E+00	1.67E+02			8.43E+01	2.08E+03			2.2E+03
Xe-139	41 sec			1.02E-03	2.60E-02			2.91E+01	7.39E+02			7.4E+02
Xe-140	13.6 sec							6.76E-01	1.67E+01			1.7E+01
N-13	9.99 minutes			7.43E-01	1.87E+01			1.04E+01	2.60E+02			2.8E+02
F-18	109.8 minutes			8.25E-01	2.08E+01			7.80E+00	1.98E+02			2.2E+02
O-19	26.8 sec							4.27E+01	1.04E+03			1.0E+03
Br-83	2.4 hr	3.81E-04	1.25E-02	1.24E-02	3.12E-01			1.11E-03	2.81E-02			3.5E-01
Br-84	31.8 minutes	6.85E-04	2.19E-02	1.85E-02	4.68E-01			1.95E-03	4.89E-02			5.4E-01
Br-85	3.0 minutes	4.32E-04	1.35E-02	1.45E-02	3.64E-01			7.85E-04	1.98E-02			4.0E-01
I-131	8.065 days	3.30E-04	1.04E-02	1.11E-02	2.81E-01			9.91E-04	2.39E-02			3.2E-01
I-132	2.284 hr	3.03E-03	9.57E-02	9.90E-02	2.50E+00			8.67E-03	2.19E-01			2.8E+00
I-133	20.8 hr	2.25E-03	7.08E-02	7.43E-02	1.87E+00			6.61E-03	1.67E-01			2.1E+00

TABLE 11.3-1 EXPECTED GASEOUS RELEASES FROM FERMI 2 (ACTIVITY RELEASE RATES BASED ON 3499 MWt)

		SOURCE OF RELEASE						SOURCE OF RELEASE				
		Reactor Building Ventilation (R.B. Vent)		Turbine Building* Ventilation (R.B. Vent)		Mechanical Vacuum Pump (R.B. Vent)		Turbine Gland Seal Condenser (R.B. Vent)		Offgas System (R.B. Vent)		
Isotope	Half-Life	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	Total Curies/Year
I-134	52.3 minutes	6.09E-03	1.87E-01	1.81E-01	4.58E+00			1.74E-02	4.37E-01			5.2E+00
I-135	6.7 hr	3.29E-03	1.04E-02	1.11E-01	2.81E+00			9.50E-03	2.39E-01			3.1E+00
H-3***	12.262 years											5.25E+01
Sr-89	50.8 days			7.02E-04	1.77E-02							1.8E-02
Sr-90	28.9 years			5.37E-05	1.25E-03							1.2E-03
Sr-91	9.67 hr			1.53E-02	3.85E-01							3.9E-01
Sr-92	2.69 hr			2.35E-02	5.93E-01							5.9E-01
Zr-95	65.5 days			9.08E-06	2.29E-04							2.3E-04
Zr-97	16.8 hr			7.02E-06	1.77E-04							1.8E-04
Nb-95	35.1 days			9.50E-06	2.39E-04							2.4E-04
Mo-99	66.6 hr			9.07E-03	2.29E-01							2.3E-01
Tc-99m	6.007 hr			6.19E-02	1.56E+00							1.6E+00
Tc-101	14.2 minutes			1.95E-02	4.79E-01							4.8E-01
Ru-103	39.8 days			4.13E-06	1.04E-04							1.0E-04
Te-132	78 hr			1.11E-02	2.71E-01							2.7E-01
Cs-134	2.06 years			3.59E-05	8.95E-04							8.9E-04
Cs-136	13 days			2.48E-05	6.24E-04							6.2E-04
Cs-137	30.2 years			5.37E-05	1.35E-03							1.4E-03
Cs-138	32.2 minutes			3.42E-02	8.64E-01							8.6E-01
Ba-139	83.2 minutes			3.30E-02	8.33E-01							8.3E-01
Ba-140	12.8 days			2.02E-03	5.10E-02							5.1E-02
Ba-141	18.3 minutes			2.60E-02	6.56E-01							6.6E-01
Ba-142	10.7 minutes			1.98E-02	5.00E-01							5.0E-01
Ce-141	32.53 days			8.67E-06	2.19E-04							2.2E-04
Ce-143	33 hr			7.85E-06	1.98E-04							2.0E-04
Ce-144	284.4 days			7.85E-06	1.98E-04							2.0E-04

TABLE 11.3-1 EXPECTED GASEOUS RELEASES FROM FERMI 2 (ACTIVITY RELEASE RATES BASED ON 3499 MWt)

		SOURCE OF RELEASE						SOURCE OF RELEASE				
		Reactor Building Ventilation (R.B. Vent)		Turbine Building* Ventilation (R.B. Vent)		Mechanical Vacuum Pump (R.B. Vent)		Turbine Gland Seal Condenser (R.B. Vent)		Offgas System (R.B. Vent)		
Isotope	Half-Life	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	µCi/sec	Ci/yr	Total Curies/Year
Pr-143	13.58 days			8.46E-06	2.19E-04							2.2E-04
Np-239	2.35 days			5.33E-02	1.35E+00							1.4E+00

NOTES:

1. The drywell purge, radwaste building ventilation, and other potential sources of radioactive gaseous waste are discussed in UFSAR Subsections 11.3.2.4, 11.3.2.5, and 11.3.2.6. These potential sources have been evaluated, and it has been determined that the potential releases are negligible.

2. Isotopes with total released activities in excess of 1.0E-04 curies are listed.

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* The source of radionuclides released to the turbine building is assumed to be steam leakage, and since this is the only source of steam leakage, only the turbine building releases will contain particulate radionuclides other than halogens.

** This release will occur following a plant shutdown lasting longer than 10 hr. The mCi/sec represent an average concentration over a 4-hour pump down period.

*** A total of 105 Ci of tritium is expected to be released yearly with 52/5 Ci released via liquid effluents and 52.5 released via gaseous effluents. The gaseous tritium releases are not attributed to any particular source.

TABLE 11.3-2 RADIONUCLIDE INVENTORY IN OFFGAS SYSTEM (ACTIVITIES BASED ON 3499 MWt)

Isotope	Half-Life	Preheater (ci)	Recombiner (ci)	Condenser (ci)	After-Cooler (ci)	Precooler (ci)	Delay Pipe (ci)	Sand Filter (ci)	Chiller (ci)	First Charcoal Units (ci)	All Charcoal Units (ci)	Absorber Filter (ci)	Radionuclide Inventory in System (ci)
Xe-131m	11.9 days	3.1E-06	7.8E-06	2.8E-04	4.7E-04	2.4E-04	2.1E-03	4.7E-04	2.8E-04	3.3E+00	1.4E+01	3.7E-04	1.4E+01
Xe-133m	2.3 days	6.1E-05	1.6E-04	5.4E-03	9.2E-03	4.5E-03	4.0E-02	9.1E-03	5.4E-03	4.7E+01	8.3E+01	1.1E-04	8.3E+01
Xe-133	5.27 days	1.7E-03	4.3E-03	1.6E-01	2.6E-01	1.3E-01	1.1E+00	2.6E-01	1.6E-01	1.7E+03	5.0E+03	6.5E-02	5.0E+03
Xe-135m	15.6 min	5.4E-03	1.4E-02	4.8E-01	7.9E-01	3.9E-01	3.2E+00	6.9E-01	4.1E-01	3.0E+01	3.0E+01		3.6E+01
Xe-135	9.2 hr	4.6E-03	1.1E-02	4.2E-01	7.0E-01	3.4E-01	3.0E+00	6.9E-01	4.1E-01	1.0E+03	1.0E+03	3.4E-13	1.1E+03
Xe-137	3.8 min	3.0E-02	7.6E-02	2.7E+00	4.2E+00	1.8E+00	1.4E+01	2.5E+00	1.4E+00	2.5E+01	2.5E+01		5.1E+01
Xe-138	14.0 min	1.9E-02	4.6E-02	1.7E+00	2.7E+00	1.4E+00	1.0E+01	2.3E+00	1.4E+00	9.3E+01	9.3E+01		1.1E+02
Xe-139	41.0 sec	5.2E-02	1.3E-01	4.0E+00	4.5E+00	1.5E+00	4.6E+00	2.3E-01	6.1E-02	2.6E-01	2.6E-01		1.5E+01
Xe-140	13.7 sec	4.4E-02	1.0E-01	2.5E+00	1.3E+00	1.9E-01	1.6E-01	1.6E-04	2.6E-05	1.8E-05	1.8E-05		4.3E+00
Xe-141	1.6 sec	2.8E-03	6.1E-03	2.8E-02	1.8E-05	7.7E-11	1.8E-13	1.8E-36	9.1E-42				3.7E-02
Xe-142	1.2 sec	2.5E-04	5.1E-04	1.6E-03	4.7E-08	1.1E-15	2.0E-19						2.3E-03
Xe-143	0.96 sec	1.9E-05	3.7E-05	8.7E-05	3.3E-10	2.5E-19	7.7E-24						1.4E-04
Xe-144	8.8 sec	6.7E-05	1.7E-04	3.0E-03	8.9E-04	6.3E-05	2.7E-05	8.9E-10	7.0E-11	2.2E-11	2.2E-11		4.2E-03
Cs-135	3.0E06 yr	1.6E-12	4.0E-12	4.8E-13	9.8E-12	3.7E-13	1.8E-12	1.6E-07	1.3E-11	2.5E-04	2.5E-04	7.8E-20	2.5E-04
Cs-137	30.2 min	1.6E-10	4.1E-10	3.2E-08	1.3E-07	8.4E-08	1.4E-06	5.6E-02	2.2E-05	5.7E-01	5.7E-01		6.3E-01
Cs-138	32.2 min	4.7E-05	1.3E-04	9.8E-03	4.0E-02	2.9E-02	5.1E-01	2.3E+00	1.4E+00	9.3E+01	9.3E+01		9.7E+01
Cs-139	9.0 min	4.5E-04	1.1E-03	8.6E-02	2.1E-01	8.1E-02	6.8E-01	2.3E-01	9.2E-02	2.6E-01	2.6E-01		1.6E+00
Cs-140	65.0 sec	2.7E-03	7.0E-03	4.2E-01	3.4E-01	3.2E-02	7.0E-02	1.6E-04	2.6E-05	1.8E-05	1.8E-05		8.7E-01
Cs-141	24.0 sec	1.7E-04	4.2E-04	1.3E-02	5.3E-05	5.8E-12	2.3E-14	1.8E-36	9.1E-42				1.3E-02
CS-142	2.3 sec	2.9E-05	6.7E-05	4.4E-04	4.3E-11	2.0E-22	2.2E-28						5.3E-04
Cs-143	1.6 sec	1.3E-06	2.8E-06	1.3E-05	1.3E-14	2.0E-29	9.2E-37						1.7E-05
Cs-144	1.0 sec	4.3E-05	1.0E-04	2.0E-03	1.4E-04	8.6E-07	1.1E-07	8.9E-10	7.0E-11	2.2E-11	2.2E-11		2.3E-03
Ba-137m	153.0 sec	2.4E-12	6.6E-12	1.4E-09	1.1E-08	1.1E-08	3.8E-07	5.6E-02	2.1E-05	5.7E-01	5.7E-01		6.3E-01
Ba-139	83.0 min	2.3E-07	6.2E-07	1.1E-04	7.0E-04	4.3E-04	9.4E-03	2.3E-01	8.7E-02	2.6E-01	2.6E-01		5.9E-01
Ba-140	12.8 days	6.4E-09	1.8E-08	2.8E-06	6.7E-06	1.3E-06	8.9E-06	1.6E-04	3.6E-07	1.8E-05	1.8E-05		1.9E-04
Ba-141	18.0 min	5.8E-07	1.6E-06	1.4E-04	2.2E-07	6.1E-13	1.4E-14	1.8E-36	9.1E-42				1.4E-04

TABLE 11.3-2 RADIONUCLIDE INVENTORY IN OFFGAS SYSTEM (ACTIVITIES BASED ON 3499 MWt)

Isotope	Half-Life	Preheater (ci)	Recombiner (ci)	Condenser (ci)	After-Cooler (ci)	Precooler (ci)	Delay Pipe (ci)	Sand Filter (ci)	Chiller (ci)	First Charcoal Units (ci)	All Charcoal Units (ci)	Absorber Filter (ci)	Radionuclide Inventory in System (ci)
Ba-142	11.0 min	3.7E-07	9.4E-07	4.1E-05	1.4E-09	1.7E-17	2.3E-20						4.2E-05
Ba-143	12.0 sec	1.1E-06	2.9E-06	7.2E-05	7.8E-11	7.2E-21	1.6E-25						7.6E-05
Ba-144	12.0 sec	1.5E-05	3.8E-05	1.8E-03	3.9E-04	6.1E-06	1.6E-06	8.9E-10	7.0E-11	2.2E-11	2.2E-11		2.2E-03
La-140	40.2 hr	2.1E-08	5.0E-08	1.1E-06	2.3E-07	6.9E-09	4.9E-10	1.6E-04	1.8E-08	1.8E-05	1.8E-05		1.8E-04
La-141	3.9 hr	1.3E-09	2.7E-09	4.6E-08	2.6E-10	1.1E-15	6.9E-17	1.8E-36	5.7E-42				5.0E-08
La-142	92.0 min	4.3E-09	8.7E-09	3.6E-08	6.5E-12	1.3E-19	4.1E-22						4.8E-08
La-143	14.0 min	9.3E-09	1.6E-08	9.8E-07	7.1E-12	2.9E-21	7.5E-25						1.0E-06
La-144	41.0 sec	1.4E-03	3.1E-03	6.1E-02	4.3E-03	3.8E-05	1.7E-06	8.9E-10	7.0E-11	2.2E-11	2.2E-11		6.9E-02
Ce-141	32.4 days	9.8E-16	2.1E-15	9.9E-14	1.0E-15	6.9E-21	1.0E-21	1.8E-36	1.7E-44				1.0E-13
Ce-143	33.7 hr	1.7E-13	4.0E-13	5.2E-11	1.0E-15	7.5E-25	5.1E-28						5.3E-11
Ce-144	284.0 days	4.7E-10	1.1E-09	2.1E-08	1.3E-09	6.3E-12	7.7E-11	5.2E-10	4.0E-14	1.4E-11	1.4E-11		2.4E-08
Pr-143	13.6 days	6.1E-19	6.4E-19	1.9E-16	9.6E-21	1.0E-29	2.0E-32						1.9E-16
Pr-144	17.3 min	4.0E-12	9.7E-12	1.9E-10	1.4E-11	3.2E-13	3.9E-12	5.2E-10	4.0E-14	1.4E-11	1.4E-11		7.6E-10
Nd-144	2.4E15 yr	1.6E-27	2.0E-26	7.1E-25	2.7E-25	1.3E-26	3.2E-26	1.7E-23	1.5E-24	4.8E-25	4.8E-25		2.0E-23
I-131	8.065 days	9.4E-08	4.8E-01									4.8E-01	
I-132	2.284 hr	1.5E-06	8.9E-02									8.9E-02	
I-133	20.8 hr	1.0E-06	6.0E-01									6.0E-01	
I-134	52.3 min	3.0E-06	6.9E-02									6.9E-02	
I-135	6.7 hr	1.6E-06	2.9E-01									2.9E-01	
Kr-83m	1.86 hr	7.1E-04	1.8E-03	6.4E-02	1.0E-01	5.3E-02	4.6E-01	1.0E-02	6.3E-02	2.6E+01	3.4E+01	3.3E-05	3.5E+01
Kr-85m	4.4 hr	1.3E-03	3.1E-03	1.1E-01	1.9E-01	9.5E-02	8.3E-01	1.9E-01	1.1E-01	6.3E+01	1.1E+02	3.1E-03	1.2E+02
Kr-85	10.76 yr	3.1E-06	7.8E-06	2.8E-04	4.7E-04	2.4E-04	2.1E-03	4.7E-04	2.8E-04	2.3E-01	1.4E+00	9.4E-04	1.4E+00
Kr-87	76.0 min	4.2E-03	1.0E-02	3.8E-01	6.3E-01	3.1E-01	2.6E+00	6.1E-01	3.7E-01	1.1E+02	1.4E+02	2.4E-06	1.4E+02
Kr-88	2.8 min	4.2E-03	1.0E-02	3.8E-01	6.3E-01	3.1E-01	2.7E+00	6.2E-01	3.7E-01	1.9E+02	3.0E+02	3.2E-03	3.1E+02
Kr-89	3.2 min	2.6E-02	6.5E-02	2.2E+00	3.4E+00	1.6E+00	1.0E+01	1.8E+00	9.8E-01	1.5E+01	1.5E+01		3.5E+01
Kr-90	33.0 sec	5.0E-02	1.3E-01	3.7E+00	3.8E+00	1.1E+00	2.7E+00	8.3E-02	2.9E-02	6.1E-02	6.1E-02		1.2E+01
Kr-91	10.0 sec	3.9E-02	9.3E-02	1.7E+00	4.6E-01	2.9E-02	1.1E-02	2.4E-07	1.7E-08	5.0E-09	5.0E-09		2.3E+00

TABLE 11.3-2 RADIONUCLIDE INVENTORY IN OFFGAS SYSTEM (ACTIVITIES BASED ON 3499 MWt)

Isotope	Half-Life	Preheater (ci)	Recombiner (ci)	Condenser (ci)	After-Cooler (ci)	Precooler (ci)	Delay Pipe (ci)	Sand Filter (ci)	Chiller (ci)	First Charcoal Units (ci)	All Charcoal Units (ci)	Absorber Filter (ci)	Radionuclide Inventory in System (ci)
Kr-92	3.0 sec	1.4E-02	3.1E-02	2.5E-01	4.0E-03	3.4E-06	1.1E-07	1.0E-20	9.8E-24	1.6E-25	1.6E-25		3.0E-01
Kr-93	2.0 sec	1.8E-03	3.9E-03	2.1E-02	4.0E-05	1.0E-09	6.0E-12	1.6E-31	4.6E-36	8.9E-39	8.9E-39		2.7E-02
Kr-94	1.0 sec	3.4E-05	6.8E-05	1.7E-04	5.8E-10	4.1E-19	1.1E-23						2.7E-04
Kr-95	0.5 sec	2.4E-08	3.9E-08	3.9E-08	6.3E-19	4.4E-37	4.5E-46						1.0E-07
Kr-97	1.0 sec	2.1E-08	4.2E-08	1.0E-07	3.9E-13	2.9E-22	9.0E-27						1.6E-07
Rb-87	4.7E10 yr	1.3E-17	3.2E-17	1.1E-15	1.9E-15	9.5E-16	8.1E-15	9.0E-12	5.1E-15	1.8E-09	1.9E-09	3.6E-17	1.9E-09
Rb-88	17.8 min	1.9E-05	5.0E-05	4.1E-03	1.7E-02	1.3E-02	2.3E-01	6.2E-01	2.7E-01	1.9E+02	3.0E+02	3.2E-03	3.0E+02
Rb-89	15.0 min	1.4E-04	3.7E-04	2.8E-02	1.0E-01	6.9E-02	1.0E+00	1.8E+00	9.8E-01	1.5E+01	1.5E+01		1.9E+01
Rb-90	2.6 min	1.5E-03	3.8E-03	2.6E-01	5.4E-01	1.7E-01	1.0E+00	8.3E-02	2.9E-02	6.1E-02	6.1E-02		2.2E+00
Rb-91	57.0 sec	2.4E-03	6.2E-03	3.2E-01	1.3E-01	4.0E-03	4.7E-03	2.4E-07	1.7E-08	5.0E-09	5.0E-09		4.7E-01
Rb-92	4.4 sec	3.9E-03	9.6E-03	1.6E-01	1.9E-04	1.5E-09	4.8E-12	1.0E-20	9.8E-24	1.6E-25	1.6E-25		1.7E-01
Rb-93	5.9 sec	3.2E-04	7.9E-04	1.4E-02	2.9E-06	1.9E-12	2.2E-15	1.6E-31	4.6E-36	8.9E-39	8.9E-39		1.5E-02
Rb-94	2.7 sec	3.3E-06	7.6E-06	5.6E-05	1.3E-12	3.6E-25	2.3E-31						6.7E-05
Rb-95	0.36 sec	5.3E-12	8.5E-12	8.6E-12	8.8E-34	4.2E-70	4.4E-88						2.2E-11
Rb-97	0.14 sec	1.5E-10	3.9E-10	9.2E-10	8.4E-21	4.8E-39	4.5E-48						1.5E-09
Sr-89	50.6 days	7.9E-11	2.2E-10	4.3E-08	3.7E-07	3.7E-07	1.3E-05	1.8E+00	3.1E-03	1.4E+01	1.4E+01		1.5E+01
Sr-90	28.8 yr	4.1E-12	1.1E-11	2.0E-09	1.0E-08	5.4E-09	9.4E-08	2.3E-03	4.8E-07	1.5E-03	1.5E-03		3.4E-03
Sr-91	9.7 min	1.9E-07	5.1E-07	7.3E-05	8.7E-05	5.5E-06	2.3E-05	2.4E-07	6.0E-09	5.0E-09	5.0E-09		1.9E-04
Sr-92	2.7 hr	1.8E-06	4.6E-06	3.1E-04	8.9E-06	4.1E-09	1.0E-09	1.0E-20	7.8E-24	1.6E-25	1.6E-25		3.3E-04
Sr-93	8.3 min	2.9E-06	7.6E-06	5.0E-04	1.8E-06	2.2E-11	9.3E-13	1.6E-31	4.6E-36	9.1E-39	8.9E-39		5.1E-04
Sr-94	1.3 min	3.4E-07	8.8E-07	3.7E-05	1.1E-10	3.2E-20	4.6E-24						3.8E-05
Sr-95	26.0 sec	4.6E-10	1.1E-09	3.2E-08	1.8E-19	3.3E-38	6.7E-47						3.4E-08
Sr-97	0.4 sec	3.2E-10	6.4E-10	1.6E-09	1.4E-20	8.0E-39	7.5E-48						2.5E-09
Y-90	64.4 hr	8.1E-11	2.0E-10	6.1E-09	4.1E-09	6.3E-10	1.0E-09	2.0E-03	1.6E-08	1.5E-03	1.5E-03		3.4E-03
Y-91m	50.0 min	1.3E-07	3.0E-07	5.5E-06	4.4E-08	3.7E-08	4.3E-07	2.4E-07	4.9E-09	5.0E-09	5.0E-09		6.7E-06
Y-91	59.0 days	2.1E-13	5.1E-13	9.4E-12	1.1E-12	1.0E-13	3.1E-12	2.4E-07	6.4E-12	4.9E-09	4.9E-09		2.5E-07
Y-92	3.53 hr	1.3E-06	2.9E-06	2.4E-05	9.9E-09	1.1E-11	7.5E-12	1.0E-20	4.0E-24	1.6E-25	1.6E-25		2.8E-05

TABLE 11.3-2 RADIONUCLIDE INVENTORY IN OFFGAS SYSTEM (ACTIVITIES BASED ON 3499 MWt)

Isotope	Half-Life	Preheater (ci)	Recombiner (ci)	Condenser (ci)	After-Cooler (ci)	Precooler (ci)	Delay Pipe (ci)	Sand Filter (ci)	Chiller (ci)	First Charcoal Units (ci)	All Charcoal Units (ci)	Absorber Filter (ci)	Radionuclide Inventory in System (ci)
Y-93	10.1 min	1.1E-07	2.4E-07	1.3E-06	9.2E-10	2.2E-14	2.3E-15	1.6E-31	1.5E-36	8.9E-39	8.9E-39		1.6E-06
Y-94	20.0 min	5.8E-13	5.6E-10	2.6E-07	2.7E-12	1.4E-21	5.7E-25						2.6E-07
Y-95	10.5 min	3.3E-12	8.7E-12	6.6E-10	1.4E-20	5.5E-39	5.4E-47						6.7E-10
Y-97	1.11 sec	1.9E-08	3.7E-08	8.7E-08	2.4E-19	2.9E-36	5.3E-45						1.4E-07
Zr-93	9.5E05 yr	1.3E-16	2.3E-17	3.3E-18	1.5E-21	1.8E-24	1.9E-26	1.1E-37	3.8E-46	6.5E-45	6.5E-45		1.5E-16
Zr-95	65.5 days	1.1E-18	3.3E-18	7.3E-16	3.9E-26	2.7E-44	7.1E-52						7.4E-16
Zr-97	16.8 min	6.8E-13	1.6E-12	3.6E-11	1.4E-16	5.1E-26	1.4E-29						3.8E-11
Nb-95	3.51 days	9.8E-22	7.1E-22	8.1E-22	1.4E-31	1.5E-49	1.0E-56						2.5E-21
Nb-97	74.0 min	1.3E-16	4.0E-16	6.7E-14	7.7E-19	4.7E-28	2.7E-31						6.7E-14
N-13	9.99 min	2.5E-03	6.2E-03	2.2E-01	3.7E-01	1.8E-01	1.4E+00	2.9E-01	1.7E-01	7.6E+00	8.1E+00	3.0E-08	1.1E+01
N-16	7.13 sec	1.8E+01	4.3E+01	7.1E+02	1.5E+02	6.1E+00	1.9E+00	5.6E-06	2.7E-07	5.6E-08	5.6E-08		9.3E+02
N-17	4.14 sec	1.7E-03	3.9E-03	4.3E-02	2.2E-03	1.3E-05	1.1E-06	4.3E-16	2.7E-18	1.5E-19	1.5E-19		5.1E-02
O-19	26.8 sec	2.4E-01	6.1E-01	1.8E+01	1.6E+01	4.3E+00	8.7E+00	1.7E-01	5.3E-02	9.0E-02	9.0E-02		4.8E+01

Note: With Hydrogen Water Chemistry in operation, the conservative calculated N-16 estimates will increase by a maximum factor of six.

TABLE 11.3-3 OFFGAS SYSTEM DECONTAMINATION FACTORS[a]

Isotope	Decontamination Factor[c]	Isotope	Decontamination Factor[c]
Kr-83m	7,660	Xe-131m	2.5
Kr-85m	44	Xe-133m	136
Kr-85	1	Xe-133	8.2
Kr-87	50,000	Xe-135m	b
Kr-88	388	Xe-135	b
Kr-89	b	Xe-137	b
Kr-90	b	Xe-138	b
Kr-91	b	Xe-139	b
Kr-92	b	Xe-140	b
Kr-93	b	Xe-141	b
Kr-94	b	Xe-142	b
Kr-95	b	Xe-143	b
Kr-97	b	Xe-144	b

The decontamination factor provided by the offgas system for noble gases only is approximately 1160. If all gases and particulates entering the offgas system were considered in determining the decontamination factor, this would be much higher.

[a] Decontamination Factor equals:

$$\frac{\text{Concentration at inlet to offgas system}}{\text{Concentration at outlet to offgas system}}$$

[b] Extremely large--essentially all of the isotope has been removed.

[c] Values are based on condenser offgas rate equivalent to 100,000 mCi/sec after 30 minutes delay and condenser air inleakage rate of 40 scfm (nominal).

TABLE 11.3-4 DESIGN PARAMETERS[t] FOR STEAM-JET AIR EJECTOR OFFGAS SYSTEM COMPONENTS

Component Parameters	Preheater	Condenser	Aftercooler	Precooler	Chiller	Ring Water Cooler
Shell side						
Design pressure, psia	210	375	375	375	375	156
Design temperature, °F	480	840	390	212	212/-22	176
Material	Carbon steel	ASTM-A-387	Stainless steel	Stainless steel	Stainless steel	Stainless steel
Fluid	Steam	Offgas	Offgas	Offgas (air)	Offgas (air)	Closed cooling water
Flow rate	1100 lb/hr	15,142 lb/hr	40.0 scfm	40.0 scfm	40.0 scfm	27 gpm
Pressure drop, psi	-	0.15	0.3	0.3	0.3	3.0
Outlet pressure, psia	160	13	13	12.8	12.5	128 max.
Outlet temperature, °F	364	≤ 203	≤ 109	57-61	14 (nom)	82-92
Tube side						
Design pressure, psia	375	420	156	210	210	375
Design temperature, °F	480	480	390	120	176	176
Material	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Stainless steel
Fluid	Offgas/Steam	Condensate	TBCCW	Freon	Freon	Demin. water
Flow rate	15,142 lb/hr	2700 gpm	780 gpm	-	-	13 gpm
Pressure drop, psi	0.142	8.55	5.0	-	-	0.71
Outlet pressure, psia	14.2	356	114	-	-	-
Outlet temperature, °F	≥ 320	144	104	-	-	-
Heat exchanger area, ft^2	1130	1560	840	-	-	64.5
Duty, Btu/hr approx.	0.94×10^6	22.0×10^6	0.52×10^6	6.0×10^3	6.0×10^3	71×10^3
Empty weight, lb approx.	7000	13,000	5500	3100	3100	1100
Operating weight, lb approx	15,000	18,000	9000	3100	3100	1500

TABLE 11.3-4 DESIGN PARAMETERS[t] FOR STEAM-JET AIR EJECTOR OFFGAS SYSTEM COMPONENTS

Component parameters	Water Separator	Recombiner	Sand Filter	Adsorbers	Absolute Filter	Ring Water Buffer Tank	Drain Receiver Tank	Condensate Receiver Tank	Water Ring Pump
Design pressure, psia	375	375	375	375	375	375	375	375	80
Design temperature, °F	390	840	122	122	122	176	650	650	160
Material	Carbon steel	Low alloy	Carbon steel	Carbon steel	Carbon steel	Stainless steel	Carbon steel	Carbon steel	Stainless steel or mfg std.
Fluid	Offgas and steam	Offgas and steam	Air	Air	Air	Air	Water	Water	Air
Nominal flow rate, scfm	5330[a]	5330[a]	40	40	40	40	-	-	40
Pressure drop, psi	0.3	0.7	0.7	1.2	0.3	0.2	-	-	-
Operating pressure, psia	14.2	14.2	12.5	12.5	11.8	14.5	13.0	0.75	15.7
Maximum operating temperature, °F	284	≤ 788	95	68	95	100	190	91	104
Duty, Btu/hr	-	2.7×10^6	-	-	-	-	-	-	-
Empty weight, lb approx.	4600	20,000	3600	34,000	800	600	-	-	-
Operating weight, lb	7000	32,000	7600	55,000	800	1000	-	-	-

[a] The flow rate for steam = 14,500 lb/hr, H_2 - 52 lb/hr, O_2 - 410 lb/hr, and air - 180 lb/hr.

NOTE: The data given in this table is based on condenser air inleakage of 40 scfm (nonimal). Under certain conditions, the air inleakage will be higher and the related data will vary.

[t] This table contains both design and expected operating parameters. Design parameters are designated explicitly (e.g., “design temperature”, “design pressure”).

TABLE 11.3-5 GASEOUS RADWASTE SYSTEM INSTRUMENTATION DESIGN PARAMETERS

Flow Transmitters

Number	Service	Range (scfm)	Accuracy[a] ±percent
N426	Offgas and gland stem exhaust to reactor/auxiliary building vent	0-3100	0.25
N530	Offgas leaving charcoal filters	0-100 (80 in. WC)	0.64

Level Indicators

Number	Service	Design Pressure (psig)	Design Temperature (°F)	Range, in. Water Column	Accuracy[a], ± % of Span
R411 A	Offgas north ring water buffer tank	0	150	0-20	0.5
R411 B	Offgas south ring water buffer tank	0	150	0-20	0.5

Pressure Transmitters

Number	Service	Type	Range (psia)	Accuracy[a] ±percent
N400	Offgas system 18-in. manifold	Bourdon Tube	11.8 to 26.8	0.4
N457 A	Offgas after delay piping	Bourdon Tube	7 to 15	0.4
N457 B	Offgas after delay piping	Bourdon Tube	7 to 15	0.4
N489 A	Offgas entering ring water pump north	Bourdon Tube	0 to 15	0.4
N489 B	Offgas entering ring water pump south	Bourdon Tube	0 to 15	0.25
N491	Offgas system exhaust	Bourdon Tube	0 to 16	0.25
N525	Offgas charcoal units to adsorber filters	Diaphragm	0 to 12.2	0.25

[a] The instrument accuracy information provided in the UFSAR tables is a bounding value.

TABLE 11.3-5 GASEOUS RADWASTE SYSTEM INSTRUMENTATION DESIGN PARAMETERS

Thermocouples

Number	Service	Design Temperature (°F)	Type
N408 A	Offgas east water separator to east preheater	480	Dual element swaged chromel alumel ungrounded MGO insulated
N408 BB	Offgas west water separator to west preheater	480	Dual element swaged chromel alumel ungrounded MGO insulated
N409 A	Offgas preheater east discharged to recombiner west	480	Dual element swaged chromel alumel ungrounded MGO insulated
N409 B	Offgas preheater west discharged to recombiner west	480	Dual element swaged chromel alumel ungrounded MGO insulated
N418 A N419 A	Offgas east recombiner	850	Dual element swaged chromel alumel ungrounded MGO insulated
N418 B N419 B	Offgas west recombiner	850	Dual element swaged chromel alumel ungrounded MGO insulated
N424 A	Offgas east recombiner discharge to condenser	850	Dual element swaged chromel alumel ungrounded MGO insulated
N424 B	Offgas west recombiner discharge to condenser	850	Dual element swaged chromel alumel ungrounded MGO insulated
N441 A	Offgas system vapor from east aftercooler to precooler	150	Dual element swaged chromel alumel ungrounded MGO insulated
N441 B	Offgas system vapor from west aftercooler to precooler	150	Dual element swaged chromel alumel ungrounded MGO insulated
N442 A	Offgas system east precooler	---	Dual element swaged chromel alumel ungrounded MGO insulated
N442 B	Offgas system west precooler	---	Dual element swaged chromel alumel ungrounded MGO insulated
N448	2-minute delay line to reactor/ auxiliary building vent	150	Dual element swaged copper-constantan ungrounded MGO insulated
N462 A, B & C	Offgas chiller (one for each chiller)	---	Dual element swaged copper-constantan ungrounded MGO insulated

Number	Service	Design Temperature (°F)	Type
N468, N469 and N470	Offgas system charcoal bed 1	---	Dual element swaged copper-constantan ungrounded MGO insulated
N471	Offgas system charcoal bed 2	---	Dual element swaged copper-constantan ungrounded MGO insulated
N472	Offgas system charcoal bed 3	---	Dual element swaged copper-constantan ungrounded MGO insulated
N473	Offgas system charcoal bed 4	---	Dual element swaged copper-constantan ungrounded MGO insulated
N474	Offgas system charcoal bed 5	---	Dual element swaged copper-constantan ungrounded MGO insulated
N475	Offgas system charcoal bed 6	---	Dual element swaged copper-constantan ungrounded MGO insulated

TABLE 11.3-6 EXPECTED YEARLY AVERAGE RADIONUCLIDE CONCENTRATIONS AT SITE BOUNDARY[a] (3499 MWt)

Isotope	Concentration ($\mu Ci/cm^3$)	Isotope	Concentration ($\mu Ci/cm^3$)
Kr-83m	3.6(-12)[b]	Sr-89	6.5(-16)
Kr-85m	1.4(-10)	Sr-90	4.9(-17)
Kr-85	1.9(-11)	Sr-91	1.4(-14)
Kr-87	2.3(-12)	Sr-92	2.2(-14)
Kr-88	5.3(-11)	Zr-95	8.3(-18)
Kr-89	7.9(-11)	Zr-97	6.5(-18)
Kr-90	2.1(-11)	No-95	8.7(-18)
Kr-91	2.0(-14)	Mo-99	4.6(-15)
Xe-131m	5.7(-12)	Tc-99m	5.7(-14)
Xe-133m	2.4(-12)	Tc-101	1.8(-14)
Xe-133	9.5(-10)	Ru-103	3.7(-18)
Xe-135	2.4(-11)	Te-132	1.0(-15)
Xe-137	2.3(-11)	Cs-134	3.3(-17)
Xe-138	9.9(-11)	Cs-136	2.3(-17)
Xe-139	2.7(-11)	Cs-137	4.9(-17)
Xe-140	6.0(-13)	Cs-138	3.1(-14)
		Ba-139	3.0(-14)
N-13	1.0(-11)	Ba-140	1.9(-15)
F-18	8.3(-13)	Ba-141	2.4(-14)
O-19	3.7(-11)	Ba-142	1.8(-14)
		Ce-141	7.9(-18)
Br-83	1.2(-14)	Ce-143	7.2(-18)
Br-84	2.0(-14)	Ce-144	7.2(-18)
Br-85	1.4(-14)	Pr-143	7.9(-18)
I-131	1.1(-14)	Np-239	4.9(-14)
I-132	1.0(-13)		
I-133	7.6(-14)		
I-134	1.9(-13)		
I-135	1.1(-13)		
H-3	7.6(-14)		

a Corresponding to a condenser offgas rate of 100,000 μCi/sec after 30 minutes delay. This value has not been adjusted for 102 percent of uprated power (refer to introductory paragraphs to Chapter 11, page 11.1-1).

b 3.6(-12) = 3.6×10^{-12}.

TABLE 11.3-7 MAXIMUM INDIVIDUAL EXPOSURE FROM GASEOUS RELEASES[a] (3499 MWt)

Pathway	Whole-Body Dose (mrem/yr)	Skin Dose (mrem/yr)	Thyroid Dose (mrem/yr) Child	Thyroid Dose (mrem/yr) Adult
1. From cloud immersion	4.6	8.9		
2. From radiaoiodine inhalation			0.46	0.37
3. From radioiodine ingestion via cow-milk-Man pathway			2.2	0.44
4. From contaminated land surfaces	0.08	0.23		
5. From leafy vegetables				0.95
6. From tritium exposure	0.0037			
Total from gaseous releases	4.68	9.13	2.66	1.76

a Values are based on condenser offgas rate equivalent to 100,000 μCi/sec after 30 minutes delay and condenser air inleakage rate of 40 scfm (nominal). The value for the offgas rate has not been adjusted for 102 percent uprated power (refer to introductory paragraphs to Chapter 11, page 11.1-1).

Figure Intentionally Removed
Refer to Plant Drawing M-2017-1

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FIGURE 11.3-1, SHEET 1

OFFGAS SYSTEM P&ID

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Refer to Plant Drawing M-2017-1A

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FIGURE 11.3-1, SHEET 2

OFFGAS SYSTEM P&ID

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Refer to Plant Drawing M-2017-2

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UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.3-1, SHEET 3

OFFGAS SYSTEM P&ID

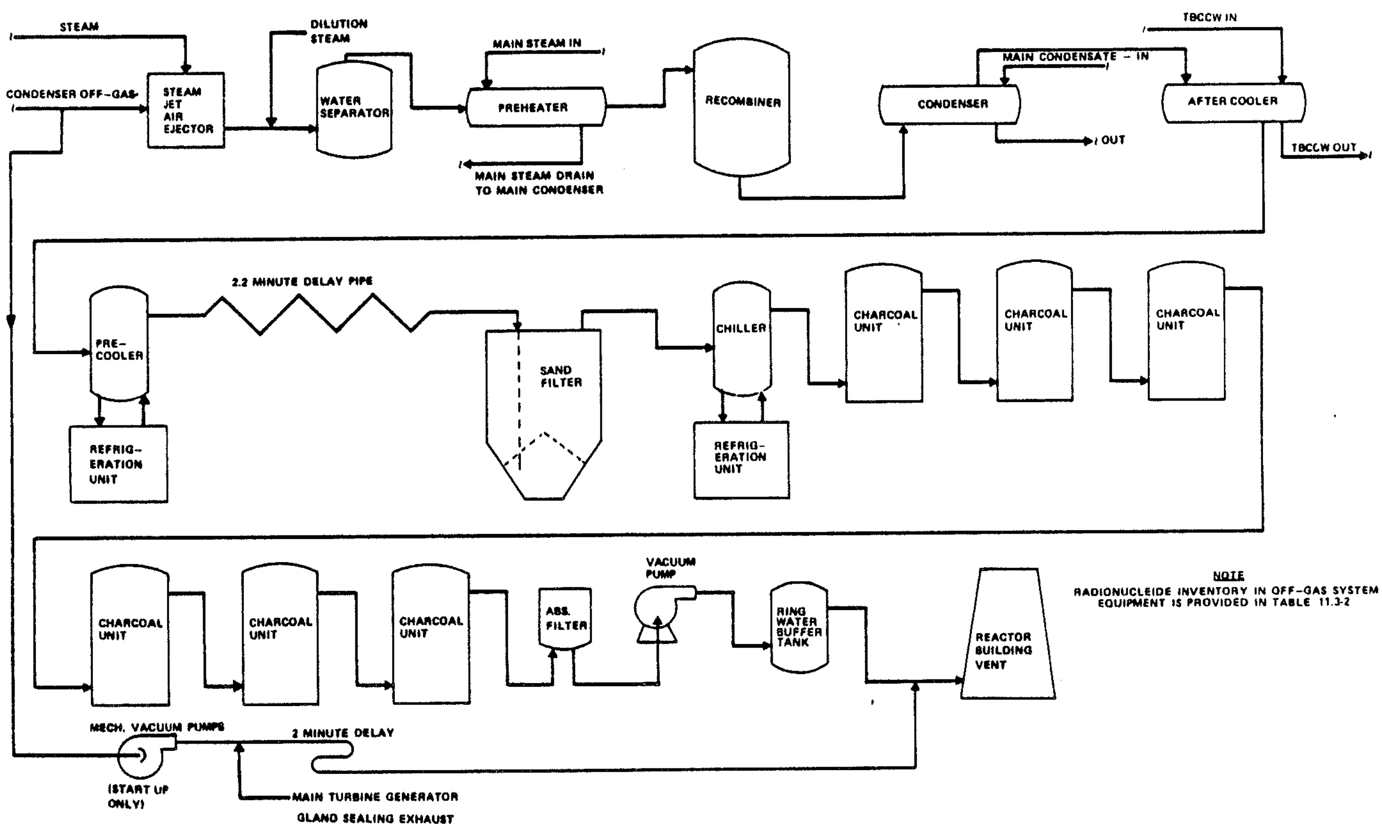

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FIGURE 11.3-2

CONDENSER OFFGAS SYSTEM FLOW DIAGRAM

11.4 PROCESS AND EFFLUENT RADIATION MONITOR SYSTEMS

11.4.1 Introduction

The process and effluent radiation monitor systems are contained in the process radiation monitoring system. The process radiation monitoring system furnishes information to operations personnel regarding the levels of radioactivity in effluent and selected process streams. This information is used to maintain radiation levels as low as reasonably achievable and to verify compliance with applicable governmental regulations for the containment, control, and release of radioactive liquids, gases, and particulates generated as a result of normal or emergency operation of the plant.

The process radiation monitoring system is composed of the following process and effluent radiological monitoring systems:

a. Gaseous and airborne monitors

   1. Offgas radiation monitor system
   2. Main steam line radiation monitor system
   3. Reactor building ventilation exhaust radiation monitor system
   4. Offgas vent pipe radiation monitor system (installed spare)
   5. Radwaste building ventilation exhaust radiation monitor system
   6. Turbine building ventilation exhaust radiation monitor system
   7. Deleted
   8. Standby gas treatment system (SGTS) radiation monitor system
   9. Reactor building exhaust plenum radiation monitor system
   10. Fuel pool ventilation exhaust radiation monitor system
   11. Control center makeup air radiation monitor system
   12. Two-minute holdup pipe exhaust radiation monitor system
   13. Control center emergency air inlet radiation monitor system
   14. Onsite storage facility ventilation exhaust radiation monitor system
   15. Standby gas treatment system postaccident radiation monitor system
   16. Primary containment monitor system.

b. Liquid monitors

   1. Radwaste effluent radiation monitor system
   2. General service water effluent radiation monitor system

3. Reactor building closed cooling water (RBCCW) radiation monitor system
4. Emergency equipment cooling water (EECW) radiation monitor system
5. Residual heat removal service water (RHRSW) radiation monitor system
6. Circulating water reservoir decant line radiation monitor system.

c. Containment area high-range monitor.

d. Post Accident Gaseous Effluent Radiation Monitors

1. Noble gas effluent monitor system
2. Radioactive iodine and particulate effluent monitor system
3. Torus hardened vent radiation monitor system

The process radiation monitoring system described in the following sections serves in conjunction with a comprehensive sampling program. The sampling program is the primary method for quantitatively and qualitatively evaluating system and effluent activity levels to comply with Regulatory Guide 1.21, Revision 1.

11.4.2 Design Objectives

The process radiation monitoring system is designed to measure and record radioactivity levels, to alarm on high radioactivity levels, and to control, as required, the release of radioactive liquids, gases, and particulates produced during operation of the plant. It is also designed to comply with the requirements of 10 CFR 50, 10 CFR 20, and Regulatory Guide 1.21, Revision 1. The process radiation monitoring system aids in protection of the general public and plant personnel from exposure to radiation or radioactive materials in excess of those allowed by the applicable regulations of governmental agencies. All the building gaseous effluent monitors have been upgraded to meet the range requirements of NUREG-0737 (refer to Subsection 11.4.3.11).

The design objectives of the process radiation monitoring system for normal operation are:

a. To provide continuous surveillance of radioactivity levels in process and effluent streams from minimum detectable levels to levels commensurate with Offsite Dose Calculation Manual radiological effluent control limits by indicating and recording these levels and by alarming at abnormal activity levels

b. To provide data for estimating total released activity to comply with Regulatory Guide 1.21, Revision 1

c. To give early warning of increasing radioactivity levels indicative of equipment failure, system malfunction, or deteriorating system performance

d. To initiate prompt corrective action, either automatically or through operator response.

For some anticipated operational occurrences resulting from accidents or malfunctions, the process radiation monitoring system activates necessary isolation or diversion valves, thereby terminating releases if radioactivity levels exceed alarm setpoints, as indicated in Tables 11.4-1 and 11.4-2.

11.4.3 Continuous Monitoring

11.4.3.1 Design Criteria

The following design criteria were employed in the design of the process radiation monitoring system:

a. To facilitate compliance with applicable regulations and guides (10 CFR 50 and Regulatory Guide 1.21), monitors and detectors were selected with sensitivities and ranges in accordance with radiation levels anticipated at specific detector locations

b. Independence of redundant monitors that are safety related is maintained by providing adequate separation of detectors, signal cabling, power supplies, and actuation circuits for isolation and diversion valves to meet IEEE-279 criteria

c. Radioactivity levels are continuously indicated in the relay room or at local panel H21P284 (PCRMS only) and recorded in the main control room

d. Main control room alarms annunciate high radioactivity levels and signal, circuit, or power failures

e. For selected detectors, alarms and recorders are provided in the radwaste control room

f. Access to the alarm setpoints is under the administrative control of the Executive Director – Nuclear Production or his authorized delegate

g. Adequate lead shielding is provided for detectors when the ability to sense low activity levels requires that background radiation have a minimum effect on the instruments

h. Monitor components requiring maintenance and inspection are readily accessible or spare equipment is available in the plant

i. Environmental design conditions for the components are listed in Table 11.4-3. In addition, those safety- related components of the system are protected from the effects of extreme winds, floods, tornadoes, or missiles because they are housed in a structure designed to withstand the above environmental conditions as described in Chapter 3

j. None of the monitors are designed to Category I requirements unless specifically stated in the section describing the particular monitor

k. All in-line monitors have detector housings of the same quality level and category as the system being monitored. Off-line monitors are provided with valves to permit manual isolation of monitors from the process.

11.4.3.2 Basis for Detector Location Selection

An aid for the selection of each location to be continuously monitored is found in Regulatory Guide 1.21, which suggests "all normal and potential paths for release of radioactive material during normal reactor operation, including anticipated operational occurrences and accidents should be monitored." Based on the above, monitors are provided for:

a. Process lines that may discharge radioactive fluids to the environment, in order to indicate the radioactivity level and to alarm in the main control room when preestablished limits for the release of radioactive materials are reached or exceeded

b. Process lines that do not discharge directly to the environment, in order to indicate possible process system malfunctions by detecting increases in radioactivity levels.

11.4.3.3 Expected Radiation Levels

Expected radioactivity concentrations in the process and effluent streams will be such that radiation levels at the site boundary are a small fraction of 10 CFR 20 limits and will be as low as reasonably achievable. The expected concentrations each monitor will be measuring are listed in Tables 11.4-1 and 11.4-2.

11.4.3.4 Quantity To Be Measured

The principal radionuclides that are monitored are indicated in Tables 11.4-1 and 11.4-2. All channels measure gross radioactivity.

11.4.3.5 Detector Type, Sensitivity, and Range

The detectors are Geiger-Mueller tubes, ionization chambers, or scintillation crystals that detect beta radiation or gamma radiation over an energy range of at least 0.07 to 2.5 MeV. The sensitivity and range have been selected so that the alarm setpoint is at least an order of magnitude higher than the detector threshold, and so that the instrument reads on scale during normal operation. If it does not read on scale, a small "bug" source, attached to the detector, is used to clear the low (failure/operate) alarm. Detector type, estimated sensitivity, and nominal ranges of each process and effluent monitor are indicated in Tables 11.4-1 and 11.4-2.

11.4.3.6 Setpoints

Setpoints for effluent monitors are established to meet Offsite Dose Calculation Manual radiological effluent control limits that encompass 10 CFR 20 limits and 10 CFR 50, Appendix I, limits. Setpoints for process monitors are established to provide a warning of increased system activity and to take corrective action where appropriate.

Two independently adjustable radiation setpoints are provided for most monitors. The lower, or high setpoint, normally activates only an alarm, while the upper, or high-high setpoint, activates an alarm and initiates corrective action where appropriate. Setpoints are at least twice the background level to reduce the number of spurious trips. High setpoints when used in conjunction with high-high setpoints are between background and the high-high setpoints. The setpoints are under the administrative control of the Executive Director – Nuclear Production or his authorized delegate, and can be changed if needed as long as Offsite Dose Calculation Manual radiological effluent control limits are not exceeded.

11.4.3.7 Annunciators and Alarms

All process and effluent radiation monitors are annunciated in the main control room on panel H11-P603. A specific annunciator window alarms for low (failure/operate), alert, high or high-high (high) radiation alarm or low-sample-flow alarm, as shown in Tables 11.4-1 and 11.4-2.

An operator can acknowledge and silence the audible alarm but cannot clear the annunciator window until the alarm has been cleared. General Atomics alarms must be reset in the relay room to clear the annunciator window and the Eberline alarms must be reset in the main control room.

For the process radiation monitoring system, the channel that alarmed and the type of alarm are determined by the lights associated with the three types of alarms. These alarms are as follows:

a. A high (or alert) alarm light illuminates when the radioactivity exceeds preset limits that have been selected to provide an early warning

b. A high-high (or high) alarm light illuminates when radioactivity levels exceed a preset limit that is set at or slightly below the Offsite Dose Calculation Manual radiological effluent control limits. This initiates prompt corrective action either automatically or through operator response

c. A low (failure/operate) alarm light is activated when the meter reaches a downscale trip point that indicates that there is a detector signal, circuit, flow, or power failure. In certain cases, as discussed in Subsections 11.4.3.8 and 11.4.3.9, this downscale trip also initiates action.

11.4.3.8 Description of Gaseous and Airborne Monitors

Each channel of the system contains a completely integrated modular assembly as described below. Specific details of each monitor are described in Subsections 11.4.3.8.2.1 through 11.4.3.8.2.16.

11.4.3.8.1 General

11.4.3.8.1.1 Sampling Devices

For each off-line monitor, a sample is drawn from the vessel or system through a sample line. For the Eberline Sping 3/Sping 4/AXM-1 and the containment system (which have detectors viewing the filters) and the GE offgas vent pipe monitor (spare detector), the sample air stream then passes through a paper filter to collect particulates and then through an iodine-adsorbent cartridge. The air stream next passes through a shielded, internally polished chamber (or chambers), where the air is monitored for any radioactive gases by a scintillation detector and/or an energy- compensated Geiger-Mueller tube. The air is then drawn through a sample pump and returned to the vessel or system from which it was sampled.

Each sample pump is capable of drawing 2 cfm of air through the monitor (with the exception of the AXM-1s). Each monitor has a flow out of limits alarm. A local flow indicator is also provided for vent stack monitors that have particulate and iodine filters so that the total volume that has passed through the filters can be determined.

The filter papers used to collect particulates have a collection efficiency of at least 90 percent for 0.3-μm particulates. The iodine-adsorbent cartridges used to collect iodine have been tested and shown to have an efficiency of at least 90 percent for elemental and organic iodine. The filters and cartridges are replaced periodically and are counted in the counting room to determine particulate and iodine activity.

Each monitor has manually operated sample valves, and several types also have solenoid-operated valves. This allows room air to be purged through the gas monitor to check the background radiation level and allows for samples to be taken, or calibrated gas to be introduced, to check the monitor calibration.

The location of sample probes and off-line monitors has been chosen to minimize sample plateout. Unavoidable bends are made with gradual radii of approximately five times the tubing diameter. Stainless steel lines and ball valves are used to further minimize plateout.

11.4.3.8.1.2 Detector-Preamplifier Unit

The detectors are Geiger-Mueller tubes, solid-state, ionization chambers, or scintillation detectors. The General Atomic (Gulf) scintillation detectors, either beta (plastic) or gamma (NaI), generally have preamplifiers mounted on top of the detectors. The Eberline detectors use an interface box (IB-X) to provide this function. The detectors are designed to remain fully operational over a wide range of temperatures, as listed in Table 11.4-3.

Solenoid-operated check sources are provided to check detector response on all General Atomic (Gulf) supplied monitors (nine μCi ^{137}Cs for gamma detectors and 0.5 μCi ^{36}Cl for beta detectors), on the Eberline Sping 3/Sping 4 (30 μCi ^{137}Cs for the beta particulate detector, 0.5 μCi ^{133}Ba for the iodine detector, 30 μCi ^{137}Cs for the beta gas detector, 0.5 μCi ^{90}Sr/Y for the gamma gas detectors, and 0.5 μCi ^{90}Sr/Y for the gamma area detector), on the Eberline AXM-1 (30 μCi ^{137}Cs for the intermediate-range detector and 0.5 μCi ^{90}Sr/Y for the high-range detector), and on the GE-supplied offgas vent pipe radiation monitor (installed spare - 5 μCi ^{137}Cs). Each source is operated from the respective radiation analyzer in the relay room for the General Atomic monitors and from a panel in the main control room for the Eberline monitors (with the exception of the offgas vent pipe radiation ratemeter, which was removed and support equipment abandoned in place). One method of performing effluent monitor source checks is by local activation of the check source mechanism. Other approved check sources may be used if needed.

Off-line detectors are mounted as close as practicable to the system being monitored in a low-radiation area so that the detectors have maximum sensitivity and there is minimum sample plateout.

11.4.3.8.1.3 Radiation Monitor

The radiation analyzer for General Atomic, Mirion, and GE units, which is located in the relay room on panel H11-P604, P606, P883, P884, P914, or P915, is typically composed of an amplifier, a single channel analyzer (if used), a count rate meter (if used), a trip unit, and power supplies as described below:

a. The amplifier accepts pulses from the detector or preamplifier, performs a log integration (if required), and amplifies the output

b. The single channel analyzer, if used, has an adjustable pulse height window and a low-level discriminator for high- and low-level energy discrimination of gamma scintillation detector outputs

c. The meter displays the output in counts per minute, counts per second, or milliroentgens per hour on a four to seven-decade log scale

d. The trip unit provides adjustable trips that can be set for alarm control functions over the entire range of the unit. One low (failure/operate), one high, and one high-high trip are provided for most monitors

e. The Mirion power supply provides the necessary AC and DC voltages for the radiation analyzer and the detector-preamplifier unit. A separate power supply unit provides the necessary DC voltage for the associated trip units. Power for these units and other auxiliary equipment is supplied from the reactor protection system (RPS) buses A and B (120 VAC), the instrument power supply (120 VAC), or the plant 48/24 VDC battery.

All of the analyzer, monitor, and trip functions of the Eberline systems are performed remotely in the Sping units.

11.4.3.8.1.4 Recorder

A recorder is provided in the main control room or radwaste control room to record the output of required channels. Alarms are displayed out on the sequence-of-events recorder. The Eberline instrument channels are displayed in digital format on a control room terminal.

11.4.3.8.2 Specific Gaseous and Airborne Monitor Details

11.4.3.8.2.1 Primary Containment Radiation Monitor System

The primary containment radiation monitor system measures the activity in the drywell and suppression chamber and, in doing so, complies with Regulatory Guide 1.45 and General Design Criterion (GDC) 30. It is designed to detect leakage from the reactor coolant pressure boundary during normal operation (Subsection 5.2.7).

The monitor subsystem includes a noble gas detector. Primary containment atmosphere source terms are discussed in Section 11.1.

A continuous representative sample is extracted from either the drywell or the suppression chamber and is passed through the monitor. The sample is then returned to the suppression chamber through 1-in. stainless steel sample lines. The drywell sample system has five inlet lines of approximately equivalent flow rates that carry the sample from various locations in the drywell to a manifold located outside the containment. A single line routes the sample from the manifold to the monitors and then returns it to the suppression chamber. A single line from the suppression chamber branches into the line above before it enters the monitor, and another line on the discharge of the monitors returns to the suppression chamber as shown in Figure 11.4-1. Valves are provided on these lines to prevent flow when a sample of the suppression chamber is not desired. Normally, the five drywell lines are open to provide an averaged, representative sample. Electrically controlled air operated valves are provided on each of the six inlet lines and the one discharge line so that any one of the drywell sample lines or the suppression chamber sample line can be selected. The valve selector station is located in the main control room on panel H11-P808.

The sample selected is first passed through a coalescer, which removes moisture, and a filter paper to collect particulates. Capability to perform a laboratory analysis of the sample media is retained. The sample is then passed through an impregnated charcoal cartridge to a shielded chamber, where the noble gases are viewed by a shielded beta-sensitive scintillation detector mounted in the top of the chamber. The sample stream then passes through a flow-regulating valve, through a sample pump, and finally returns to the suppression chamber. Table 11.4-1 lists the sensitivity and range of the detectors.

The Primary Containment Radiation Monitoring channel consists of the local detector-preamplifier unit, a radiation analyzer at local panel H21P284, and one pen on a recorder in the main control room. The recorder is a three-pen, six-decade strip-chart recorder located on panel H11-P812. The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from the 120-V ac inductive bus for the channel components and 120-V dc instrument bus for the recorder.

This monitor subsystem can withstand the changes of the atmosphere expected for normal conditions as listed in Table 11.4-3. This subsystem is a part of the primary containment monitor system described in Subsection 7.6.1.12. Arrangement details are shown in Figure 11.4-1.

This monitoring subsystem is provided with remotely controlled check-source features to allow on-line operability tests to be performed from the local control panel H21P284.

11.4.3.8.2.2 Offgas Radiation Monitor System

This monitor subsystem measures the radioactivity in the condenser offgas at the discharge of the 2.2-minute delay pipe after it has passed through the steam-jet air ejector and the recombiner. The monitor detects the radiation level that is attributable to the fission gases produced in the reactor and transported in the steam through the turbine to the condenser. It complies with GDC 13.

A continuous representative sample is extracted from the offgas pipe via a 1-in. stainless steel sample line. It is then passed through a sample chamber and a flow indicator and returned to the offgas system. The sample chamber is a 3-ft long section of a 4-in. Schedule 40 stainless steel pipe, which is internally polished to minimize plateout. It can be purged with room air to check detector response to the background radiation by using a three-way solenoid-operated valve. The valve can be controlled locally or from a switch located under the recorder on panel H11-P601 in the main control room. Three gamma-sensitive ion chambers are positioned adjacent to the vertical sample chamber. Two of the chambers are connected to channels that have logarithmic readouts, and the third is connected to a channel with a linear readout. These chambers are listed in Table 11.4-1 for sensitivity and range.

The linear channel consists of a local detector (gamma-sensitive ion chamber), current to frequency converter, and digital ratemeter in the relay room, and a recorder in the main control room. A linear readout with a range of 1 to 10^6mR/hr is used in conjunction with a recorder. The recorder is located on panel H11-P601 in the main control room. The channel has no trip functions and no alarms. Power is supplied from the 48/24-V dc battery for the channel and the 120-V ac instrument bus for the recorder. The auxiliary trip unit is powered from a 24/12 VDC power supply. This channel is classified Quality Level NQ and nonseismic.

The radiation level detected by the logarithmic channels can be directly correlated to the concentration of the noble gases. This concentration can be determined by using the semiautomatic sample system incorporated as part of this monitor. To use this system, a septum bottle is inserted into a sample chamber so that a hypodermic needle pierces the rubber cap. A vacuum pump is used to evacuate the bottle and then a solenoid-operated sample valve is opened to allow offgas to enter the bottle. The bottle is then removed and counted in the counting room with a multichannel gamma pulse height analyzer to determine the concentration of the various noble gas radionuclides. The correlation of sample activity and monitor reading can then be used by the operators to determine what activity is being discharged from the steam-jet air ejectors and ultimately from the roof vent.

Each of the two logarithmic channels consists of a local detector (gamma-sensitive ion chamber), current to frequency converter, a digital ratemeter in the relay room, and a recorder in the main control room. The recorder is a six-decade recorder located on panel H11-P601. The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from RPS bus A for one channel, from RPS bus B for the second channel, and from the 120-V ac instrument bus for the recorder. The auxiliary trip unit is powered from a 120 VAC/12 VDC power supply. These channels are classified Quality Level 1M and nonseismic. Arrangement details are shown in Figures 11.4-2 and 11.4-3 and in Sheet 3 of Figure 11.3-1.

11.4.3.8.2.3 Main Steam Line Radiation Monitor System

This monitor subsystem measures the radioactive gases coming from the reactor through the main steam lines. These gases are activation gases that come mainly from activation of oxygen, and fission gases that come from small fuel leaks and tramp uranium impurities. If the reactor fuel fails and a gross release of fission products occurs, the monitoring subsystem provides signals to trip the gland seal exhausters (when reactor power is below the low power setpoint associated with RWM), trip the condenser mechanical vacuum pumps and line valves, and isolate the reactor water sample system to contain the released fission products, thus mitigating the potential for release through these pathways as described in Chapter 15. The main steam line radiation monitoring system complies with Regulatory Guide 1.22 and GDC 13, 20, 21, 23, and 24.

The six detectors are located near the main steam lines just downstream of the outboard main steam line isolation valves in the space between the primary containment and secondary containment walls. The detectors are geometrically arranged so that this system is capable of detecting significant increases in radiation level with any number of main steam lines in operation. Their location along the main steam lines allows the earliest practical detection of a gross fuel failure. Two of the detectors are installed spares that can be electrically connected, if needed, outside the main steam tunnel. Table 11.4-1 lists the sensitivity and range of the detectors, as well as the alarm and trip setpoints.

The subsystem consists of four separate, redundant instrument channels. Each channel consists of a local detector (gamma- sensitive ion chamber) and a radiation analyzer in the relay room. A two-pen, six-decade strip-chart recorder on panel H11-P601 in the main control room is used to record two of the four channels. There are two selector switches located under the recorder, one to select channel A or C and the other to select channel B or D for recording.

A "one-out-of-two-taken-twice" logic is used to provide a trip signal to the gland seal exhausters (when reactor power is below the low power setpoint associated with RWM) and condenser mechanical vacuum pumps and line valves. Two “two-out-of-two” logics are used to provide an isolation signal to the reactor water sample system valves, with one logic closing the inboard valve and the other closing the outboard valve. Power is supplied from RPS bus A for two channels, from RPS bus B for two channels and from the 120-V ac instrument bus for the recorder. This subsystem is Quality Level 1 and Category I. Arrangement details are shown in Figure 11.4-3.

The alarms for this monitor subsystem are set to 1.5 times the “full power background” to allow for prompt sampling of the reactor coolant to determine possible sources of contamination and the need for corrective/mitigative actions.

11.4.3.8.2.4 Reactor Building Ventilation Exhaust Radiation Monitor System

This monitor subsystem measures the radioactivity in the reactor building ventilation system exhaust duct prior to its discharge from the building and, in doing so, complies with GDC 13, 23, and 64. The exhaust duct is in the form of a "T" with north and west legs that come together into a common line prior to passing through the building isolation dampers. During normal operation and during refueling operation (including criticality tests), the monitors act to detect a high activity level in the ductwork. Two independent redundant monitors are located on the common line downstream of the isolation dampers.

A continuous representative sample is extracted from the common duct through the gas monitor, a low-flow alarm switch, and then through a sample pump prior to being returned to the ventilation duct.

The shielded gas monitor has a beta-sensitive scintillation detector mounted in the top of a stainless steel chamber. Table 11.4-1 lists the sensitivity and range of the detector. In the event that this chamber becomes highly contaminated, it can be disassembled for cleaning or replacement.

Each channel consists of the local detector and preamplifier and a radiation analyzer in the relay room. No recorder is provided. One high-high trip or two low alarms (one from each detector) start the SGTS, close the primary containment vent valves, trip and isolate the reactor building vent system, isolate the control center, and initiate emergency recirculation mode for the control center ventilation system. A low trip also initiates all the above actions because the trip circuit has been designed to fail safe in the event of loss of power. Power is supplied from the 120-V ac instrument bus for each channel. This system is Quality Level 1M and seismic II/I. Arrangement details are shown in Figures 11.4-2, 11.4-4, 11.4-5, and 9.4-4, Sheets 1 and 2.

11.4.3.8.2.5 Offgas Vent Pipe Radiation Monitor System

This monitor system is not required since the reactor building exhaust plenum monitor measures the activity leaving the reactor building stack and is therefore not in operation. The system measures the activity in the offgas vent pipe before it discharges into the reactor building ventilation exhaust plenum. The activity this monitor detects is the effluent from the offgas system, which is composed of fission gases from the reactor. During startup, the condenser offgas passes through the mechanical vacuum pumps, through a 2-minute delay line, at the discharge end of which is a monitor, as described in Subsection 11.4.3.8.2.13, and into the common vent pipe.

A continuous representative sample is extracted from the vent pipe through an isokinetic probe, passed through a filter paper to collect particulates, and through an impregnated charcoal cartridge to collect iodine. The sample continues past a pressure switch used as a low-flow alarm, through the sample pump, through two gas monitors in series, and then through a rotameter prior to being returned to the vent pipe. Table 11.4-1 lists the location, sensitivity, and range of the monitors.

Each gas monitor has a sample chamber viewed by a shielded gamma-sensitive (NaI) scintillation detector. Each channel consists of a local detector and preamplifier, a radiation analyzer in the relay room (ratemeter removed and supporting components abandoned in place), and a recorder in the main control room. The recorder is a seven-decade recorder located on panel H11-P601. A switch located under the recorder is used to operate solenoid valves to stop the sample flow and admit room air to purge the detectors. Two other switches, also under the recorder, can be used to move solenoid- operated check sources into position to check detector response. Three local control switches are also provided for the same purposes at the rack where all the local equipment is mounted.

This subsystem provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from the 48/24-V dc batteries for the channels and from the 120-V ac instrument bus for the recorder. This subsystem is Quality Level NQ and seismic II/I. Arrangement details are shown in Figures 11.4-2 and 11.4-3 and in Sheet 3 of Figure 11.3-1.

11.4.3.8.2.6 Radwaste Building Ventilation Exhaust Radiation Monitor System

This monitor subsystem measures the radioactivity in the building exhaust prior to its discharge to the environment and, in doing so, complies with Regulatory Guide 1.21, Revision 1, and GDC 23 and 64. The activity this monitor detects is from samples in the laboratory fume hoods, tank vents, and the extruder fill station and ventilation exhaust from contaminated cubicles. The gaseous activity is normally expected to be below detectable levels. The particulate and iodine activity is accumulated on filters. These filters are periodically changed-out for counting. The filters are counted using certified equipment to aid in determining the quantities of specific radionuclides released. The gaseous activity is monitored by a beta scintillator and energy-compensated Geiger-Mueller tube viewing the same gas sample volume. The analysis results, combined with the data files and printouts from the detectors, provide a record of the activity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe. The sample first passes through a filter paper to collect particulates. Next the sample passes through an iodine-adsorbent cartridge. The sample then passes through the gas monitor, a combined high/low-flow alarm switch and indicator, and then a regulated sample pump before being returned to the exhaust vent.

The shielded gas monitor has a beta scintillator and energy-compensated Geiger-Mueller tube viewing a common sample plenum. A second Geiger-Mueller tube embedded in the shield exterior serves as a spare detector. Background compensation for both detector channels is performed using fixed background subtraction. Table 11.4-1 lists the sensitivity and ranges of these detectors. In the event that the sample chamber or detector housings should become highly contaminated, the units can be disassembled for cleaning or replacement.

This Sping 3 Radwaste Building Ventilation Exhaust Radiation Monitor (D11-N503/D11-P281) is a self-contained microprocessor-based detection system for sampling of particulates and iodines, and for monitoring of noble gases. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. The monitor is powered from 120-V ac instrumentation and control (I&C) panel H21-P515. All data are accessed and printed out from the Eberline SS-1 system server located in the control room complex. A high- or low-flow condition, a high or low failure of a detector channel or a channel reading above setpoint results in an audible and visual alarm in the control room. In addition, a high channel alarm on the noble gas channel will initiate a trip of the radwaste building ventilation fans and automatically close the isolation dampers.

This system is Quality Level 1M and nonseismic. Arrangement details are shown in Figures 11.4-2, 11.4-4, and 9.4-5.

11.4.3.8.2.7 Turbine Building Ventilation Exhaust Radiation Monitor System

This monitor subsystem measures the radioactivity in the turbine building exhaust prior to its discharge to the environment and, in doing so, complies with Regulatory Guide 1.21, Revision 1, and GDC 23 and 64. The activity this monitor detects is from fission products in the steam that may leak from the turbine or other components in the building. The gaseous activity is normally expected to be below detectable levels. The particulate and iodine activity is accumulated on filters. These filters are normally changed out weekly. The filters are counted using certified equipment to aid in determining the quantities of specific radionuclides released. The gaseous activity is monitored by a beta scintillator and energy-compensated Geiger-Mueller tube viewing the same gas sample volume. The analysis results, combined with the data files and printouts from the detectors, provide a record of the activity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe. The sample first passes through a filter paper to collect particulates. Next the sample passes through an iodine-adsorbent cartridge. The sample then passes through the gas monitor, a combined high/low-flow alarm switch and indicator, and then a regulated sample pump before being returned to the exhaust vent.

The shielded gas monitor has a beta scintillator and energy- compensated Geiger-Mueller tube viewing a common sample plenum. A second Geiger-Mueller tube embedded in the shield exterior serves as a spare detector. Background compensation for both detector channels is performed using fixed background subtraction. Table 11.4-1 lists the sensitivity and ranges of these detectors. In the event that the sample chamber or detector housings should become highly contaminated, the units can be disassembled for cleaning or replacement.

This Sping 3 Turbine Building Ventilation Exhaust Radiation Monitor (D11-N504/D11-P279) is a self-contained microprocessor- based detection system for sampling particulates and iodines and monitoring noble gases. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. The monitor is powered from 120-V ac I&C panel H21-P563. All data are accessed and printed out from the Eberline SS-1 system server located in the control room complex. A high- or low-flow condition, a high or low failure of a detector channel or a channel reading above setpoint results in an audible and visual alarm in the control room. In addition, a high channel alarm on the noble gas channel will initiate a trip of the turbine building ventilation fans. This system is Quality Level 1M and nonseismic. Arrangement details are shown in Figures 11.4-2, 11.4-4, and 9.4-7.

11.4.3.8.2.8 Deleted

11.4.3.8.2.9 Standby Gas Treatment System Radiation Monitor System

This monitor subsystem measures the radioactivity in the exhaust vent lines from the SGTS prior to its discharge to the environment and, in doing so, complies with Regulatory Guide 1.21, Revision 1, and GDC 23 and 64. There is a monitor on both SGTSs. The activity these monitors are designed to detect is composed of fission products from the reactor building that have been treated by the SGTS. The gaseous activity in the exhaust is normally expected to be below detectable levels. Particulate and iodine activity is accumulated on filters. These filters are normally changed-out weekly. The filters are counted using certified equipment to aid in determining the quantities of specific radionuclides released. The gaseous activity is monitored by a beta scintillator and energy-compensated Geiger-Mueller tube viewing the same gas sample volume. The analysis results, combined with the data files and printouts from the detectors, provide a record of the activity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe. The sample first passes through a filter paper to collect particulates. Next the sample passes through an iodine-adsorbent cartridge. The sample then passes through the gas monitor, a combined high/low-flow alarm switch and indicator, and then a regulated sample pump before being returned to the exhaust vent.

The shielded gas monitor has a beta scintillator and energy- compensated Geiger-Mueller tube viewing a common sample plenum. A second Geiger-Mueller tube embedded in the shield exterior serves as a spare detector. Background compensation for both detector channels is performed using fixed background subtraction. Table 11.4-1 lists the sensitivity and ranges of these detectors. In the event that the sample chamber or detector housings should become highly contaminated, the units can be disassembled for cleaning or replacement.

These Sping 3 SGTS System Exhaust Radiation Monitors (D11-N510A/ D11-P275 and D11-N510B/D11-P276) are both self-contained microprocessor-based radiation detection systems for sampling particulates and iodines and monitoring noble gases. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. The monitors are powered from 120-V ac I&C panels. All data are accessed and printed out from the Eberline SS-1 system server located in the control room complex. A high- or low-flow condition, a high or low fail of a detector channel or a channel reading above setpoint results in an audible and visual alarm in the control room. The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. This system is Quality Level 1M and seismic II/I. Arrangement details are shown in Figures 11.4-2 and 11.4-4.

See Subsection 11.4.3.8.2.16 for a discussion of the SGTS post-accident radiation monitor system.

11.4.3.8.2.10 Reactor Building Exhaust Plenum Radiation Monitor System

This monitor subsystem measures the activity in the reactor building exhaust plenum prior to its discharge to the environment and in doing so complies with Regulatory Guide 1.21, Revision 1, and GDC 64. The activity this monitor is designed to detect is due to corrosion and fission products from the reactor/auxiliary building ventilation system (Subsection 11.4.3.8.2.4) and from the offgas system (Subsection 11.4.3.8.2.5). The gaseous activity in the exhaust is mainly due to the condenser offgas. The particulate and iodine activity is accumulated on filters. These filters are normally changed-out weekly. The filters are counted using certified equipment to aid in determining the quantities of specific radionuclides released. The gaseous activity is monitored by a beta scintillator and energy-compensated Geiger-Mueller tube viewing the same gas sample volume and a high-range noble gas monitor using another energy-compensated Geiger-Mueller tube. The analysis results, combined with the data files and printouts from the detectors, provide a record of the activity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe. The sample first passes through a filter paper to collect particulates. Next the sample passes through an iodine-adsorbent cartridge. The sample then passes through the gas monitor, a combined high/low-flow alarm switch and indicator, the high-range noble gas monitor, and then a regulated sample pump before being returned to the exhaust vent.

The shielded gas monitor has a beta scintillator and energy- compensated Geiger-Mueller tube viewing a common sample plenum. A second Geiger-Mueller tube embedded in the shield exterior serves as a spare detector. Background compensation for both detector channels is performed using fixed background subtraction. The high-range noble gas monitor consists of an energy-compensated Geiger-Mueller tube viewing a shielded 1-in. stainless steel tube as its sample volume. Table 11.4-1 lists the sensitivity and ranges of these detectors. In the event that the sample chamber or detector housings should become highly contaminated, the units can be disassembled for cleaning or replacement.

This Sping 4 Reactor Building Exhaust Plenum Radiation Monitor (D11-N507/D11-P280) is a self-contained microprocessor-based radiation detection system for sampling particulates and iodines and monitoring noble gases. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. The monitor is powered from a 120-V ac I&C panel. All data are accessed and printed out from the Eberline SS-1 system server located in the control room complex. A high- or low-flow condition, a high or low failure of a detector channel or a channel reading above setpoint results in an audible and visual alarm in the control room. The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. This system is Quality Level 1M and seismic II/I. Arrangement details are shown in Figures 11.4-2, 11.4-4, and 9.4-4, Sheets 1 and 2.

11.4.3.8.2.11 Fuel Pool Ventilation Exhaust Radiation Monitor System

This monitor subsystem measures the activity from the fuel pool area ventilation exhaust ducts that discharge into the east and west legs of the reactor building ventilation exhaust system. The fuel pool contains gaseous activity due to mixing with the reactor coolant system during each refueling. Diffusion of this activity from the pool generates airborne activity that is swept into the spent fuel pool area ventilation system. Gaseous activity released during a fuel-handling accident is also swept into this ventilation system. Two detectors are located on each leg of the ventilation system downstream of all the spent fuel exhaust ducts. During refueling operation (including criticality tests), the monitors act to detect a high radiation level in the ductwork that could be due to fission gases from a refueling accident or a control rod drop accident. Two independent redundant monitors are provided on the east and west exhaust duct legs. The detectors are located as far upstream of the building isolation valve as practicable to allow for reaction time to close the valve to prevent the release of activity. Table 11.4-1 lists the range and sensitivity of the detectors. Subsection 15.7.4 contains a discussion of the accident analyses.

Each channel consists of a local sensor-convertor unit (gamma- sensitive detector and associated circuitry as discussed in Subsection 12.1.4), a radiation analyzer mounted in the relay room, and one pen on a recorder in the main control room. There are two, two-pen, four-decade strip-chart recorders provided, one on panel H11-P601 for channels A and B and one on panel H11-P812 for channels C and D. A high-high trip on any channel starts the SGTS, closes the primary containment vent valves, trips and isolates the reactor building vent system, isolates the control center, and initiates emergency recirculation mode for the control center ventilation system. The radiation monitors' maximum allowable value is 6mR/hr.

Two failure alarms (one from each detector on one leg) also initiate all the above actions because the trip circuit has been designed to fail safe in the event of loss of power, downscale/inop condition. Power is supplied from RPS bus A for one channel on each leg, from RPS bus B for the second channel on each leg, and from the 120-V ac instrument bus for the recorders. This system is Quality Level 1 and Category I. Arrangement details are shown in Figures 11.4-2, 11.4-3, and 9.4-4, Sheets 1 and 2.

11.4.3.8.2.12 Control Center Normal Makeup Air Radiation Monitor System

This monitor system measures the activity in the makeup air to the main control room. No measurable activity is expected to be present in the makeup air. However, in the event of a design- basis accident, fission gases could escape from the main coolant system and be drawn into the makeup air intake. There are two independent monitors at each normal makeup air intake. The system complies with GDC 13 AND 19.

A representative sample for each monitor is extracted from the ventilation duct and passes through the gas monitor, a low-flow alarm switch, and finally through a sample pump before being returned to the ventilation duct. Four source taps are located in the normal air intake prior to the normal air-intake isolation valves.

Each shielded gas monitor has a beta-sensitive scintillation detector mounted in the top of a stainless steel chamber.

Table 11.4-1 lists sensitivity and range for this detector. In the event the chamber becomes contaminated, it can be disassembled for cleaning or replacement.

Each channel consists of the local detector and preamplifier and a radiation analyzer in the relay room. No recorder is provided. One high-high or two low alarms (one from each detector) isolate the control center and initiate emergency recirculation mode for the control center ventilation system. Power is supplied from the 120-V ac instrument bus for the channel components. This system is Quality Level 1M and seismic II/I. Arrangement details are shown in Figures 11.4-2, 11.4-3, and 9.4-2.

11.4.3.8.2.13 Two-Minute Holdup Pipe Exhaust Radiation Monitor System

This monitor system measures the activity from the mechanical vacuum pumps after the discharge from the 2-minute delay pipe. In addition, it also monitors the turbine gland sealing system exhaust that enters the offgas system at the discharge of the mechanical vacuum pumps. The mechanical vacuum pumps are used during startup to remove large quantities of air from the system at high flow rates. After the offgas flow rate is reduced to normal levels, the flow is rerouted through the offgas treatment system and the mechanical vacuum pumps are shut off. The mechanical vacuum pump is also used for normal shutdowns, SCRAM related shutdowns, and during periods of low power operations when the Offgas system is not available. The mechanical vacuum pumps are shutdown when Shutdown Cooling is placed in service for normal shutdowns and SCRAM related shutdowns. The operating time for low power operations when the Offgas system is not available is generally shorter than three to five days. The monitors initially detect the activity due to fission gases produced in the reactor and transported in the steam through the turbine to the condenser. Later, the monitors detect the same gases that come through the turbine gland sealing system. Two independent redundant monitors are provided with the detectors mounted adjacent to the discharge line. The system complies with GDC 13, 23, and 64.

Each shielded monitor has a gamma-sensitive scintillation detector mounted adjacent to the offgas pipe. Table 11.4-1 lists the sensitivity and range of this detector.

Each channel consists of the local detector and preamplifier, and a radiation analyzer in the relay room. No recorder is provided. The system provides no control function, but the alarms for this monitor subsystem are set to 1.5 times the "full power background" to allow for prompt sampling of the reactor coolant to determine possible sources of contamination and the need for corrective/mitigative actions. Power is supplied from the 120-V ac instrument bus for the channel components. This system is Quality Level NQ and nonseismic. Arrangement details are shown in Figures 11.4-2, 11.4-3, and in Sheets 1 and 2 of Figure 11.3-1.

11.4.3.8.2.14 Control Center Emergency Air Inlets Radiation Monitor System

This monitor system measures the activity in the emergency air supply ducts to the main control room. No measurable activity is expected in the emergency air supply. A secondary emergency air makeup intake is provided on the north side of the auxiliary building, along with radiation detectors in both the existing air makeup intake and the second air intake. Therefore, either inlet for makeup air to the control center can be selected from either side of the potential release points, depending on the relative activity. The system is in compliance with GDC 13 and 19.

A representative sample for each of the four monitors is extracted from the emergency ventilation duct through a stainless steel sample tube, which passes through the gas monitor, a low- flow alarm switch, and a sample pump before being returned to the duct. The source taps (four each) are located in the north and south emergency air intakes upstream of the emergency intake isolation valves.

The sampling assembly consists of an off-line gas monitor, a beta-sensitive scintillation detector mounted on top of a stainless steel chamber, and a preamplifier and radiation analyzer in the relay room panel. High-radiation and low-flow or inoperative alarms are provided in the main control room. The sensitivity and range of these detectors are listed in Table 11.4-1. Recorders are not provided.

This system makes an initial automatic selection of emergency air inlets during a radiation-release accident. The monitors would sample the air for 5 minutes; after 5 minutes, if there were high radiation at either the north or south inlet, the corresponding damper with the lower radiation would stay open. The operators then would assume manual control of the selection process following the radiation release, using the radiation monitors to determine which inlet has the lowest radiation level.

This system is Quality Level 1 and Category I. For redundancy, two detectors are provided for each intake (north and south). Arrangement details are shown in Figures 11.4-2, 11.4-5, and 9.4-2.

11.4.3.8.2.15 Onsite Storage Facility Ventilation Exhaust Radiation Monitor System

This monitor subsystem measures the radioactivity in the radwaste onsite storage facility exhaust prior to its discharge to the environment and, in doing so, complies with Regulatory Guide 1.21, Revision 1, and GDC 23 and 64. The activity this monitor detects is a result of the storage and handling of radwaste and equipment in the building. Resultant radioactivity is normally expected to be below detectable levels. The particulate and iodine activity is accumulated on filters. These filters are periodically changed out for counting. The filters are counted using certified equipment to aid in determining the quantities of specific radionuclides released. The gaseous activity is monitored by a beta scintillator and energy-compensated Geiger-Mueller tube viewing the same gas sample volume. The analysis results, combined with the data files and printouts from the detectors, provide a record of the activity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe. The sample first passes through a filter paper to collect particulates. Next the sample passes through an iodine-adsorbent cartridge. The sample then passes through the gas monitor, a combined high/low-flow alarm switch and indicator, and then a regulated sample pump before being returned to the exhaust vent.

The shielded gas monitor has a beta scintillator and energy-compensated Geiger-Mueller tube viewing a common sample plenum.

A second Geiger-Mueller tube embedded in the shield exterior serves as a spare detector. Background compensation for both detector channels is performed using fixed background subtraction. Table 11.4-1 lists the sensitivity and ranges of these detectors. In the event that the sample chamber or detector housings should become highly contaminated, the units can be disassembled for cleaning or replacement.

This Sping 3 Onsite Storage Building Ventilation Exhaust Radiation Monitor (D11-N508/D11-P299) is a self-contained microprocessor-based radiation detection system for sampling particulates and iodines and monitoring noble gases. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. The monitor is powered by a 120-V ac I&C panel. All data are accessed and printed out from the Eberline SS-1 system server located in the control room complex. A high- or low-flow condition, a high or low failure of a detector channel or a channel reading above setpoint results in an audible and visual alarm in the control room. This system provides no trip or control function but is a diagnostic tool that enables operations personnel to take appropriate action. This system is Quality Level 1M and nonseismic. Arrangement details are shown in Figures 11.4-2, 11.4-4, and 9.4-7.

11.4.3.8.2.16 Standby Gas Treatment System Postaccident Radiation Monitor System

This monitor subsystem measures the radioactivity in the exhaust vent lines from the SGTS after an accident has occurred and prior to discharge to the environment. In doing so, the subsystem complies with Regulatory Guide 1.97 and GDC 60 and 64. The activities these monitors are designed to detect are fission products (following an accident) from the reactor building that have been treated by the SGTS. The activity in the exhaust is expected to be high levels of noble gases resulting from a breach of primary system integrity. The gaseous activity of the SGTS unit exhaust is monitored by two shielded energy-compensated Geiger-Mueller tubes. In addition, a grab sample pallet (GSP-1) contains a particulate filter and charcoal cartridge in a removable shielded holder to allow count room analysis of particulates and iodine in the exhaust using certified equipment. The GSP-1 also has hose-barbed sample taps for removal of a gaseous sample for count room analysis. The analysis results, combined with the data files and printouts from the units, provide a record of the activity released to the environment.

A continuous representative sample is extracted from the exhaust vent through an isokinetic probe. The sample passes through a heat-traced line and bulk filter assembly (BFA-1) to remove any particulates. The filtered sample then passes through a regulated sample pump that provides a continuous sample flow rate of 5.43 liter/minute and a local flow indicator on the noble gas pallet (NGP-1). A flow switch tapped into the sample line at this point provides a loss-of-flow alarm trip to the unit. On the NGP-1 the sample passes through two shielded detector assemblies in series, the intermediate-range noble gas detector (SA-14), and the high-range noble gas detector (SA-15). Both the SA-14 and the SA-15 consist of an energy-compensated Geiger- Mueller tube viewing a shielded polished stainless steel sample volume. The SA-15 also has a second Geiger-Mueller tube embedded in its shield exterior which serves as a spare detector. Background compensation is provided using fixed background subtraction. The sample then returns to the SGTS exhaust header.

In addition to the NGP-1, another isokinetic probe in the sample line upstream of the BFA-1 splits off a portion of the sample flow (1/73.2) for the grab sample pallet assembly (GSP-1). The grab sample pallet flow driving head is provided by a manual throttling valve (V-3). The sample flow of $\geq$ 74.1 cm^3/minute passes through a shielded, removable particulate filter and iodine cartridge holder (SA-16), a visual flow indicator before returning to the sample line upstream of the BFA-1. The SA-16 contains an energy-compensated Geiger-Mueller tube to indicate the relative amount of radiation present in the filter and cartridge.

The detector outputs are translated by interface boxes and the resultant signal is transmitted to the data acquisition module (DAM-4) for each monitor (D11-N520A/D11-P300A and D11-N520B/D11-P300B). The DAM-4s are both self-contained microprocessor-based radiation detection systems for monitoring accident-range noble gases. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. The monitors are powered from 120-V ac I&C panels. All data are accessed and printed out from the Eberline SS-1 system server located in the control room complex. A low-flow condition, a high or low failure of a detector channel or a channel reading above setpoint results in an audible and visual alarm in the control room. This system provides no control functions but is a diagnostic tool that enables the main control room operator to take appropriate action. This system is Quality Level 1M and seismic II/I. Arrangement details are shown in Figures 11.4-2 and 11.4-4.

The SGTS radiation monitor system for normal operation is described in Subsection 11.4.3.8.2.9.

11.4.3.9 Description of Liquid Monitors

Each channel of the system contains a completely integrated modular assembly as described below. Specific details of each monitor are described in Subsections 11.4.3.9.2.1 through 11.4.3.9.2.6.

11.4.3.9.1 General Liquid Monitor Details

11.4.3.9.1.1 Sampling Devices

For each off-line monitor except the circulating water decant line monitor, a sample is drawn from a process line through a sample tap, passed through a shielded sample chamber, through the sample pump, and returned to the system. The circulating water decant line radiation monitor does not have a sample pump (see Subsection 11.4.3.9.2.6).

Each sample pump is capable of drawing 1 gpm of liquid through the monitor. The sample flow rate is controlled with a manual flow-control valve. Each monitor has a low sample-flow alarm.

The monitor inlet and outlet lines are flanged and have isolation valves so that the monitor can be disassembled if decontamination is necessary. Sample valves are provided so that clean water can be purged through the chamber to check the background radiation level, and so that samples can be taken for analysis, or calibrated liquids introduced, to check the monitor calibration.

Each in-line monitor has a polished stainless steel well bolted to a flange on the line being monitored. The pressure and temperature limits and the Category and Quality Level for the well are the same as that for the line in which the well is mounted.

11.4.3.9.1.2 Detector-Preamplifier Unit

Each detector is a NaI gamma-sensitive scintillation detector. A preamplifier is mounted on top of the detector. The detectors are designed to remain fully operational over a wide range of temperatures, as shown in Table 11.4-3. If they are exposed to high radiation transients exceeding the channel range, the channel maintains full-scale deflection and returns to normal functioning when the transient has subsided. Since gamma detectors are used, comparison of monitor readout with the results of grab samples is easily made. The grab samples are counted in the plant multichannel gamma pulse height spectrometer to check monitor calibration. Solenoid-operated check sources are provided to check detector response on the General Atomics-supplied monitors. Each check source is operated from the respective radiation analyzer in the relay room.

Off-line detectors are mounted as close as practicable to the system being monitored, and yet are still in a low-radiation area (y<0.5 mR/hr in most cases) so that the detectors have maximum sensitivity and so there is minimum sample plateout.

11.4.3.9.1.3 Radiation Analyzer

Subsection 11.4.3.8.1.3 contains a description of the radiation analyzer.

11.4.3.9.1.4 Recorder

Subsection 11.4.3.8.1.4 contains a description of the recorder.

11.4.3.9.2 Specific Liquid Monitor Details

11.4.3.9.2.1 Radwaste Effluent Radiation Monitor System

This monitor subsystem measures the activity in the radwaste effluent discharge line to comply with Regulatory Guide 1.21 and GDC 23 and 64. The radwaste effluent line discharges through the blowdown discharge line into the circulating water decant line, which dilutes the waste prior to its discharge to Lake Erie. This monitor detects the activity in the blowdown discharge line to prevent the concentration in the circulating water decant line from exceeding the 10 CFR 20, Appendix B, Table II, Column 2, activity limits. Waste liquid can be discharged from any of the three waste sample tanks. The liquid radwaste system for Fermi 2 is designed to be a closed-loop system which does not normally discharge effluent to Lake Erie. As discussed above, provision is made for a discharge should it be required, and instrumentation that satisfies the requirements of NUREG-0473, Revision 2, is provided on the decant line.

Prior to discharge, the liquid in the appropriate waste sample tank is sampled and analyzed in the laboratory for radioactivity to comply with Regulatory Guide 1.21. Based upon this analysis, a discharge permit is issued specifying the release rate, the dilution rate, and the tank to be discharged. The release rate and dilution rate are used to determine the alarm setpoints. Prior to the release, the radwaste control room operator or other authorized personnel on approval of radiochemistry may reset the High alarm point for a flow rate that will be lower than the maximum for which the alarm is normally set. The Shift Manager or his authorized delegate verifies that it is set correctly and initials the permit to signify that he has checked the setting.

The shielded detector is located in a well in the common discharge line from the liquid radwaste system through which all liquid radwaste discharges to the blowdown line must pass. Table 1.4-2 lists the sensitivity and range of this detector. The piping arrangement is designed so that the section of pipe in which the well is located can be flushed to remove crud to lower the background radiation levels or to remove a slug of highly radioactive liquid to clear the high alarm. The flanged stainless steel well, which protrudes into the liquid flow path, is bolted to the blowdown pipe. If the well becomes highly contaminated, it can be removed for decontamination after draining the line.

The channel consists of the local detector and preamplifier, a digital ratemeter in the relay room, and a recorder in the radwaste control room. The recorder is a seven-decade recorder located in the radwaste control room on panel G11-P604. A high alarm also sounds in the radwaste control room and light annunciator window 4D30 on panel G11-P604. A high-high trip or downscale failure initiates closure of the radwaste discharge isolation valve. A low trip also initiates an alarm. Power is supplied from the 48/24-V dc battery for the channel components and from the 120-V ac instrument bus for the recorder. The auxiliary trip unit is powered from a 24/12 VDC power supply. This subsystem is Quality Level 1M and nonseismic. Arrangement details are shown in Figures 11.4-2 and 11.4-3.

11.4.3.9.2.2 General Service Water Radiation Monitor System

This monitor subsystem measures the activity in the general service water line to comply with GDC 64. The general service water line discharges into the main condenser circulating water discharge line. Some of this liquid is evaporated, and the remainder is discharged to the circulating water reservoir where a portion is decanted through the circulating water decant line to Lake Erie. No activity attributable to reactor operation is expected to be present in this line. To have activity in this line, a leak would have to develop simultaneously in equipment cooled by the reactor building closed cooling water system (RBCCWS) and in the RBCCW heat exchanger, or simultaneously in equipment cooled by the turbine building closed cooling water system (TBCCWS) and TBCCW heat exchanger. Samples of the closed cooling water systems are checked periodically for activity that would warn if a leak had developed in a component. In addition, there is an in-line radiation monitor on the RBCCWS (Subsection 11.4.3.9.2.3), which would warn of any gross leak from a component cooled by that system between analyses.

The service water monitor provides a backup for the above detection methods and detects gross leaks of radioactive liquid into the service water.

The shielded detector is located in a well in the service water discharge line. Table 11.4-2 lists the sensitivity and range of this detector. The flanged stainless steel well, which protrudes into the liquid flow path, is bolted to the service water pipe. If the well should become contaminated, it can be removed for decontamination.

The channel consists of the local detector and preamplifier, a digital ratemeter in the relay room, and a recorder in the main control room. The seven-decade recorder is located in the main control room on panel H11-P601. The recorder is shared with the RBCCW monitor. The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from the 48/24-V dc battery for the channel and from the 120-V ac instrument bus for the recorder. The auxiliary trip unit is powered from a 24/12 VDC power supply. This subsystem is Quality Level NQ and nonseismic. Arrangement details are shown in Figures 11.4-2, 11.4-3, and 9.2-1, Sheet 1.

11.4.3.9.2.3 Reactor Building Closed Cooling Water Radiation Monitor System

This monitor subsystem measures the activity in the RBCCWS and, in doing so, complies with GDC 64. The RBCCWS cools components that contain radioactive liquids, but does not normally have any activity unless one of these components develops a leak. Samples of the RBCCWS are checked periodically for activity to determine if a leak is starting in a component. A laboratory analysis has much greater sensitivity than a radiation monitor, and therefore can detect smaller leaks. Since leaks usually start small and develop gradually, the radiological analyses performed in the laboratory normally detect the leak prior to the monitor. If a leak should increase dramatically between samples, or if a gross failure should occur, the monitor would detect it. Each RBCCW supplemental cooling loop and the associated EECW loop it services form a separate flow circuit that does not circulate fluid past the RBCCW radiation monitor. These circulation loops (one for each EECW division) are provided with sample points. As stated above, laboratory analysis has a better sensitivity for detecting small leaks. For larger leaks into a RBCCW supplemental cooling circuit, the extra fluid added to the circuit upsets the hydraulic balance between the RBCCW circulation inside and outside of RBCCW supplemental cooling. This hydraulic imbalance forces fluid into the flow of RBCCW outside of the RBCCW supplemental cooling which does pass by the RBCCW radiation monitor. The RBCCW radiation monitor will then detect the increase in activity as it does when the RBBCW supplemental cooling loops are not in operation.

This design meets the criteria stated above that small leaks are detected by sampling and large leaks are detected with the radiation monitor.

The shielded detector is located in a well in the 20-in. discharge header of the RBCCW pumps. Table 11.4-2 lists sensitivity and range of this detector. The flanged stainless steel well, which protrudes into the liquid flow path, is bolted to the cooling water pipe. If the well should become contaminated, it can be removed for decontamination.

The channel consists of the local detector and preamplifier, a digital ratemeter in the relay room, and a recorder in the main control room. The recorder is a seven-decade recorder located on panel H11-P601. The recorder is shared with the general service water effluent monitor. The RBCCWS monitor system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from the 48/24-V dc battery for the channel and from the 120-V ac instrument bus for the recorder. The auxiliary trip unit is powered from a 24/12 VDC power supply. This subsystem is Quality Level NQ and seismic II/I. Arrangement details are shown in Figures 11.4-2 and 11.4-3.

11.4.3.9.2.4 Emergency Equipment Cooling Water Radiation Monitor System

This monitor subsystem measures the activity in the emergency equipment cooling water system (EECWS) and, in doing so, complies with GDC 64. The EECWS cools certain vital components in the reactor building if use of the RBCCWS is lost. When this system is used, the components it cools have water that contains radioactive contaminants. This monitor is used to determine if a leak occurs. One detector is located on each of the two redundant systems.

Each shielded detector (Table 11.4-2 lists the sensitivity and range of this detector) is located in a well in the 8-in. EECW line downstream of the components that have been cooled. The flanged stainless steel well, which protrudes into the liquid flow path, is bolted to the pipe. If the well should become contaminated, it can be removed for decontamination.

Each channel consists of the local detector and preamplifier and radiation analyzer in the relay room. No recorder is provided. The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from the 120-V ac instrument bus for each channel. This subsystem is Quality Level NQ and seismic II/I. Arrangement details are shown in Figures 11.4-2, 11.4-3, 9.2-3, and 9.2-4.

11.4.3.9.2.5 Residual Heat Removal Service Water System Radiation Monitor System

This monitor subsystem measures the activity in the residual heat removal service water system (RHRSWS) and, in doing so, complies with GDC 23 and 64. The RHRSWS cools the RHR system, which is used when the reactor is shut down to remove decay heat from the reactor coolant system. The RHRSWS is discussed in detail in Subsection 9.2.5. This cooling water is discharged to the RHR cooling tower and then into the RHR reservoir. This monitor detects gross leaks to warn of contamination. One detector is located on each of the two redundant systems downstream of the respective RHR heat exchanger.

A representative sample is extracted from each 24-in. line through a sample tap, the liquid monitor, a low-flow alarm switch, and then a sample pump prior to being returned to the RHRSW line downstream.

The shielded detector is mounted in the top of a stainless steel chamber. Table 11.4-2 lists the location, sensitivity, and range of this detector. In the event that this chamber becomes contaminated, it can be disassembled for cleaning or replacement.

Each channel consists of the local detector and preamplifier and radiation analyzer in the relay room. No recorder is provided. Power is supplied from the 120-V ac instrument bus for each channel. This subsystem is Quality Level NQ and seismic II/I and has been upgraded to Quality Level 1 and Seismic I for pressure boundary integrity only. Arrangement details are shown in Figures 11.4-2 and 11.4-3.

11.4.3.9.2.6 Circulating Water Reservoir Decant Line

This monitor subsystem measures the activity in the circulating water decant line and, in doing so, complies with Regulatory Guide 1.21, Revision 1, and GDC 64. The decant line is the blowdown line from the circulating water reservoir to Lake Erie and provides dilution for the liquid radwaste that discharges into this line upstream of the monitor. This is the final point at which a measurement can be made prior to discharge into Lake Erie. This monitor provides a permanent record of this discharge.

A continuous sample flows from the decant line through a tap, the liquid monitor, and a low-flow alarm switch prior to being discharged into the circulating water reservoir downstream.

The shielded detector is mounted in the top of a stainless steel chamber. Table 11.4-2 lists the sensitivity and range of this detector. In the event this chamber becomes contaminated, it can be disassembled for cleaning or replacement.

The channel consists of the local detector and preamplifier, a radiation analyzer in the relay room, and one pen on a recorder in the main control room. The recorder is a two-pen, six-decade strip-chart recorder located on panel H11-P812.

The system provides no control function but is a diagnostic tool that enables the main control room operator to take appropriate action. Power is supplied from the 120-V ac instrument bus. This subsystem is Quality Level 1M and nonseismic. Arrangement details are shown in Figures 11.4-2 and 11.4-3.

11.4.3.10 Containment Area High Range Monitors

Redundant monitors manufactured by General Atomic have been installed to meet the requirements of NUREG-0578, NUREG-0737, and Regulatory Guide 1.97, Revision 2.

These monitors are General Atomic Model RP-2C, and the detectors are Model RD-23 units. This system hardware, including cables, has been designed and qualified to meet the requirements contained in Table II.F.1-3 of NUREG-0737, with the exception of the upper decade criteria for "special environmental qualifications." This exception has been presented to the NRC and approved in Supplement 6 to the Fermi 2 Safety Evaluation Report, NUREG-0798, July 1985.

Radiation levels resulting from gamma photons in the general area of the detectors are indicated in the relay room and displayed on strip-chart recorders in the main control room. The two detectors are located in the primary containment, one at drywell azimuth 302 degrees, Elevation 605 ft 0 in., approximately 6 ft from the shield wall, and the other at drywell azimuth 125 degrees, Elevation 605 ft 0 in., 7 ft from the shield wall. The area chosen is relatively free of massive shielding and is accessible for maintenance.

The monitors and power supplies are located in the plant relay room and are powered from divisional ac power supplies.

11.4.3.11 Postaccident Gaseous Effluent Radiation Monitoring

11.4.3.11.1 Noble Gas Effluent Monitor

Extended range requirements for noble gas effluent monitors have resulted in the installation of an Eberline Company Sping-3/4 series digital monitor on each gaseous effluent discharge point. The effluent channels affected are listed in Table 11.4-4.

All of the normal range channels will trip their respective ventilation system on high-radiation level and/or downscale failure. Following a postulated design-basis accident, the reactor building's ventilation system is tripped, and the SGTS exhaust becomes the single primary discharge vent for the entire secondary containment air space. For this reason, only the SGTS discharge has been provided with Eberline AXM monitors.

Each Sping monitor is a self-contained unit that uses a multisensor approach to meet the broad-range requirements. The Sping employs a local microprocessor to perform the necessary control and digital signal conversion and processing. A history file of the data from each detector is maintained by the processor. This file consists of the last 4 hr of 10-minute averages, the last 24 hr of 1-hr averages, and the last 24 days of 1-day averages.

A control and display are provided in the main control room to allow bidirectional communication with any of the individual radiation channels. This same data base is accessible in the technical support center. Radiation data are reported to operating personnel via both alarms and typewritten data summaries.

The AXM channels are installed in the discharge of the SGTS and use a low-flow isokinetic sample of approximately 5.43 liters/ minute. The accident monitor meets the range requirement of 1×10^5 μCi/cm^3 imposed by NUREG-0737 for noble gas accident monitors in this application. The AXM monitors are environmentally qualified by the vendor to meet IEEE 323-1974.

The Sping and AXM monitors have backup local battery power supplies that are part of the instrument system. These batteries are continuously maintained in a state of full charge by self- contained chargers. The battery has a capacity of 8 hr of operation without recharge. The sampling pump power is derived from the power feed supplying the particular ventilation system fan being monitored.

These monitors provide an activity release rate in units of μCi/sec by direct comparison with the results of actual samples of the effluent that have been analyzed on a gamma isotopic analysis system. All monitor calibrations are performed using approved site procedures developed from the vendor instructions.

The flow rate of each stack/vent is initially determined by measurement to a reasonable degree of accuracy. Each of the Sping monitors includes an isokinetic sample provision. In the case of the SGTS, the actual process airflow is automatically controlled to a design value within a tolerance of ±10 percent. Since the AXM channels include an isokinetic sample system and the process flow is maintained at a constant value, no additional provisions are required to maintain system accuracy.

11.4.3.11.2 Radioactive Iodine and Particulate Effluent Monitoring

Each of the Eberline Sping monitors installed on the plant ventilation discharge stacks provides continuous sampling of both radioactive iodine and particulates. Following a design-basis postulated accident, the SGTS becomes the single primary discharge vent; hence the AXM monitors, which are installed on the SGTS, use a special particulate filter and iodine cartridge assembly that is designed for easy retrieval and incorporates integral shielding. Procedures for retrieval of the samples have been developed with Eberline assistance. The accessibility of the sample locations has been considered, and the GDC 19 requirements are satisfied during retrieval of the samples.

All of the sample probes are designed to take isokinetic samples. In the case of the SGTS, the flow is controlled, which obviates any concern with regard to the adequacy of the sampling system.

The AXM system sample lines have been analyzed and correction factors identified to address potential sample line losses attributable to the plate-out of radioiodines.

None of the effluent streams measured have water entrained in the gas, and moisture degradation is not considered a problem.

11.4.3.11.3 Torus Hardened Vent Radiation Monitor System

This monitor subsystem measures the radioactivity in the exhaust vent line from the torus after a severe accident has occurred and prior to discharge to the environment. Torus venting is used only during accidents which are beyond the plant design basis. This release path is not required to be used during normal or design basis accident conditions, and therefore, need not comply with Regulatory Guide 1.97. When used, the torus vent will prevent rupture of the primary containment by permitting direct vent to the environment. If fuel damage occurs concurrent with the loss of all containment cooling, the effluent would consist primarily of noble gases. The majority of the iodines and particulates would be removed by scrubbing action in the wetwell.

The THVRMS consists of a Process Radiation Detector and Ratemeter. The radiation monitor is mounted adjacent to the 24-inch vent pipe on RB4. The radiation monitor covers a range of 1E-4 R/hr to 1E+5 R/hr.

The THVRMS provides no control function but does provide an alarm and indication in the control room that alerts the operator of a radioactive release in progress. The monitor is also interfaced with the emergency response function of the Integrated Plant Computer System (IPCS). The THVRMS is classified as QA Level 1M and Seismic II/I. The system is powered from an Uninterruptable Power System (UPS). During normal plant operation input power will be from a BOP 120 VAC Distribution Panel (from BOP MPU #3). During a BDBEE the UPS provides input power to the HCVS Radiation Monitoring System for the first 24 hours of the Hardened Containment Venting scenario. After 24 hours into a Hardened Containment Venting scenario, power is shifted to a Class 1E Distribution Panel (from Class 1E MPU #2). Arrangement details are shown in Figure 11.4-4.

For further information on primary containment venting see Section 6.2.5.2.5.1.

11.4.3.12 In-Plant Iodine Radiation Monitoring

In-plant iodine radiation monitoring is implemented to accurately determine the airborne iodine concentration in areas within the facility where plant personnel may be present following an accident.

An adequate number of in-plant iodine monitoring instruments are available for the four vital areas necessary for postaccident operation of the plant. These areas are the operational support center, the technical support center, the postaccident sampling facility, and the postaccident sample analysis area.

Three separate laboratory facilities with gamma isotopic analysis capability are available: one in the chemistry laboratory counting room (located in the radwaste building), one in the Radiation Protection Count Room (located in the plant office service building), and one remote laboratory facility (located at the Nuclear Operations Center in the Emergency Operations Facility).

To perform rapid postaccident in-plant determinations of the airborne iodine concentration, a stabilized sodium iodide detector coupled to an analyzer will be used to continuously evaluate an iodine adsorbent cartridge. This cartridge will be coupled to a flow-stabilized air sampler. These entire units are cart-mounted and portable. Procedures for the use and calibration of the unit are available. Personnel are trained in the use and calibration of the unit.

To evaluate air samples, health physics routinely uses gamma isotopic analysis to identify and quantify the results. This analyzer will be backed up by two units in the chemistry laboratory. In addition, if both the chemistry and health physics counting rooms are unavailable (such as might occur during worst-case accident conditions), a remote laboratory facility located at the emergency operations facility will be available for air sample analysis. This remote facility will basically use the same analysis equipment and procedures as those normally used by health physics and chemistry.

In addition, a supply of silver zeolite, or equivalent, adsorbent cartridges is available to allow the determination of the airborne iodine concentrations in the presence of noble gas.

11.4.4 Sampling

The following sections present a detailed description of the radiological sampling procedures, frequencies, and objectives for all plant process and effluent sampling. This sample program provides the means to comply with the Offsite Dose Calculation Manual radiological effluent controls for the process radiation monitoring system and radwaste system.

11.4.4.1 Process Sampling

Subsection 9.3.2 presents a detailed description of the design of sampling facilities provided for general sampling. The sample frequency, type of analyses, analytical sensitivity, and the purpose of the sample are summarized in Table 11.4-5 for each liquid process sample location, and in Table 11.4-6 for each gas process sample location. The analytical procedures used in sample analysis are presented in Subsection 11.4.4.3. These samples monitor activity levels within various plant systems.

11.4.4.2 Effluent Sampling

Effluent sampling of all potentially radioactive liquid and gaseous effluent paths is conducted on a regular basis in order to verify the adequacy of effluent processing to meet the discharge limits to unrestricted areas. This effluent sampling program provides the information for the effluent measuring and reporting programs required by 10 CFR 50.36a in annual reports to the NRC. The frequency of the periodic sampling and analysis described herein is nominal and may be increased if the effluent levels approach the Offsite Dose Calculation Manual (ODCM) Radioactive effluent control limits. Radioactive effluent sampling and analysis requirements are given in the ODCM Radiological Effluent Controls.

11.4.4.3 Analytical Procedures

Samples of process and effluent gases and liquids may be analyzed for alpha, beta, and gamma radiation.

Instrumentation available on-site for the measurement of radioactivity includes:

a. 2-π proportional counter

b. Liquid scintillation counter

c. Gamma isotopic analysis

Gross beta analyses of liquid process samples are performed with a proportional counter. These samples are evaporated to dryness on planchets prior to counting. Sample volume, counting geometry, and counting time are chosen to achieve the required measurement sensitivities. Correction factors are applied for sample-detector geometry, self-absorption, and counter-resolving time, as needed.

Gross beta and gross alpha analyses are performed with the proportional counter. The samples are prepared for counting by evaporation onto planchets. Sample volume and counting times are chosen to achieve the required measurement sensitivity. Correction factors are applied for self-absorption.

Gross beta and alpha analyses of air particulate composite samples will be performed by counting using the proportional counter.

Gamma isotopic analysis will be used exclusively for the radionuclide analysis of gaseous, air particulate, and liquid samples. The detectors are calibrated against gamma energy for a variety of sample detector geometries.

Gaseous tritium samples are collected by the use of bubblers, condensation, or adsorption (silica gel). Liquid samples for tritium analysis are purified prior to analysis by either passing the samples through mixed-bed ion-exchange columns or by distilling the samples, or both. The liquid scintillation counter is used to count the samples.

Radiochemical separations and gas proportional counting are used for the routine analysis of ^{89}Sr and ^{90}Sr.

Depending on initial experience, either activated charcoal, impregnated charcoal, or silver zeolite will be employed as the adsorption media in gaseous radioiodine sampling devices.

11.4.4.4 Postaccident Sampling System

The postaccident sampling system (PASS) provides the capability of obtaining reactor coolant and containment atmosphere samples under accident conditions. To ensure the ability to sample under post-LOCA environments, the design incorporates sufficient safeguards (shielding/ventilation) to keep the radiation exposure to individuals within the limits of 10 CFR 50, Appendix A, General Design Criteria 19. Compliance to these limits was verified by performance of a time and motion study covering sampling, transport and analysis.

This system has the capability for dilution and remote operation in order to safely obtain representative reactor coolant, suppression pool and containment atmosphere samples.

The design and operation of the Fermi 2 PASS was approved by the NRC in Supplement 5 of the Fermi 2 Safety Evaluation Report and NRC Safety Evaluation dated June 12, 2001.

11.4.4.4.1 Sampling System

A schematic of the PASS is shown in Figure 11.4-6. The general arrangement of the postaccident sample station is shown in Figure 11.4-7 and a schematic diagram of the station is shown in Figure 11.4-8.

The PASS isolation valves and sampling panel are supplied with Class 1E power and on-site backup power, respectively. Both can be operated within 30 minutes of an accident in which there is a loss of offsite power.

The system is installed in the auxiliary building adjacent to the secondary containment, and consists of liquid- and air-sampling subsystems. Appropriate procedures have been written to ensure proper operation.

From the sample station, samples are transported to the analytical laboratory or to an exit for offsite analysis. The short transport route within the building ensures that radiation doses received during transport are minimal.

The PASS will be operated periodically to ensure operability and to provide the opportunity for training. Nuclear Chemistry technician proficiency in PASS operation is verified and maintained in accordance with the Chemistry Technician Training and Qualification Program Description, which includes initial classroom and on-the-job (OJT) training. Documentation of this training is maintained as part of training department records.

The PASS has the capability to obtain:

a. Reactor coolant samples via RHR, when in the shutdown cooling mode, or via jet pumps #5 and #15 when the reactor is at pressure.

b. Containment atmosphere samples

c. Suppression pool atmosphere samples

d. Suppression pool liquid samples from the RHR system when in the suppression pool cooling mode

e. Reactor building (secondary containment) atmosphere.

The ability to obtain these samples does not rely on the use of any isolated contaminated auxiliary system.

Sample lines tie in upstream of automatic isolation systems and are provided with isolation valves operated from the control room. Routing is as direct as possible, and gas lines are heat traced. Long sweep bends and continuous pitch minimize plate- out, blockage, and dissociation of dissolved gases. Shielding is provided in areas where personnel exposure may occur.

Restriction devices are not being used because they are potential crud traps. The small size of the sample lines essentially serves as a flow limiter in case of line rupture.

The PASS sample station, as well as the sample return lines, are purged with either demineralized water or nitrogen gas after taking samples. This reduces the chance of system plugging, reduces radiation buildup by minimizing plate-out, and provides assurance of obtaining representative samples.

Return lines provide a closed loop and return any unused liquids to the suppression pool, and any unused gases to the suppression pool or secondary containment. Refer to Figure 11.4-6.

Postaccident containment sampling is accomplished by connecting into the primary containment monitoring system lines. These lines are routed from opposite sides within containment. The elevation and location on opposite sides of containment permit representative sampling of the upper portion of containment where gases could accumulate. The upper elevation also minimizes the probability of blockage should flooding of the containment occur. Sample nozzle blockage is reduced by pointing the nozzles downward, having the nozzles the same size as the pipes, and not installing traps or filters on the inlet. Recirculation is accomplished by a metal-bellows-type pump at the sample station that draws containment samples through the sample station and returns the sample back to containment.

Suppression pool atmosphere is sampled by tying into two 1-in. primary containment monitoring system lines that connect to suppression pool penetrations X-230 and X-231. The elevation, locations, and nozzle designs similar to primary containment sampling aid in ensuring a representative sample and in minimizing blockage. A pump separate from the primary containment sampling pump recirculates the sample from and back to the suppression pool.

The gas sample system is designed to operate at pressures ranging from subatmospheric to the maximum design pressures of the primary and secondary containments. Heat-traced sample lines are used to prevent the precipitation of moisture and to minimize plate-out.

The gaseous sample flow is chilled to remove entrained moisture, and a nominal grab sample can be taken for the determination of gaseous activity and for hydrogen or oxygen analysis by gas chromatography. A standard sample vial has been adopted for all gas samples to be consistent with present offgas sample vial counting factors. Provision has been made in the laboratory to aliquot fractions of the initial vial contents to other vials if the activity is too high to count directly.

A sample line is provided to obtain reactor coolant samples from two points (jet pumps 5 and 15) in the jet pump pressure instrument system when the reactor is at pressure. This sample location is recommended over the normal reactor sample points as the reactor cleanup system is expected to be isolated under accident conditions, and it is possible that the recirculation line containing the normal reactor water sample lines may be secured. The jet pump pressure system has been determined to be an optimum sample point for accident conditions. The pressure taps are well protected from damage and debris. If the recirculation pumps are secured, there is normally excellent circulation of the bulk of the coolant past these taps. The pressure taps are located sufficiently low to permit sampling at a reactor water level even below the lower core support plate.

In order to ensure that these pressure taps provide a representative sample, two conditions should exist:

a. Enough core flow to allow circulation of water from inside the shroud to the jet pump intake

b. No significant dilution by makeup water.

Two assumptions were made for this determination:

a. Reactor water level can be maintained at or near normal water level after the accident

b. Reactor power level is greater than 1 percent rated, up to approximately 10 percent rated, when the water sample is taken.

Regarding condition (a), after a small break or non-break accident, the reactor water level will be maintained at or near normal water level by the operator using emergency procedures. For decay power above 1 percent of rated power, the core flow is estimated to be greater than 10 percent rated recirculation flow due to natural circulation. This amount of core flow ensures the existence of a flow route from the core to the sampling points; it takes about 3 to 4 minutes to circulate the entire reactor water inventory through the jet pumps. Therefore, a representative sample of the core water will be available at the jet pumps.

Regarding condition (b), for small steam line breaks or non-break accidents, makeup water is pumped in to remove decay heat and to make up for steam loss through the break. This makeup water amounts to approximately 2 percent of the core flow present. Even for small liquid line breaks, the makeup water flow rate is estimated to be less than 18 percent of the core flow present. Therefore, it can be concluded that no significant dilution would occur; the bulk of the water going through the jet pump comes from the reactor core.

A single sample line is also connected to both loops in the RHR system. This provides a means of obtaining a reactor coolant sample when the reactor is depressurized and at least one of the RHR loops is operated in the shutdown cooling mode. To ensure that the sample is representative under these conditions, samples will be acquired after the reactor water level has been raised (approximately 18 in.) to the point where water flows from the steam separators. Similarly, a suppression pool liquid sample is obtained from the RHR loop lined up in the suppression pool cooling mode. These lines are installed on the discharge side of the RHR pumps, downstream of the pump check valves. The representativeness of the suppression pool sample is ensured by the following:

a. No safety/relief valves discharge directly into RHR suction

b. The selected RHR loop will be recirculated approximately 30 minutes prior to taking a sample

c. Sample lines are installed on the discharge side of the RHR pumps, downstream of the pump check valves.

Suppression pool atmospheric samples are taken from taps on opposite sides of the pool proper. Each tap location is selected to maximize the distance to either a downcomer or safety/relief valve discharge sparger.

The sample station is provided with a sump to collect spillage, should it occur. The sump drains into the collector, which is then emptied back into the suppression pool. The collector contains provisions for purging. Should contamination take place, the spread of the contamination is precluded by the fact that it is enclosed and shielded and returned via a closed loop to the suppression pool and the collector has the capability to be purged to eliminate any further contamination.

The PASS isolation valves are independent of automatic isolation or safety injection signals. These isolation valves are always maintained in a closed position by administratively controlled, key-locked pushbuttons in the control room and are opened only when required for sampling, training, maintenance, or testing. Valve position is indicated on the control panel and operability is ensured by the use of Class 1E power. The Target Rock isolation valves conform to IEEE 323-1974 and IEEE 382-1972, and are environmentally qualified. It is estimated that conformance to these requirements ensures the operability of the valves for the period when secondary containment is inaccessible.

11.4.4.4.2 Radiological and Chemical Analysis

Onsite radiological and chemical analysis is provided (in accordance with the guidelines of NUREG-0737 and Reg. Guide 1.97) to quantify source-term radionuclides in the nuclide categories as discussed in Regulatory Guide 1.3. In conjunction with gamma isotopic analysis, selected radionuclides are quantified for use in procedure 78.000.15 (determination of extent of core damage). Analysis of hydrogen levels in the containment and suppression pool atmosphere is performed by gas chromatograph. The PASS can provide diluted liquid samples, which will subsequently minimize personnel exposure during analysis. The sensitivity of onsite liquid sample analysis will permit the measurement of nuclide concentration from approximately 1 μCi/g to 10 Ci/g. Background radiation levels in the onsite laboratory are such that an acceptably small error, less than a factor of 2, will result during sample analysis. The instruments will provide the operator with the radiological and chemical status of the reactor coolant. A remote analysis facility is provided and has the same capabilities as outlined above. Confirmatory analysis may also be performed by an offsite facility.

Automatic, on-line, analytical-type monitors are not used in the PASS. The sample station control panel contains indicators for pressure, temperature, flow, radiation, and conductivity.

A Fermi 2 Radiation Chemistry procedure has been developed for estimating core damage based on the concentrations of volatile and nonvolatile radionuclides. By appropriately normalizing actual Fermi plant data with reference plant data under postulated LOCA conditions, an estimation of core damage can be provided.

11.4.4.4.3 Evaluation

The sample lines up through the second isolation valve are designed to the nuclear classification of the process lines to which they connect. Remote manual isolation valves are provided on these lines. The PASS system is not safety related.

11.4.4.4.4 Testing

The PASS is operated periodically to ensure operability. Operability is demonstrated by obtaining a liquid and gas sample consistent with plant operating mode.

11.4.4.4.5 Procedures

Procedures for sample collection, sample transfer or transport, and sample analysis have been prepared and are summarized below.

All liquid samples are taken into septum bottles mounted on sampling needles. The sample panel is basically a bypass loop on the sample purge line. In the diluted sample lineup, the sample flows through a conductivity cell (readable range 0.1 to 1000 µmho/cm) and then through a ball valve. Flow through the sample panel is established, the valve is rotated 90°, and a syringe is used to flush the sample plus a measured volume of diluent through the valve and into the sample bottle. This provides an initial dilution and supplies a sample for further dilution and subsequent counting on a gamma spectrometer. Alternatively, the flow can be diverted through a sample bomb to obtain a large, pressurized volume. This volume can be circulated and depressurized into a gas sampling chamber where the dissolved gases are stripped from the coolant sample. A gas sample can then be obtained for gas chromatography and quantitative analysis of the dissolved gases associated with the liquid volume. Aliquots of this degassed liquid can also be taken for offsite chemical analyses requiring a relatively large sample. A radiation monitor in the liquid sample enclosure monitors liquid flow from the sample station to provide immediate assessment of the sample activity level. This monitor also provides information as to the effectiveness of the demineralized-water flushing of the sample system following sample operation.

For gas samples, appropriate sample-handling tools are used within the sample station. A gas sampler vial positioner and gas vial cask are also used. The gas vial is installed and removed by the use of the vial positioner through the front of the gas sampler. The vial is then manually dropped into the cask with the positioner, which allows the vial to be maintained about 3 ft from the individual performing the operation.

For liquid samples, a small-volume liquid sample is remotely obtained through the bottom of the sample station by the use of the small-volume cask and cask positioner. The cask positioner holds and positions the cask directly under the liquid sampler. The sample vial is manually raised within the cask to engage the hypodermic needles. When the sample vial has been filled, the bottle is manually withdrawn into the cask. The sample vial is always contained within lead shielding during this operation. The cask is then lowered and sealed before transport to the laboratory.

A large-volume cask and cask positioner containing a nominal 25 ml bottle within a lead-shielded cask are also provided. This sample bottle is raised from its location in the cask to the sample station needles for bottle filling. The sample station will deliver approximately 10 ml to this sample bottle. When filled, the bottle is withdrawn into the cask. The sample bottle is always shielded by lead when in position under the sample station and during the fill and withdraw cycles; thus operator exposure is controlled.

The cask is transported to the required position under the sample station by a dolly cask positioner. When in position, this cask is hydraulically elevated by a small handpump for contact with the sample station shielding under the liquid sample enclosure floor. The sample bottle is raised, held, and lowered by a simple push-pull cable. The cask is sealed by a threaded top plug that inserts above the sample bottle. The weight of this large-volume cask is approximately 700 lb.

Sample radionuclide analysis is performed in a counting laboratory that is shielded to limit exposure rates under accident conditions. Prepared samples are introduced into a gamma isotopic analysis system for automatic peak search and identification. It is calibrated for geometries required for PASS samples under accident conditions.

A wet analysis/sample preparation facility is employed to prepare the sample. Equipment is provided to minimize exposure to personnel.

For extended storage of samples, a shielded facility is available in the laboratory.

The analytical laboratory has the capability to perform the following postaccident analyses on samples acquired from primary coolant, suppression pool and containment air. The analysis of post-accident samples utilize established, routinely-performed analytical procedures to ensure chemistry laboratory technician proficiency.

<u>Primary coolant</u>

Total activity

Gamma isotopic analysis

Dissolved hydrogen

pH

Conductivity

Dissolved oxygen (performed if chloride is greater than 0.15 ppm and dissolved hydrogen is less than 10 cm^3/kg)

Boron (performed if boron is injected)

Chlorides

Containment air

Hydrogen

Oxygen

Gamma isotopic analysis

A more specific discussion of each analysis is given below.

11.4.4.4.5.1 Gamma Isotopic and Total Activity Analysis

Gamma isotopic analysis of postaccident samples will follow normal counting room procedures. Gas samples will be counted in standard offgas sample vials, and liquid samples will be counted in standard sample bottles.

Previously established geometries and calibration curves for liquids and gases will be readily available and regularly updated. Gamma isotopic analysis will handle the acquired samples.

A total activity determination based on the gamma isotopic analysis will be used for the gross beta and gamma activity. The determination of total activity from the gamma isotopic analysis will minimize personnel exposure.

11.4.4.4.5.2 Dissolved-Hydrogen Analysis

Dissolved hydrogen will be determined by gas chromatography. Gas chromatography has been demonstrated to be successful in the determination of hydrogen in the presence of gamma radiation through testing and analysis by Babcock & Wilcox on TMI-2 post-accident gas samples.

11.4.4.4.5.3 pH Analysis

The pH will be determined by micro-pH probe. Confirmatory analysis may be performed by an offsite analytical laboratory.

11.4.4.4.5.4 Conductivity Analysis

The PASS is equipped with a 0.1-cm^{-1} conductivity cell. The conductivity meter has a linear scale with a six-position range- selector switch to give a conductivity range from 0.1 to 1000 μs/cm.

11.4.4.4.5.5 Dissolved-Oxygen Analysis

The dissolved oxygen concentration will be assumed to be less than 0.1 ppm if the measured positive hydrogen residual is greater than 10 cc/kg. If necessary or desirable, the oxygen concentrations will be measured directly, when ALARA conditions so permit.

11.4.4.4.5.6 Boron Analysis

Boron analysis will be performed by using the carminic acid colorimetric method, if boron injection is initiated.

11.4.4.4.5.7 Chloride Analysis

Chloride analysis may be performed by an offsite analytical laboratory.

11.4.5 Inservice Inspection, Calibration, and Maintenance

11.4.5.1 Inspections and Tests

During reactor operation, daily checks of monitor operability are made by observing channel behavior. At monthly intervals during reactor operation, the detector response of each monitor to remotely positioned check sources supplied as specified in the Offsite Dose Calculation Manual radiological effluent controls is recorded together with the instrument background count rate to ensure proper functioning of the monitors.

Some channels have electronic testing and calibrating equipment, which permits channel testing without relocating or dismounting channel components. An internal trip test circuit, adjustable over the full range of the readout meter, is normally used for testing. Each channel is tested at an interval specified in the Offsite Dose Calculation Manual radiological effluent controls prior to performing a calibration check. Verification of valve operation, ventilation diversion, or other trip function is done at this time if it can be done without jeopardizing plant safety. The tests are documented.

11.4.5.2 Calibration

Continuous radiation monitor calibrations are traceable to certified National Bureau of Standards or commercial radionuclide standards. The source-detector geometry during primary calibration approximates the sample-detector geometry in actual use. Secondary standards that were counted in reproducible geometry during the primary calibration are supplied with each continuous monitor for calibration after installation. The check sources have also been related to the primary standard. Each continuous monitor is calibrated every once per fuel cycle during plant operation, or during the refueling outage if the detector is not readily accessible, using the secondary radionuclide standard. A calibration can also be performed by using liquid or gaseous radionuclide standards or by analyzing liquid, particulate, iodine, or gaseous grab samples with laboratory instruments.

11.4.5.3 Maintenance

The channel recorders are serviced and maintained on a periodic basis or per manufacturers' recommendations to ensure reliable operation. Such maintenance includes cleaning, lubrication, and assurance of free movement of the recorder in addition to the replacement or adjustment of any components required after performing a test or calibration check. If any work is performed that could affect the calibration, a recalibration is performed at completion of the work.

11.4.5.4 Laboratory Radiation Detectors

Counting efficiencies of all laboratory radiation detectors are determined with certified radionuclide standards having accuracy better than 6 percent. The gamma isotopic analysis detectors are calibrated in terms of photopeak efficiency versus gamma energy and counting efficiencies for individual gamma emitters.

The response of each laboratory detector to alpha, beta, or gamma check sources is recorded during the primary calibration with the certified radionuclide standards. These check sources are fabricated to maintain their integrity during repeated handling. The response of each counter to the appropriate check source and the background count rate of each detector are determined at least weekly. A control chart showing check source response is maintained for each laboratory counter. A control chart showing counter background is maintained for each laboratory counter for which no automatic background correction of results is performed. Instrument responses falling outside statistical limits imposed by counting statistics are investigated and the instruments serviced as required.

TABLE 11.4-1 PROCESS RADIATION MONITORING SYSTEM (GASEOUS AND AIRBORNE MONITORS)

PRM Number	Monitor	Configuration	Type	Detector Sensitivity	Readout Range	Principal Radionuclides Measured	Expected Activity	Alarms & Trips	Control Function
1.	Primary Containment Radiation Monitor (GA)[a]	Offline						Low Flow	
	Gas (T50-N003)		β-Scint.	30 cpm/pCi/cm^3	10^1-10^7 cpm	Xe-133[b] Kr-85		Failure High	None
2.	Off-Gas Radiation Monitor (GE/Mirion)	Offline						Low Flow	
	Gas - Log Scale (N004A, N004B)		γ-Ion Chamber	3.7 x 10^{-10} Amp/R/h	10^0-10^6 mR/h	Xe-133 Xe-135 Xe-138	Off-gas activity defined in Table 11.3-1	Failure High High-High = (c)	None
	Gas - Linear Scale (N005)		γ-Ion Chamber	3.7 x 10^{-10} Amp/R/h	10^0-10^6 mR/h	Kr-85M Kr-87 Kr-88		None	
3.	Main Steam Line Radiation Monitor (GE) Steam (N006A, N006B, N006C, N006D) (N006E, N006F - Spares)	Adjacent to steam lines	γ-Ion Chamber	3.7 x 10^{-10} Amp/R/h	10^0-10^6 mR/h	N-16 O-19 Xe-133 Xe-135 Xe-138	Steam line activity defined in Section 11.1	Failure High = 1.5 x background High - High = 3 x background	1 High-High alarm in each trip system trips the gland seal exhausters and trips the condenser mechanical vacuum pumps and line valves. 2 High-High alarms in one trip system close the associated reactor water sample system valve.
4.	Reactor Building Ventilation Exhaust Radiation Monitor (GA)[a] Air (N408, N410)	Offline	β-Scint.	30 cpm/pCi/cm^3	10^1-10^7 cpm	Xe-133[b] Kr-85	Reactor Building activity defined in Table 11.3-1	Low Flow Failure High High-High = (c)	1 High-High or 2 (one from each detector) Low alarms start the SGTS, close the P/C vent valves, trip & isolate R/B vent system, isolate control center and initiate emergency recirculation mode for the control center ventilation system.
5.	Off-Gas Vent Pipe Radiation Monitor (GE) Gas (N105, N106)[c]	N/A	N/A	N/A	N/A			N/A	N/A
6.	Radwaste Building Ventilation Exhaust Radiation Monitor (Eber)[d] Air (N503A through N503G)	Offline	Part. Filter Iodine Filter α-Solid-State β-Scint. γ-Scint. GM Tube GM Tube	60 cpm/mR/h	0-1.2E6 cpm 0-1.2E6 cpm 0-1.2E6 cpm 0-1.2E6 cpm	Radon-Thoron Kr-85[b] I-131 Xe-133/Kr-85[b] Cs-137[b]	Negligible activity discussed in Section 11.3	Failure (external, channel high, or channel low) High radiation level or flow out of limits Alert radiation level	1 High radiation level alarm trips radwaste bldg. vent fan.
7.	Turbine Building Ventilation Exhaust Radiation Monitor (Eber)[d] Air (N504A through N504G)	Offline	Part. Filter Iodine Filter α-Solid-State β-Scint. γ-Scint. GM Tube GM Tube	60 cpm/mR/h	0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm	Radon-Thoron Kr-85[b] I-131 Xe-133/Kr-85[b] Cs-137[b]	Turbine Building activity defined in Table 11.3-1	Failure (External, channel High, or channel low) High Radiation Level or Flow Out of Limits [c] Alert Radiation Level [c]	1 High radiation level alarm trips turbine bldg. vent fan.
8	Deleted								
9.	Standby Gas Treatment System Radiation Monitor (Eber)[d] Air (N510A through N516A) and N510B through N516B)	Offline	Part. Filter Iodine Filter α-Solid-State β-Scint. γ-Scint. GM Tube GM Tube	60 cpm/mR/h	0 to 2.4E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm	Radon-Thoron Kr-85[b] I-131 Xe-133/Kr-85[b] Cs-137[b]	Activity discussed in Chapter 6	Failure (External, channel High, or channel Low) High Radiation Level or Flow Out of Limits [c] Alert Radiation Level [c]	None
10.	Reactor Building Exhaust Plenum Radiation Monitor (Eber)[d]	Offline	Part. Filter Iodine Filter α-Solid-State		0 to 1.2E6 cpm	Radon-Thoron	Reactor Building Activity defined in Table 11.3-1	Failure (External, channel High, or channel Low) High Radiation Level or Flow Out of	None

TABLE 11.4-1 PROCESS RADIATION MONITORING SYSTEM (GASEOUS AND AIRBORNE MONITORS)

PRM Number	Monitor	Configuration	Type	Detector Sensitivity	Readout Range	Principal Radionuclides Measured	Expected Activity	Alarms & Trips	Control Function
	Air (N507A through N507H)		β-Scint. γ-Scint. GM Tube GM Tube	 80 cpm/mR/h	0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm	Kr-85[b] I-131 Xe-133/Kr-85[b] Cs-137[b]		Limits[c] Alert Radiation Level[c]	
11.	Standby Gas Treatment System Postaccident Radiation Monitor System (N520A through N523A and N520B through N523B)	Offline	GM Tube (SA-14) GM Tube (SA-15) GM Tube (SA-16) GM Tube (background)	40 cpm/γ-Bq-MeV/cc 1.1E-2 cpm/γ-Bq-MeV/cc 80 cpm/mR/h 80 cpm/mR/h	0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm	Xe-133/Kr-85 Xe-133/Kr-85 I-131 Cs-137	Postaccident Noble Gas Activity	Failure (External, channel High, or channel Low) High Radiation Level or Flow Out of Limits[c] Alert Radiation Level[c]	None
12.	Fuel Pool Ventilation Exhaust Radiation Monitor (GE) Air (N010A, N010B, N010C, N010D)	Adjacent to Vent Lines	GM Tube	28 mR/h per μ Ci/cm³	10^{-2}-10^{2} mR/h	Xe-133[b] Xe-135 I-131 Kr-85M	Activity discussed in Chapter 6	Failure (Downscale/Inop) High High-High	1 High-High or 2 Failure alarms (1 from each detector on one leg) start the SGTS, close the P/C vent valves, trip & isolate R/B Vent System, isolate control center and initiate emergency recirculation mode for the control center ventilation system.
13.	Control Center Makeup Air Radiation Monitor (GA)[a] Air (N409, N413)	Offline	β-Scint.	30 cpm/pCi/cm³	10^{1}-10^{7} cpm	Xe-133[b] Kr-85	Activity discussed in Chapter 6	Failure High High-High = (c)	1 High-High or 2 Low alarms (1 from each detector) isolate the control center and initiate emergency recirculation mode for the control center ventilation system
14.	Two Minute Holdup Pipe Exhaust Radiation Monitor (GA)[a] Gas (N414, N415)	Adjacent to Line	γ-Scint.	10 cpm/pCi/cm³	10^{1}-10^{7} cpm	Xe-133[b] Kr-85	Activity defined in Table 11.3-2	Failure High = 1.5 x background High-High	None
15.	Control Center Emergency Air South Inlet Radiation Monitor (GA)[a] (N436A, N436B)	Offline	β-Scint.	40 cpm/pCi/cm³	10^{1}-10^{7} cpm	Xe-133[b] Kr-85	Activity discussed in Chapter 6	Low Flow Failure High[c]	Trip isolation damper of non selected inlet
16.	Control Center Emergency Air North Inlet Radiation Monitor (GA)[a] (N437A, N437B)	Offline	β-Scint.	40 cpm/pCi/cm³	10^{1}-10^{7} cpm	Xe-133[b] Kr-85	Activity discussed in Chapter 6	Low Flow Failure High[c]	Trip isolation damper of non selected inlet
17.	Onsite Storage Facility (OSSF) Ventilator Exhaust Radiation Monitor (N508A through N508G)	Offline	Part. Filter Iodine Filter α-Solid-State β-Scint. γ-Scint. GM Tube GM Tube	 60 cpm/mR/h	 0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm 0 to 1.2E6 cpm	 Radon-Thoron Kr-85[b] I-131 Xe-133/Kr-85[b] Cs-137[b]	Radwaste Building Activity defined in Table 11.3-1	Failure (External, channel High, or channel Low) High Radiation Level or Flow Out of Limits[c] Alert Radiation Level[c]	None
18.	Containment High Range Radiation Monitor	Area environment	γ-Ion Chamber	1 x 10^{-11} amp/R/h	10^{0}-10^{8} R/h	Xe-133[b] Kr-85 I-131	Post-LOCA Source Term	Failure Alert High	Primary containment postaccident monitor (NUREG-0737, II.F.1-3)

[a] (GA) = General Atomic Technologies (Gulf).

[b] Sensitivity based upon this radionuclide.

[c] The alarm point will be set, based upon the activity, radionuclides, and dilution factor, so that the discharge concentration in the decant line is less than 10 CFR Part 20 Appendix B, Table II, column 2 limits.

[d] Alarm point to be determined in field.

[e] Ratemeter removed and supporting components abandoned in place.

TABLE 11.4-2 PROCESS RADIATION MONITORING SYSTEM (LIQUID MONITORS)

PRM Number	Monitor	Configuration	Type	Detector Sensitivity	Readout Range	Principal Radioniclides Measures	Expected Activity	Alarms and Trips	Control Function
19.	Radwaste Effluent Radiation Monitor (N007) (GE/Mirion)	Inline	γ-Scint.	1 x 10^{-4} μCi/ml estimated	10^{-1} – 10^{6} cps	Cs-137[b] Co-60	Discussed in Section 11.2	Failure High-High[c]	High-High alarm closes discharge valve
20.	General Service Water Effluent Radiation Monitor (N008) (GE/Mirion)	Inline	γ-Scint.	5 x 10^{-9} μCi/em^{3} estimated	10^{-1} – 10^{6} cps	Cs-137[b] Co-60	Less than minimum detector sensitivity	Failure High = (d)	None
21.	Reactor Building Closed Cooling Water Radiation Monitor (N009) (GE/Mirion)	Inline	γ-Scint.	1 x 10^{-4} μCi/ml estimated	10^{-1} – 10^{6} cps	Cs-137[b] Co-60	Less than minimum detector sensitivity	Failure High = (d)	None
22.	Emergency Equipment Cooling Water Radiation Monitor (N400A, N400B) (GA)[a]	Inline	γ-Scint.	100 cpm/pCi/ml	10^{-1} – 10^{7} cpm	Cs-137[b] Co-60	Less than minimum detector sensitivity	Failure High = (d)	None
23.	Residual Heat Removal Service Water Radiation Monitor (N401A, N401B) (GA)[a]	Offline	γ-Scint.	200 cpm/pCi/ml	10^{-1} – 10^{7} cpm	Cs-137[b] Co-60	Less than minimum detector sensitivity	Low Flow Failure High = (d) High-High = (d)	None
24.	Circulating Water Reservoir Decant Line Radiation Monitor (N402) (GA)[a]	Offline	γ-Scint.	200 cpm/pCi/ml	10^{-1} – 10^{7} cpm	Cs-137[b] Co-60	Less than minimum detector sensitivity	Low Flow Failure High = (d) High-High = (d)	None

[a] (GA) = General Atomic Technologies (Gulf).

[b] Sensitivity based upon this radionuclide.

[c] The alarm point will be set, based upon the activity, radionuclides, and dilution factor, so that the discharge concentration in the decant line is less than 10 CFR Part 20 Appendix B, Table II, column 2 limits.

[d] Alarm point to be determined in field.

TABLE 11.4-3 PROCESS RADIATION MONITORING SYSTEM ENVIRONMENTAL DESIGN CONDITIONS

Radiation Monitor System	Pressure (psig)	Temperature (°F)	Relative Humidity (%)
Primary containment (GA)[a]			
sample systems	-2 to 56	135 to 340	40 to 100
equipment and instruments	0	65 to 130	40 to 95
Main steam line detectors (GE)[b]	0 to 250	392 max	-
Offgas vent pipe (GE)			
sample systems[c]	0 to 375	480 max	-
All remaining GE and Mirion subsystems			
equipment and instruments	0	32 to 140	20 to 98
All remaining Gulf subsystems			
sample systems	0 to 156	32 to 120	-
equipment and instruments	0	50 to 135	0 to 95
Eberline Sping 3/Sping 4	-	32 to 122	-
Eberline AXM-1			
sample systems	10 in. Hg to 30 psia	32 to 120	-
electronics	-	32 to 122	-

[a] GA = General Atomics Technologies (Gulf).
[b] GE = General Electric Company.
[c] Ratemeter removed and supporting components abandoned in place.

TABLE 11.4-4 AFFECTED EFFLUENT CHANNELS

Location	Instrument Number	Noble Gas Required Range ($\mu Ci/cm^3$ ^{133}Xe)		Eberline Model	Noble Gas Channel – Eberline Equipment Range		
Radwaste building ventilation exhaust	D11-N503A through D11-N503G	1×10^{-7}	1×10^{2}	Sping 3	1×10^{-7}	1×10^{3}	$\mu Ci/cm^3$ for ^{133}Xe
Turbine building ventilation exhaust	D11-N504A through D11-N504G	1×10^{-7}	1×10^{3}	Sping 3	1×10^{-7}	1×10^{3}	$\mu Ci/cm^3$ for ^{133}Xe
Reactor building exhaust plenum	D11-N507A through D11-N507H	1×10^{-7}	1×10^{4}	Sping 4	1×10^{-7}	1×10^{5}	$\mu Ci/cm^3$ for ^{133}Xe
Standby gas treatment system (Divisions I and II)	D11-N510A through D11-N516A D11-N510B through D11-N516B D11-N520A through D11-N523A D11-N520B through D11-N523B	1×10^{-7}	1×10^{5}	Sping 3 AXM-1 with particulate and iodine collector to 10^{2} $\mu Ci/cm^3$	1×10^{-7} 1×10^{-4}	4×10^{2} 1×10^{5}	$\mu Ci/cm^3$ for ^{133}Xe $\mu Ci/cm^3$ for ^{133}Xe

TABLE 11.4-5 RADIOLOGICAL ANALYSIS SUMMARY OF LIQUID PROCESS SAMPLES

Sample Description	Grab Sample Frequency	Analysis	Lower Limit of Detection (LLD) (μCi/ml)	Purpose
1. Reactor coolant	7 days	Dose equivalent ^{131}I	10^{-7}(b)	Evaluate fuel-cladding integrity
2. Reactor water cleanup system	Weekly	Gamma isotopic	10^{-6}(a)	Evaluate cleanup efficiency
3. Condenser demineralizer				
Influent and effluent	Monthly	Gamma isotopic	10^{-6}(a)	Evaluate decontamination factor
4. Condensate storage tank	Weekly	Gamma isotopic	10^{-6}(a)	Tank inventory
5. Condensate return tank	Weekly	Gamma isotopic	10^{-6}(a)	Tank inventory
6. Fuel pool filter-demineralizer				
Inlet and outlet	Periodically	Gamma isotopic	10^{-6}(a)	Evaluate decontamination factor
7. Evaporator bottoms	Periodically	Gamma isotopic	10^{-6}(a)	Evaluate performance
8. Evaporator distillate	Periodically	Gamma isotopic	10^{-6}(a)	Evaluate evaporator performance

(a) The principal gamma emitters for which the LLD value applies are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99,Cs-134 Cs-137, Ce-141 and Ce-144.

(b) The LLD value applies to I-131.

TABLE 11.4-6 RADIOLOGICAL ANALYSIS SUMMARY OF GASEOUS PROCESS SAMPLES

Sample Description	Sample Frequency	Analysis	Sensitivity ($\mu Ci/cm^3$)	Purpose
Offgas pretreatment	Weekly	Gamma isotopic	10^{-10}	Determine offgas activity

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Refer to Plant Drawing I-2679-01

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FIGURE 11.4-1

PRIMARY CONTAINMENT MONITORING SYSTEM

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Refer to Plant Drawing I-2181-01

Fermi 2

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FIGURE 11.4-2

PROCESS RADIATION MONITORING SYSTEM
GENERAL DESCRIPTION

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Refer to Plant Drawing I-2181-02

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FIGURE 11.4-3

PROCESS RADIATION MONITORING SYSTEM
GE SUPPLIED SUBSYSTEMS

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Refer to Plant Drawing I-2181-06

FIGURE 11.4-4

PROCESS RADIATION MONITORING SYSTEM
SUBSYSTEM DIAGRAM

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Refer to Plant Drawing I-2181-03

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FIGURE 11.4-5

PROCESS RADIATION MONITORING SYSTEM
GULF SUPPLIED SUBSYSTEM

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Refer to Plant Drawing I-2400-25

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FIGURE 11.4-6, SHEET 1

POSTACCIDENT SAMPLING SYSTEM

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Refer to Plant Drawing I-2400-26

FIGURE 11.4-6, SHEET 2

POSTACCIDENT SAMPLING SYSTEM

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Refer to Plant Drawing I-2400-15

Figure Intentionally Removed
Refer to Plant Drawing I-2400-11

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FIGURE 11.4-8

SIMPLIFIED POSTACCIDENT SAMPLE FLOW DIAGRAM

11.5 SOLID RADWASTE SYSTEM

The Fermi 2 Solid Radwaste System is intended primarily to process and package radwaste for ultimate burial/disposal. It could be considered as three separate systems. The first is for handling dry waste (DAW), whereas the other two are for handling waste resulting from processing liquids. One of these is a vendor supplied system, located in the radwaste onsite storage facility (OSSF), which normally processes liquid radwaste by dewatering or solidification, etc. The second is the asphalt-extruder process system, located in the radwaste building. Each of these systems would produce end products which can be shipped and disposed of in full compliance with the appropriate state and federal regulations.

Note: Section 11.5 describes the as-designed and as-installed design basis of the Radwaste Solidification System (asphalt extruder system). However, this system has never been operational. Pre-operational testing of this system was suspended in 1987 before testing was completed (see Section 14.1.1). Part of the system remains in place. Equipment was removed by modification (e.g., drum turntable, Drum Capper/Seamer, Transfer car, conveyors and conveyor drive units). The centrifuge feed line from the centrifuge feed tank is also capped by a modification. The original design-basis description, design data, figures, and tables for the solidification system are being retained in Section 11.5 and in other pertinent sections of this UFSAR as historical information. Currently, full-time “solid radwaste” processing takes place in the Onsite Storage Facility with a vendor-supplied system, as described in UFSAR Sections 11.5 and 11.7.

The installed Fermi 2 solid radwaste system is the radwaste volume reduction and solidification system, which was designed by the Werner-Pfleiderer Corporation; the volume reduction and solidification system is described in detail in a topical report (WPC-VRS-1) through Amendment II, approved for use as a reference by the NRC on April 12, 1978. This system, which includes the VRS-T 120 extruder/evaporator, is described in Subsection 11.5.3.2.16.7.

The key difference between the design described in the referenced topical report and the Fermi 2 design is the feed concept. The topical report describes a slurry feed, whereas the Fermi 2 plant was originally designed to use a centrifuge feed concept with a slurry feed as a backup. Subsection 11.5.3.2.16.2 describes the primary method of feed.

Three subsystems described in the topical report are not included in the Fermi 2 scope of supply. First, the distillate skid has been replaced by a process that returns the water to other parts of the radwaste system for cleanup. Second, the lubrication oil skid was eliminated by using an extruder gear box design with integral lube oil circulation capability. Third, the overhead bridge crane listed in the topical report has been replaced with a monorail.

11.5.1 Design Objectives

The objectives of the solid radwaste system are to collect, process (solidify or dewater), and package liquid and wet solid wastes and slurries from the liquid radwaste system, the reactor water cleanup (RWCU) system, the fuel pool cooling and cleanup system, and the condensate demineralizer system. The solid radwaste system collects and processes the increased volumes of wastes and slurries that are produced during anticipated operational occurrences without affecting the operation or availability of the plant. It processes, packages, handles, and temporarily stores radioactive wastes and provides a means to transfer solidified or dewatered wastes to vehicles for transport ultimately to an offsite burial facility.

A subsystem also packages, stores, and prepares for transport compressible dry wastes generated during operation of the plant. These wastes include paper, rags, and other disposables that are normally processed conveniently by compaction.

The process equipment and disposable containers prevent the release of significant quantities of radioactive material, and keep the radiation exposure of plant personnel and the general public as low as reasonably achievable (ALARA).

The system is designed to:

a. Collect and solidify or otherwise process radioactive wastes, which consist primarily of evaporator bottoms, filter backwash, tank sludge letdown, and spent resins

b. Provide for the transfer of decantate, resin sluice water, etc., to the liquid radwaste system for processing and eventual reuse or controlled discharge

c. Package, handle, and temporarily store processed, solidified, and compressed radioactive wastes generated as a result of normal operation of the plant, including those from anticipated operational occurrences

d. Provide a means to transfer the packaged wastes to vehicles for transport ultimately to an offsite burial facility

e. Package radioactive wastes in a manner that will allow shipment and burial in accordance with all applicable federal and state regulations

f. Provide means for processing or the solidification of wet wastes that results in freestanding water in the final product less than that required for disposal

g. Provide means to transfer wet wastes to the vendor-supplied system in the OSSF

h. Compact dry waste in a container that is suitable for transportation and eventual burial

i. Protect plant personnel from radiation exposure and incorporate the basic ALARA principles through the use of automated systems, shielding, and remotely operated instrumentation and controls.

Fermi 2 is operated in accordance with its process control program (PCP). The purpose of this PCP is to provide reasonable assurance of the complete solidification, encapsulation, or dewatering of processed wastes and the absence of free water in excess of required limits in the processed waste. For vendor-supplied processing services, a PCP approved by Edison in accordance with Section 17.2 will be utilized. This is described in greater detail in Subsection 11.5.6.

11.5.2 System Inputs

Table 11.5-1 lists the conservative values for all major inputs to the solid radwaste system. This table shows that the majority of the input to the solid radwaste system is from the condensate filter-demineralizer backwash when the two etched-disk filters are in use. On the other hand, when the precoat filters are used in place of the etched-disk units, their inputs would be the largest contributor to the totals.

11.5.3 System and Equipment Description

11.5.3.1 System Description

11.5.3.1.1 General

The solid radwaste system collects, processes, and packages the liquid wastes, wet solid wastes, and slurries from the liquid radwaste system, the RWCU system, the fuel pool cooling and cleanup system, and the condensate demineralizer system. The solid waste package produced by the process must be suitable for transportation to an offsite burial facility. In the course of processing liquid inputs, the solid radwaste system must be able to separate solids from the incoming slurries, which maximizes the amount of liquid that can be returned to the liquid radwaste system for recycling to the plant.

The solid radwaste system will receive periodic inputs from a variety of plant sources. Since the operator should know in advance of major impending inputs of waste batches to the solid radwaste system, system operation can usually be planned before most inputs are received.

The design and classification of the solid radwaste system is essentially the same as the liquid system, and therefore the general discussion of Subsection 11.2.3.1 applies also to the solid system. The principal design parameters for the major components are listed in Table 11.5-2.

The inputs to the solid radwaste system consist of filter backwashes of several types, evaporator concentrates, and spent bead resin. By volume, most of this input is liquid. A major goal of the solid radwaste system is to allow solids in the liquid inputs to settle, leaving a relatively clear decantate, which is sent to the liquid radwaste system for processing. The remaining solids are pumped to an intermediate set of collection tanks from which the sludge (resin beads, powdered resin, and tank sludge) is pumped for final processing, either to the vendor system in the OSSF or to the asphalt solidification system. With the centrifuge currently in a non-functional configuration, the wet waste can be forwarded directly to the solidification process, where the liquid is driven from the waste, leaving only a dry, solid product. One exception to this process is the evaporator concentrates source, which is pumped directly to the solidification process without an intermediate solids settling step. The drains from the high-chloride laboratory are also fed directly to the extruder/ evaporator via the chloride waste tank and the concentrates feed tank.

For the installed system, asphalt is used as the solidification binder. The asphalt and waste are heated and mixed in an extruder/evaporator that simultaneously removes the remaining moisture from the waste while producing a homogeneous product. When the asphalt/waste mixture cools, it forms a solid, homogeneous product that has no freestanding water. The asphalt storage tank is located at grade, on the north side of the radwaste building, opposite the floor drain filter. The radiation zone in this area is designed to be less than 1 mrem/hr and is therefore in compliance with Branch Technical Position (BTP) ETSB 11-3, which states that solidification agents should be stored in low-radiation areas that are less than 2.5 mrem/hr.

11.5.3.1.2 Solid Radwaste System Process Rates

The solid radwaste system uses a batch-type process. Individual batches of inputs from the sources listed in Table 11.5-1 are delivered to the solid radwaste system collection tanks. The radwaste operator will be aware of an expected input for the etched-disk filter backwash, which occurs automatically, and also for the waste collector and floor drain precoat filter backwashes. Thus, the minimum processing rates required for the solid radwaste system components are based on the system's ability to pump out a tank of its decantate, sludge, or bead and powdered resin in a time frame consistent with the incoming batch frequency.

In several cases, the solid radwaste system processing rate and pump size are determined by the recirculation conditions needed to mix tanks or by the flow rate needed to avoid plugging. Design parameters for components of the solid radwaste system are given in Table 11.5-2.

11.5.3.1.3 Chemistry of Inputs

The chemical characteristics of the solid radwaste system sources are dominated by their high concentrations of suspended and dissolved solids. Most of the suspended solids consist of spent powdered and bead resin particles, which usually are fairly large, at least 45μ. Dissolved-solids concentrations from the evaporator are expected to average less than 8 percent by weight. Table 11.5-1 lists the assumed batch solids content of each stream.

The pH of all streams except the evaporator concentrates is expected to be fairly neutral, between 6 and 8. The pH of the waste in the chloride waste tank is neutral because it will be preneutralized in the laboratory before draining to the tank. The evaporator-concentrates stream pH could fluctuate extensively, and therefore can be adjusted to the range 7 to 9 before processing by the extruder/evaporator. The pH of the feed to the extruder/evaporator process is controlled only to protect the machine's construction materials.

11.5.3.1.4 Dry Wastes

Typical values of the radionuclide content and volumes of dry solid waste for BWRs are provided in the table below:

Radionuclide Content and Volumes of Dry Solid Waste

Radionuclide	Activity (percent)	Total Annual Activity (Ci)
58_{Co}	24.0	0.96
60_{Co}	7.2	0.29
51_{Cr}	62.0	2.48

Radionuclide Content and Volumes of Dry Solid Waste

Radionuclide	Activity (percent)	Total Annual Activity (Ci)
^{95}Nb	6.8	0.27
^{137}Cs	traces	--
Total	100.0	4.00

The data in the table were obtained from AIF/NESP-0800, "A Survey and Evaluation of Handling and Disposing of Solid Low- Level Nuclear Fuel Cycle Wastes," October 1976. An average gross curie content of 1.0 Ci/1000 ft^3 was used in the above estimate. This was obtained from a range of 0.001 to 4.0 Ci/1000 ft^3 (obtained from the above reference). The average volume of compacted trash is given in the above reference as 6000 ft^3/yr. If the data are corrected for skewing, an average of 4000 ft^3/yr is obtained; this average was used. The volume of trash generated per year is primarily a function of housekeeping activities and is not heavily influenced by plant size. It should be noted that the Fermi 2 design includes a high-efficiency compactor. The 6000 ft^3/yr number is suspect, and it probably includes dry trash that has not been compacted. The 4000 ft^3/yr number agrees fairly well with the annual upper limit of 500 drums (3700 ft^3) from "A Study of Nuclear Fuel Cycle Radioactive Solid Waste Management," NESP Low-Level Waste Handling and Disposal Alternatives, March 1976.

Dry wastes (usually of low activity) can normally be handled by direct contact. These wastes are collected in bags or containers located in appropriate zones at certain locations within the plant, as determined by the volume of waste generated during plant operation and maintenance. The filled waste containers are sealed and transported for further processing.

Compressible, dry, low-activity wastes can be compacted into standard 55-gal drums by a hydraulic compactor. First, an empty drum is placed on the support plate at the front of the compactor and is moved into position under the ram by a hydraulic cylinder. Then a hinged work table is swung into position against the drum, clamping it in place and providing a seal for the air space above the drum that holds loose waste in place for compaction. Loose waste is deposited in the drum through an access door above the work table. Finally, the access door is closed and locked, and the loose waste is compacted.

An air evacuation system provided by a built-in fan prevents the escape of airborne contaminants generated during the compaction cycle. The fan directs the air trapped above the drum through a roughing filter and 0.3-μm high-efficiency particulate air (HEPA) filters. Differential pressure gages on the compactor control panel indicate when the filters require replacement. Used filters are normally dropped into a drum and compacted.

Noncompressible wastes are normally packaged in strong, tight containers. Because of its low activity, this waste can be stored until enough is accumulated to permit its economical transport to an offsite burial ground for final disposal. During outages or other heavy trash-generating periods, or for packaging of large pieces of noncompactible materials, boxes may also be used to limit handling and ensure packaging efficiency.

Activated charcoal, HEPA filters, and other dry wastes are treated as radioactively contaminated solids. Those that normally do not require solidification processing are packaged and disposed of in accordance with applicable regulations.

11.5.3.1.5 Wet Wastes

Wet wastes consist of spent bead and powdered resins, filter sludge, and evaporator concentrates (when running). They normally result as by-products from liquid processing systems and contain liquid components that require immobilization or removal. By evaporating the liquid components and combining the residues with the asphalt binding agent when the asphalt-extruder system is used, a homogeneous solid matrix of reduced volume and free of water is developed prior to offsite shipment. When the vendor-supplied system is used, wastes can be dewatered or solidified.

Spent cartridge-filter elements may be packaged in a shielded receptacle containing a suitable absorber. If necessary, they will be stored and shipped in the same manner as other radwaste in accordance with applicable regulations.

11.5.3.1.6 Irradiated Reactor Components

Because of its high activation and contamination levels, used reactor equipment is normally stored in the spent-fuel storage pool to allow sufficient radioactive decay before its removal to in-plant or offsite storage and its final disposal in shielded containers or casks.

11.5.3.2 Equipment Description

11.5.3.2.1 General

The selection of the solid radwaste system process components was based on the primary process requirement to dewater solid-laden waste inputs. The process of removing the moisture from the solid waste streams provides a volume reduction of the incoming feed, thus reducing the ultimate amount of waste to be disposed of. The liquid generated by the dewatering processes is returned to the liquid radwaste system for further processing.

Solid wastes are collected in several different ways. Liquid wastes with a low solid content are received in the condensate phase separators, where they are allowed to settle; then the clarified decantate is pumped to the waste clarifier tank. Over-flow from the clarifier tank is directed into the waste surge tank and finally into the liquid radwaste system (waste collection subsystem). The sludges from all three tanks are normally fed to the centrifuge feed tank. Other wastes with higher solids content are added to this basic line at intermediate points. The sludge from the RWCU phase separator is fed directly to the centrifuge feed tank. The spent-resin tank feeds either the centrifuge feed tank or the spent-resin slurry feed tank, which feeds directly into the extruder/ evaporator. The evaporator bottoms and the chloride wastes are fed to the concen-trate feed tank, where a caustic is added for neutralization, before they are pumped into the extruder/evaporator.

The two condensate phase separators perform a primary clarification of the waste sources that contain high suspended solids (excluding evaporator bottoms and exhausted demineralizer bead resins). After collection, the wastes are allowed to settle, clarified liquid is decanted off the top, and sludge is drawn off the bottom.

The waste clarifier tank performs a secondary clarification of condensate phase separator decantate and other wastes with low concentrations of suspended solids. The influent wastes flow through the waste clarifier tank, where the solids settle to the bottom and the clarified liquid overflows into the waste surge tank. From the waste surge tank, the clarified liquid is forwarded to the waste collector subsystem for processing. Sludge collected in the bottom of the clarifier tank is pumped out periodically to the centrifuge feed tank. Any solids that might collect in the waste surge tank can be blown down to the condensate phase separators. The waste clarifier tank also provides a source of relatively clear water, which is used for diluting the contents of the centrifuge feed tank and transporting resins from the spent-resin tank.

The spent-resin tank receives bead-type ion-exchange resins and demineralizer flushes that are produced by dumping the exhausted floor drain and waste collector demineralizer beds. The spent resins and flush water are forwarded to the centrifuge feed tank.

To summarize, the centrifuge feed tank receives concentrated sludges from the condensate phase separators, waste clarifier tank, cleanup phase separators, and spent-resin tank. The feedtank contents are mixed by recirculation and mechanical agitation to give a consistent concentration; a side stream is taken off the recirculation loop for ultimate processing, either to the vendor equipment in the OSSF or to the asphalt-extruder system. When the extruder system is used, high dissolved-solid waste from the concentrates feed tank is sent to the unit, where the waste is dried and mixed with asphalt. The asphalt/solid mixture is emptied into drums that are capped and sent to storage for eventual offsite disposal. Distillate from the evaporation process is returned to the waste clarifier tank. The sludge, originally routed to the centrifuge for dewatering, can be routed directly to the extruder/evaporator. Similarly, spent resin can be routed to the alternative spent-resin slurry feed tank for forwarding to the extruder/evaporator.

11.5.3.2.2 Normal Waste Generation and Holdup Rates

For normal waste generation rates, the holdup capacity provided in the radwaste system for spent resins and filter-demineralizer sludges is described below.

11.5.3.2.2.1 Sludge Collection

The RWCU system has two phase separators, each designed to hold the sludge from 10 RWCU filter-demineralizer backwashes (a total of about 580 lb of sludge).

In addition to the RWCU phase separators, there are two condensate phase separators in the radwaste building, each estimated to have a sludge holdup capacity of approximately 5400 gal, or 2250 lb of solids at a 5 weight-percent concentration.

Total input to the condensate phase separators will depend upon whether the precoat filters or the etched-disk filters are in use, since the precoat filters generate more waste volume. Based upon the conservative design values for input water quality (TSS, TDS), the estimated design inputs are as follows:

Condensate filter-demineralizer backwashes	214 lb/1.3 days	4940 lb/30 days
Fuel pool filter-demineralizer backwash	65 lb/10 days	195 lb/30 days
Floor drain precoat filter backwashes	17 lb/batch 11 batches/day 187 lb/day	5610 lb/30 days
Waste collector precoat filter backwashes	28 lb/batch 1.5 batches/day 42 lbs/day	1260 lb/30-days
Floor drain etched-disk filter backwashes	2.64 lb/batch 6 batches/day 15.9 lb/day	475 lb/30-days
Waste collector etched-disk filter backwashes	1.0 lb/batch 3.7 batches/day 3.7 lb/day	111 lb/30-days
Total solids generated for 30 days		5,721 or 12,000 lb

Conservatively estimated, overall solids input (over 30 days) to the condensate phase separators averages 12,000 lb when the precoat filters are used, and 5,721 lb if the etched-disk filters are used (in their un-precoated design condition).

With the etched-disk filters in use at the estimated normal solids-generation rates, both condensate phase separators would be full in approximately 23 days (about 12 days each per separator). At this time, the contents of one of the condensate phase separators would be transferred to the centrifuge feed tank in preparation for processing through the volume reduction and solidification system. The centrifuge feed tank has a working capacity of approximately 6000 gal, which is equivalent to about 2500 lb of solids at 5 weight-percent concentration. The phase separator just emptied would then have a solids-accumulation capacity of approximately 12 days at normal sludge-generation rates. Thus, the total solids holdup capacity of the two condensate phase separators and centrifuge feed tank is approximately 35 days.

11.5.3.2.2.2 Spent-Resin Collection

Spent resins are produced in the floor drain and waste collector demineralizers. Each of the two demineralizers is estimated to produce about 2250 lb of spent resin once every 16 days, or a total of about 8500 lb of spent resin every 30 days. The spent-resin tank and the spent-resin slurry feed tank can each accommodate two batches of spent bead resin, or a total of about 9000 lb.

11.5.3.2.3 Waste Clarifier Tank and Condensate Phase Separator Tanks

The waste clarifier tank collects decantates primarily from the condensate and RWCU phase separators and the centrifuge to allow solids carried over to settle. It also provides the source of the dilution water for adjusting the solids concentration in the centrifuge feed tank and the source of carrier waste for sluicing resin from the spent-resin tank.

The condensate phase separators provide for an undisturbed period during which the solid materials that enter the vessels as slurries can settle to the bottom. After the settling period, the clarified water can be decanted off to allow enough volume for the receipt of the next slurry input. The units are designed to enable measurements of the quantities of sludge and water they contain, to adjust (by decanting) the sludge concentration, and to mix the water and sludge to a uniform slurry so it can be transferred to the centrifuge feed tank for further processing. To accomplish these functions, additional auxiliary equipment including: level instrumentation, decant pumps, sludge discharge and mixing pumps, and an internal arrangement of mixing educators is provided.

11.5.3.2.4 Waste Surge Tank

The 65,700-gal-capacity waste surge tank accumulates input surges from the waste collector and floor drain collector subsystems. However, its primary function is to receive the overflow from the waste clarifier tank. Periodically, it receives the wastewater from the reactor well drain, one of the radwaste emergency drain sumps, and off-standard recycle from the waste sample tanks.

The waste surge tank also can receive inputs from the RWCU system during reactor startup.

The waste surge tank can hold the maximum daily input from the floor drain collector subsystem, the waste collector subsystem, or the solid radwaste system via the waste clarifier tank. The largest of these inputs is from the waste clarifier tank, from the condensate filter-demineralizer backwash during reactor startup. Including other design daily inputs, the estimated maximum daily input would then be 52,368 gal.

11.5.3.2.5 Centrifuge Feed Tank (See also Subsection 11.5.3.2.16.2)

This tank collects the sludge and wastewater containing high suspended solids from the condensate phase separators, waste clarifier tank, RWCU phase separators, and spent-resin tank and, if required, adjusts the solids content in the water in the range of 5 percent by weight by diluting it with decant water from the waste clarifier tank.

The contents of this tank are processed to the vendor solidification system located in the OSSF. With the isolation of the centrifuge, the contents of the tank can be processed directly by the solid radwaste system extruder/evaporator after decanting the contents to approximately 15 percent by weight.

The centrifuge feed tank is equipped with a mechanical agitator which, together with the mixing flow provided by the centrifuge feed/recirculation pumps, ensures a uniform slurry concentration in the tank.

The largest batch input to the centrifuge feed tank-5400 gal- is from the condensate phase separator. The contents of the tank are processed in a batch operation. The tank has a capacity of approximately 6000 gal.

11.5.3.2.6 Spent-Resin Tank (See also Subsection 11.5.3.2.16.4)

This tank collects the spent resin from the floor drain and waste collector demineralizers. The collected spent resin is transferred either to the centrifuge feed tank or to the slurry feed tank for further processing.

The spent-resin tank is sized to accommodate two batches of spent resin and sluicing water from either the floor drain or the waste collector demineralizer. One resin bed, including wastewater, occupies approximately 700 gal. The tank has a capacity of 1400 gal, which allows a contingency for accommodating an additional batch.

11.5.3.2.7 Chloride Waste Tank

The chloride waste tank can collect laboratory waste containing chlorides, mainly hydrochloric acid. Chloride waste can be segregated from other chemical wastes and drained directly to this tank. The waste is normally preneutralized in the laboratory before drainage. This waste can be segregated from others in the liquid radwaste system because its high chloride content could have a deleterious effect on equipment and stainless steel materials, particularly the evaporator.

The estimated monthly input to the tank is about 300 gal, reflecting the design daily volume of 10 gal. The tank volume of 250 gal requires pumping out the contents to the concentrates feed tank about once per month.

11.5.3.2.8 Condensate Phase Separator Decant Pumps

The condensate phase separator decant pumps decant the clear liquid from the condensate phase separator tanks and transfer it either to the waste clarifier tank or to the condenser hotwell (during startup only).

The pumps are designed to pump the volume of condensate demineralizer backwash decantate to the waste clarifier tank in about 0.5 hr. Either pump can also be used to pump back to the condenser hotwell, as determined by reactor-startup conditions. This ensures that the decantate can be removed before receipt of the next batch. These two pumps are shared by the two condensate phase separator tanks.

11.5.3.2.9 Condensate Phase Separator Sludge Discharge Mixing Pumps

The condensate phase separator pumps transfer the sludge from the condensate phase separators to the centrifuge feed tank and, at the same time, recirculate part of the sludge through mixing eductors in the condensate phase separator to keep the sludge mixed homogeneously.

The capacity of the pumps is based on the recirculation flow requirements to keep powdered resin in suspension and to transfer sludge to the centrifuge feed tank. The solids content during sludge transfer is in the general range of 5 percent by weight. Two 100 percent-capacity pumps are shared by the two condensate phase separator tanks.

11.5.3.2.10 Chloride Waste Pump

The chloride waste pump transfers the chloride waste collected in the chloride waste tank to the concentrates feed tank. The pump rating of 35 gpm was based on emptying the chloride waste tank in less than 10 minutes.

11.5.3.2.11 Centrifuge Feed and Recirculation Pumps

The centrifuge feed and recirculation pumps perform the following functions:

a. Mix the contents of the centrifuge feed tank by recirculating the slurry back to the tank through the mixing eductors

b. Decant the clear liquid from the centrifuge feed tank to the waste clarifier tank

c. Provide a constant flow and slurry concentration when feeding to the vendor station in the OSSF or the waste-slurry metering pump.

The capacity of the pumps is determined by the flow through eductors that is needed to keep the powdered and bead resin in suspension.

11.5.3.2.12 Slurry Dilution Pump

The slurry dilution pump provides dilution water to either the centrifuge feed tank or the spent-resin tank, taking suction from the waste clarifier tank. It can also be used to spray the waste clarifier tank bottom to assist in sludge removal. The pump capacity is based on the maximum dilution-water requirement for centrifuge feed tank operation. (The spent-resin tank requires approximately 30 gpm of dilution water.)

11.5.3.2.13 Waste Clarifier Sludge Pump

The waste clarifier sludge pump transfers sludge from the waste clarifier tank to the centrifuge feed tank. It is also used as a backup to the spent-resin transfer pump to pump the contents of the spent-resin tank to the centrifuge feed tank.

11.5.3.2.14 Spent-Resin Transfer Pump

The spent-resin transfer pump transfers the spent resin from the spent-resin tank either to the centrifuge feed tank or to the slurry feed tank. It can also be used as a backup for the waste clarifier sludge pump to pump clarified sludge to the centrifuge feed tank.

11.5.3.2.15 Centrifuge

The centrifuge, in its design configuration, dewaters the slurry of either spent bead resin or powdered resin fed by the centrifuge feed/recirculation pump so that dry solid is fed to the extruder/evaporator. Dewatering the slurry by centrifuging will maximize the solids processing rate through the extruder/evaporator.

The centrifuge is designed to dewater slurries consisting of either bead resin or spent precoat-filter cake to 40 percent to 50 percent of dry solids in the cake. The estimated recovery of solids in the cake is about 98.5 percent. The water content in the centrifuge cake has an upper limit to match the evaporative capacity of the extruder-evaporator (rated at 0.53 gpm). The centrifuge feed rate is controlled, on the basis of the percent of solids in the feed, to achieve this maximum moisture input to the extruder/evaporator, thereby ensuring that its nominal evaporative capacity is not exceeded.

11.5.3.2.16 Extruder/Evaporator Volume Reduction and Solidification System

11.5.3.2.16.1 General

The extruder/evaporator volume reduction and solidification system (VRS) is designed to perform the following functions:

a. Accepts waste inputs from the liquid radwaste system evaporator and chloride waste tank via the concentrates feed tank as well as waste in slurry form from the centrifuge feed tank

b. Accepts dewatered solid waste inputs from the centrifuge or slurry inputs (approximately 50 percent by weight) from the slurry feed tank

c. Removes moisture from waste feed while homogeneously mixing the waste with asphalt

d. Discharges the asphalt/waste mixture into 55-gal drums where the waste product cools to form a solid mass with no freestanding water

e. Crimps the 55-gal drums to form suitable containers for offsite disposal

f. Returns the cooled distillate resulting from the evaporative process to the waste clarifier tank.

The nominal rated capacity (120 liters per hr) of the VRS-T 120 is for evaporative liquid. A weight percent of solid to liquid is present in each incoming stream so that the amount of incoming water does not exceed the capacity of the extruder/evaporator. The mass flow rate into the centrifuge, by design, is controlled so that the moisture input to the extruder/evaporator, in the form of chemical-bound and surface-bound water, does not exceed its evaporative capacity.

The VRS is designed to process the radioactive wastes from the solid radwaste system collection tanks described above. The principal types and quantities of wastes processed have been estimated in the design as follows:

a. Concentrates Feed Tank

Volume/batch	800 gal
Annual volume	34,679 gal

b. Bead Resin

Volume/batch, dewatered	49 ft^3
Resin type	Rohm & Haas IRN-150 or equivalent
Annual volume	6500 ft^3 (50,000 gal)

c. Powdered Resin

1. Condensate Phase Separators

Batch weight, dewatered	2250 lb
Annual quantity, dewatered	64,800 - 137,000 lb (10,300 - 21,800 gal)

2. Reactor Water Cleanup Phase Separators

Batch weight, dewatered	580 lb
Annual quantity, dewatered	3480 lb (575 gal)

The volume reduction and solidification system includes the following subsystems:

a. Centrifuge feed system (when functional)
b. Concentrate feed system
c. Spent-resin slurry feed system
d. Asphalt feed system
e. Auxiliary steam system
f. Extruder/evaporator and utility manifold
g. Steam-dome boilout system
h. Cooling water booster pumps
i. Fill station/drum-handling system (Equipment removed by modification)
j. pH adjustment system.

Figures 12.1-3, Sheet 2, and 12.1-4 show the general layout of this equipment.

11.5.3.2.16.2 Centrifuge Feed System

The centrifuge feed system feeds radwaste resin and sludge to the extruder/evaporator, normally in a dewatered form. The slurry feed system acts as a backup.

A homogeneous solution of radwaste resin and sludge slurry, ranging from 2 percent to 15 percent by weight, is recirculated around the centrifuge feed tank. A tap is taken from this recirculation line to feed the extruder, directly in slurry form. The designed primary extruder feed method is to distribute the slurry to the centrifuge, where all free water is removed. The slurry cake is then gravity fed to the extruder/ evaporator. A valve in this gravity line diverts all washdown during flushing operations to the waste clarifier tank. The backup extruder feed method is to feed the recirculated radwaste slurry solution directly to the extruder/evaporator via the waste slurry metering pump. In both feed methods, asphalt is fed simultaneously; flow rates are proportioned.

11.5.3.2.16.3 Concentrates Feed System

The concentrates feed system collects and feeds concentrates from the evaporator and the chloride waste tank when these systems are in use.

The 1500-gal concentrates feed tank receives the radwaste concentrate directly from the evaporator, from the evaporator drain holdup tank, and from the chloride waste tank. This solution is recirculated by the concentrates recirculation pump back to the tank to keep a homogeneous solution. Caustic can be injected into the solution in the recirculation line to adjust the pH.

A tap is taken from this recirculation line to feed the extruder/evaporator through the concentrates metering pump. Asphalt is also fed to the extruder/evaporator simultaneously to provide the correct mix.

The concentrates feed tank has electrical strip heaters on its bottom head, and all lines are electrically heat traced to keep the solution at about 165°F.

11.5.3.2.16.4 Spent-Resin Slurry System

The spent-resin slurry feed tank collects bead resin from the spent-resin tank, prepares the resin slurry to a fixed concentration (normally 50 percent by weight), and feeds the slurry to the extruder/evaporator.

A slurry containing approximately a 25 percent by weight concentration of spent bead resin is transferred from the existing spent-resin storage tank to the spent-resin slurry feed tank. A decanting operation is performed to increase the slurry concentration. This operation reduces the carrier water before the resin slurry is fed to the extruder. Due to the distance between the spent-resin slurry feed tank and the extruder/evaporator, a resin recirculation loop is provided to maintain the bead resin in a homogeneous slurry form. This loop is routed from the spent-resin slurry feed tank to near the extruder and back to the tank; a positive displacement progressive cavity pump is provided for this recirculation.

The spent-resin slurry feed tank is equipped with decant screens. A vertical in-line centrifugal decant pump removes water from the resin to adjust the concentration of resin in the tank to the normal value of about 50 weight percent.

A turbine agitator supplied with the tank keeps the contents thoroughly mixed. The tank also has connections for flushing and for fluffing the resin bed, if required.

A line tap is taken from the recirculation line for feeding the extruder/evaporator through the spent-resin slurry metering pump.

11.5.3.2.16.5 Asphalt Feed System

Asphalt is used as the binder material for the radwaste resins and evaporator concentrates. It is fed to the asphalt storage tank from a tanker through the duplex fill strainer. The 9000-gal bulk-storage asphalt tank is equipped with four externally mounted steam-heating panels. These removable panels maintain the temperature in the tank at approximately 325°F so the asphalt is a pumpable liquid.

The asphalt storage tank is located at grade, outside the radwaste building. Its radiation zone is designed to be less than 1 mrem/hr. The tank is located on the north side of the radwaste building, opposite the floor-drain filter.

A positive displacement pump recirculates the asphalt through a duplex recirculation strainer back to the storage tank to keep a homogeneous, clean flow. A backup positive displacement recirculation pump acts as an operational spare.

Two lines are tapped into the recirculation line to feed the asphalt metering pumps, which are positive displacement pumps that feed directly to the extruder/evaporator. A flow element exists in the feedline. A signal from any of the three radwaste slurry flow elements is sent to a flow ratio controller to establish automatically a proper waste/asphalt mix ratio, via asphalt pump speed control.

All lines in this system are steam traced, and all pumps and strainers are steam jacketed. The steam comes from the solid radwaste system electric auxiliary boiler.

All asphalt valves in this system are the plug type.

11.5.3.2.16.6 Auxiliary Steam System

The auxiliary steam system supplies steam at approximately 400°F and 230 psig to the following:

a. The extruder/evaporator steam domes and barrels

b. The asphalt tank and asphalt supply system (at reduced pressure).

This steam is used to heat the extruder/evaporator to promote the evaporation of water from the radwaste feed. Steam at a reduced pressure is used to heat the asphalt storage tank and to heat trace the asphalt transfer and metering lines so that the asphalt is maintained at approximately 325°F. The auxiliary boiler system is a packaged unit. Demineralized makeup water is provided from plant sources. The blowdown of the boiler is via a flash tank; subsequent discharge is directed to the floor drain sump. Twin boiler feed pumps ensure reliable system operation.

11.5.3.2.16.7 Extruder/Evaporator and Utility Manifold

The heated extruder/evaporator mixes the liquid radioactive wastes with asphalt. It also evaporates free and chemically bound water from the mixture and homogeneously disperses the waste residues in the asphalt matrix. The utility manifold distributes steam to heat each barrel section and distributes cooling water to the feed barrels, discharge barrel, and vapor condensers in the steam domes.

The extruder/evaporator and utility manifold consist of three basic sections, as follows:

a. The drive section provides counter-rotating torque to the screw shafts of the extruder/evaporator

b. The process section evaporates water and transports and mixes the waste/asphalt mixture

c. The extruder/evaporator manifold, a skid-mounted assembly, has cooling water, steam, and condensate supply and return headers, distribution piping, associated temperature control valves, solenoids, and manually operated valves. Flow rates of cooling water and steam required to maintain the operating temperature in the extruder/ evaporator barrels are controlled by temperature elements in the extruder/evaporator. These elements modulate the steam or water control valves, as required. There are two levels of steam pressure on the manifold. The first is for the extruder/evaporator process section heating, which is about 230-psig steam, supplied from the auxiliary boiler; the second, for cleaning the dome devolatizing ports, is about 150-psig steam supplied from a self-contained pressure regulator mounted on the manifold.

   A condensate collection system is provided with associated valves, strainers, and steam traps. The condensate is returned to the condensate return tank on the auxiliary boiler skid, and from there it is returned to the auxiliary boiler.

11.5.3.2.16.8 Steam-Dome Boilout System

The steam-dome boilout system cleans and removes any salt sediment that might accumulate in the steam-dome ports.

This system supplies a predetermined amount of demineralized water through the respective port connection to the steam domes. It consists of a wall-mounted frame supporting a feed tank, a piping manifold, and remotely operated valves. It is operated from the main control panel. The tank is filled with water when the operator opens the tank inlet valve. When the water reaches a preset level, the valve is closed automatically by a signal from the level switch. The operator starts the boilout of one of the three steam domes by opening the valve in the distribution line to the dome to be cleaned. The boilout water flows by gravity to the selected dome. When the operator releases a pushbutton, the boilout cycle terminates automatically by closing the same valve. This sequence is repeated for the domes remaining to be cleaned.

11.5.3.2.16.9 Cooling Water Booster Pump System

This system increases the supply pressure of cooling water to approximately 105 psig (at a temperature of 85°F) to the following equipment via the utility manifold:

a. The extruder/evaporator domes

b. The extruder/evaporator feed and discharge barrels.

Note: This system has been deactivated. The Turbine Building Closed Cooling Water (TBCCW) supply line has been terminated in the turbine building and the wall penetrations have been reused to supply General Service Water (GSW) to the Side Stream Liquid Radwaste System.

11.5.3.2.16.10 <u>Fill Station and Drum-Handling System</u> (Equipment removed by modification)

The fill station and drum-handling system

a. Positions a drum under the extruder for filling
b. Provides ventilation of the drum being filled
c. Provides visual monitoring of the drum-filling process
d. Provides a remote indication of the drum level
e. Provides temporary storage for cooling on the turntable
f. Provides an automatic/manual indexing operation
g. Provides a drum-capping and drum-seaming operation
h. Provides for measuring drum radiation level at the capper/seamer
i. Provides drum handling, which consists of a monorail, a drum grab, conveyors, and a capper/seamer.

The fill station subsystem collects the final product from the extruder/evaporator. The fill station contains a vent hood, filter train, and exhauster, which provide ventilation of the fill area to prevent loose surface contamination of drums and the buildup of vapors. A drip-pan mechanism is provided for product collection during drum-indexing operations. The pan with drippings is put in the next drum available after indexing. The drum-handling system is designed to transport drums to and from the six-drum turntable via the monorail, hoist, and drum grab. The drums are filled on the turntable after being indexed, either manually or automatically. Filled drums are remotely transported via monorail and hoist to the capping station. They are capped, seamed closed, and put on the transfer cart.

The drum-handling system provides a means by which 55-gal drums filled with the solidified radwaste can be remotely moved, transported, and stored. It consists of a transfer cart, an accumulation conveyor, and a 10-ton remotely operated bridge crane equipped with a drum grab for transport of drums to onsite storage. Drums are retrieved from onsite storage by means of the same bridge crane. They are discharged to a truck dock designed to accommodate offsite shipments to a burial repository.

Except for the drum-transfer cart, these actions occur in the onsite storage facility, a separate structure adjacent to the radwaste building. This facility, its systems and equipment, and its operations are described in Section 11.7.

One method of movement of drums is as follows: Filled and seamed drums are moved from the drum capper-seamer area, by means of the transfer cart, to the onsite storage facility. There they are transferred to the accumulation conveyor to await transport offsite or to their storage location. Closed-circuit television (CCTV) cameras throughout the system permit surveillance of the drum's movement.

Drums can also be stored on the solid-radwaste storage conveyors in the radwaste building (first floor). The storage system consists of the transfer cart, 13 reciprocating gravity storage conveyors, 13 drum escapement devices, and a chain-driven live roller drum-exit conveyor.

All components of this system are remotely operated, and visual surveillance of the total system is provided by CCTV cameras, periscopes, and viewing ports. Drums are discharged from the transfer cart onto any one of the 13 reciprocating gravity storage conveyors. The reciprocating gravity storage conveyors can store approximately 380 drums.

11.5.3.2.16.11 pH Adjustment System

The pH adjustment system consists of a caustic holding tank, pumps, and a distribution system. It is used to adjust the pH in the three slurry feed tanks to protect the extruder/evaporator. The caustic is fed from the caustic tank and distributed through the caustic addition pumps to one of the three slurry tanks:

a. The centrifuge feed tank
b. The spent-resin slurry feed tank
c. The concentrates feed tank.

When the pH in the selected tank is within the allowable range, the operator manually shuts down the caustic addition pump.

The system also provides for the injection of caustic for neutralizing the contents of the chemical waste tank.

11.5.4 Estimated Quantities

Estimated design values of the principal radionuclides processed yearly through the radwaste system are presented in Table 11.5-3. This table covers system operation with the evaporator and the etched-disk filter/oil coalescer trains in service. Calculations have also been made for normal system operation with both precoat filters in use and the evaporators not in service. It was found that the total curies processed were nearly identical, which is as expected. The radioactivity inputs to the radwaste system come from various external sources, such as leakage into sumps, laboratory drains, various cleanup resins, and sludges. These input sources are independent of how the internal radwaste equipment/trains are configured. Therefore, since the radwaste systems are designed to essentially capture (and ultimately ship for burial) the majority of radionuclides, rather than releasing them in liquid discharges, it is expected that the final solid-system totals would be essentially independent of system configuration. Source quantities will be redistributed throughout various pieces of radwaste equipment, depending upon specific system configurations. The nuclide distribution for each type of solid waste was calculated by assuming that all waste initially had the same distribution of nuclides as reactor water, and by applying appropriate decay factors for utilization, collection, or processing times involved with each type of solid waste.

The estimated yearly quantity (volume, weight) of wastes to be generated and shipped, however, does depend upon the specific configuration of the overall liquid and solid system. When vendor processing is performed in the OSSF, quantities will depend upon the specific vendor being utilized, fill efficiencies, etc. If the asphalt-extruder system is utilized, results and quantities will depend on such things as drum-fill efficiencies, achievable waste-to-asphalt ratios and extruder throughput, etc. One nominal design example is given in Table 11.5-4 for the situation of waste processed with the evaporators, etched-disk filters/oil coalescers, and asphalt extruder in operation.

11.5.5 Packaging and Shipment

The solid waste system product will be packaged and shipped in accordance with current federal regulations. The majority of normal radwaste will be staged in the onsite storage facility for shipment. Waste quantities, activities, and economics will dictate shipment frequency.

11.5.6 Vendor-Supplied Solidification or Dewatering System

The Fermi 2 solid radwaste system has been set up and hard-piped so that either a full-time (mobile) vendor system can be used or the asphalt system could be used.

The portable solid waste management system is supplied and operated by the vendor. The types and quantities of waste to be processed are the same as for the Fermi solidification system. System operation will be closely monitored by Edison personnel. The vendor will utilize a process control program (PCP), which is reviewed and approved by Edison in accordance with Section 17.2. Conformance to 10 CFR 61 criteria is discussed in the vendor-supplied documentation. Fermi 2 or contractor operating procedures are used for operating this system as interfaced with the Fermi 2 solid radwaste system.

Depending upon the particular system and the expected radiation levels, portable (vendor) radwaste processing in the OSSF can take place in the pallet-loading room, in the storage bays, in the laydown areas immediately adjacent to the truck bay, or in the shielded container-processing room. It is expected that primarily this latter room will be used for such processing. If large bulk cement and chemical containers are used for such processing, however, they may be located outside of the truck bay door. These areas of the onsite storage facility were specifically designed and constructed to contain and handle mobile process systems (see Subsection 11.7.2.2.11). Concrete floors and walls of this region are coated, and drains are routed back to the liquid radwaste system. The remote-operated overhead crane is available to move equipment onto or from trucks located in the truck bay. The basic design of these areas and the methods of system operation have incorporated features to maintain operator exposures ALARA. Permanent piping installed in the shielded onsite storage facility pipe tunnel transports the radioactive process fluid directly to the vendor's equipment.

The interface connections between the portable system and the Fermi 2 system are shown in Figure 11.2-15 and described in Table 11.2-4. In general, liquid from the centrifuge feed tank is transported directly to the vendor equipment, and clarified liquid is returned to the waste clarifier tank. The waste is normally pumped to a disposable liner or high-integrity container (HIC).

If solidification of waste is performed, pretreatment of the waste with chemical additives may be conducted in accordance with values derived from a PCP. Solidification agents are then added and the waste is allowed to cure to complete the solidification process.

If dewatering of the waste is performed, the waste is transferred into a steel liner or HIC containing an internal underdrain assembly. Vacuum is applied to the underdrain system. Liquid from the underdrain system is sent back to the liquid radwaste system by a dewatering pump while the solids are trapped in the container. Some vendors provide additional accelerated dewatering capability. This accelerated capability is achieved by recirculating air at high velocity through a liner or HIC. Procedures ensure no drainable liquid at the time of shipment and <1 percent drainable liquid in HICs or <0.5 percent drainable liquid in steel liners upon receipt at the burial site.

The liners or HICs are suitable for transportation and burial at an approved burial facility. Additionally, the liners and HICs are compatible with numerous approved shipping casks if the liner or HIC requires shipment in a cask.

TABLE 11.5-1 SUMMARY OF ESTIMATED DESIGN INPUTS TO THE SOLID RADWASTE SYSTEM

Stream[a] Number	Description	Design Daily Volume (gpd)	Solids Content per Batch	Maximum Volume per Batch (gal)	Batch Frequency Normal	Batch Frequency Maximum
20	Reactor water cleanup phase separator decantate	635	200 ppm	2000	2/6.3 day	2/day
21	Condensate filter – demineralizer backwash	4838	214 lb	6400	1/2 day	8 day
22	Fuel pool filter backwash	216	65 lb	2160	1/10 day	1/10 day
27[b]	Floor drain precoat filter backwash	5170	17 lb	470	11/day	N/A
28[b]	Waste collector precoat filter backwash	1380	28 lb	920	1.5/day	N/A
29, 31, 32	Waste surge tank, FDC tank, waste collector tank sludge letdown	Infrequent (not included in mass balance)				
30	Reactor water cleanup phase separator sludge	23	580 lb	1400	1/60 day	1/60 day
35[b]	Floor drain etched-disk filter backwash	124	2.64 lb	21	6/day	6/day
36[b]	Waste collector etched-disk filter backwash	78	1.0 lb	21	4/day	15.5/day
58	Spent-resin tank	126	45 ft^3	1011	1/8 day	1/1.7 day
59	Evaporator concentrates	103	<8% by weight	800	1/8 day	1/4.5 day

[a] Refer to Figure 11.2-15.

[b] The precoat filters and the etched-disk filters are not in operation at the same time.

TABLE 11.5-2 SOLID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Component	Number	Capacity (gal)	Material	Pressure (psig)	Temperature (°F)	Design Code
Condensate phase separator tank	2	12,000	Carbon steel Lastiglas 78	Atmospheric	--	(a)
Waste clarifier tank	1	16,500	Carbon steel Plasite 7155	Atmospheric	150	API-650[a]
Waste surge tank	1	65,700	Carbon steel[b] Plasite 7155	Atmospheric	150	API-650[a]
Centrifuge feed tank	1	6,000	Stainless steel, 1/8 in. corrosion allowance (SA-240-304)	Atmospheric	150	ASME Section III, Class 3
Spent-resin tank	1	1,400	Carbon steel Plasite 7155	Atmospheric	150	API-650[a]
Chloride waste tank	1	250	Monel 400, 1/8 in. corrosion allowance (SB-127-400)	Atmospheric	150	ASME Section III, Class 3
Concentrates feed tank	1	1,500	Stainless steel (SA-240-316L)	15	200	ASME Section[e] VIII, Div. 1
Spent-resin slurry feed tank	1	1,500	Stainless steel (SA-240-304)	15	150	ASME Section[e] VIII, Div. 1
Asphalt storage tank	1	9,000	Carbon steel (SA-285-Grade C)	Atmospheric	425	API-650

TABLE 11.5-2 SOLID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Component	Number	Liquid	Flow Rating (gpm)	Head Across Pump (ft)	Materials (casing/shaft/impeller)	Type	Design Code
Condensate phase separator decant pump A	1	Liquid radwaste	475	60	Steel, mfg. std./ 316 SS/316 SS.	Single stage, vertical, inline	Manufacturer's standard
Condensate phase separator decant pump B	1	Condensate (water)	250	25	316 SS/steel, mfg. std./316 SS	Single stage, vertical, inline	Manufacturer's standard
Condensate phase separator sludge pump	2	Condensate and powdered resin slurry	410	115	316 SS/steel, mfg. std./316 SS	Single stage, vertical, inline	Manufacturer's standard
Centrifuge feed/recirculation pumps	2	Resin and water slurry	300	210	316 SS/steel, mfg. std./316 SS	Single stage, vertical, inline	Manufacturer's standard
Slurry dilution pump	1	Clarifier effluent water	150	32	316 SS/316 SS/316 SS	Single stage, vertical, inline	Manufacturer's standard
Waste clarifier sludge pump[c]	1	Wastewater with resin particles and beads	50	25[d]	316 SS/316 SS/316 SS	Progressive cavity	Manufacturer's standard
Spent-resin transfer pump[c]	1	Wastewater with resin particles and beads	50	25[d]	316 SS/316 SS/316 SS	Progressive cavity	Manufacturer's standard
Spent-resin decant pump	1	Liquid radwaste	85	42	316 SS/316 SS/316 SS	Single stage, vertical, inline	Manufacturer's standard
Cooling water booster pumps	2	Demineralized water	70	104	316 SS/316 SS/316 SS	Single stage, vertical, inline	Manufacturer's standard
Concentrates recirculation pump	1	Liquid radwaste	50	37	316 SS/316 SS/316 SS	Single stage, vertical, inline	Manufacturer's standard
Asphalt metering pumps	2	Asphalt	0.03 to 1.5	-21 to 53	Steel/steel/chrome-plated steel	Rotary gear	Manufacturer's standard
Spent-resin slurry recirculation pump	1	Resin and water slurry	80	69	316 SS/316 SS/chrome-plated 316 SS	Progressive cavity	Manufacturer's standard
Spent-resin slurry metering pump	1	Resin and water slurry	0.2 to 1.5	37	316 SS/316 SS/chrome-plated 316 SS	Progressive cavity	Manufacturer's standard

TABLE 11.5-2 SOLID RADWASTE SYSTEM – COMPONENT DESIGN PARAMETERS

Component	Number	Liquid	Flow Rating (gpm)	Head Across Pump (ft)	Materials (casing/shaft/impeller)	Type	Design Code
Waste slurry metering pump	1	Resin and water slurry	0.2 to 1.5	-158	316 SS/316 SS/chrome-plated316 SS	Progressive cavity	Manufacturer's standard
Concentrates metering pump	1	Liquid radwaste	0.2 to 1.5	28	316 SS/316 SS/chrome-plated 316 SS	Progressive cavity	Manufacturer's standard
Asphalt recirculation pumps	2	Asphalt	20	74	Ductile iron/steel/cast iron	Rotary gear	Manufacturer's standard

Centrifuge
- Type - Bowl with screw conveyor
- Capacity - 20 gpm, 98 percent recovery
- Material - 316 stainless steel
- Design Pressure - Atmospheric
- Design Temperature - 40 to 140 °F
- Design Code - Manufacturer's standard

Extruder/Evaporator (VRS)
- Type - Twin screw
- Capacity - Variable depending on input

Design Pressures
- Barrel heating jackets - 300 psig
- Barrel cooling jackets - 300 psig
- Steam dome jackets - 43 psig
- Steam dome condensers, tube side - 150 psig

Design Temperatures
- Barrel heating jackets – 410 °F
- Barrel cooling jackets – 410 °F
- Steam dome jackets – 330 °F
- Steam dome condensers, tube side – 150 °F

Materials
- Barrels, screw elements - DIN 1.8519 double nitrided
- Screw shafts - DIN 1.8550
- Steam domes, wetted surfaces - DIN 1.4571
- Steam dome condenser tubing - DIN 1.4571
- Interfacing connection - See nozzle schedule

Design Code - Manufacturer's standard

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[a] The design code for tank modification is ASME III, Class 3.

[b] SA-240-304 stainless steel bottoms.

[c] Identical pumps.

[d] Total differential pressure.

[e] These vessels function as atmospheric storage tanks and are vented. However, they are designed as pressure vessels under the rules of ASME VIII and so are more conservatively designed than called for in the code.

TABLE 11.5-3 ESTIMATED PRINCIPAL NUCLIDES TO BE SHIPPED FOR EACH TYPE OF WASTE, IN CURIES PER YEAR, FOR OPERATION WITH EVAPORATORS AND ETCHED-DISK FILTERS (3499 MWt)

Nuclide	Reactor Water Cleanup Resins	Radwaste Demineralizer Resins	Condensate Demineralizer Resins[a]	Evaporator Concentrates	Total Annual Curies
Br-83	0.00000E+00	1.21664E+00	1.86470E-01	1.31683E-06	1.40311E+00
Kr-83m	0.00000E+00	2.32973E+00	3.71962E-01	5.34344E-06	2.70170E+00
Br-84	0.00000E+00	3.95113E-03	7.52364E-04	1.53842E-21	4.70349E-03
Br-85	0.00000E+00	1.22181E-29	3.09385E-28	0.00000E+00	3.21603E-28
Kr-85m	0.00000E+00	1.77480E-02	3.33742E-03	7.25000E-07	2.10861E-02
Kr-85	1.71561E-04	4.33713E-06	2.37419E-05	1.20272E-08	1.99652E-04
Rb-89	0.00000E+00	2.39082E-06	7.55779E-07	0.00000E+00	3.14660E-06
Sr-89	1.61945E+01	1.33132E+00	6.08000E+00	3.47949E-03	2.36093E+01
Sr-90	3.73375E+00	9.74186E-02	5.12877E-01	2.59424E-04	4.34430E+00
Y-90	3.73376E+00	5.47956E-02	4.62144E-01	1.80549E-04	4.24088E+00
Sr-91	0.00000E+00	4.73841E+00	1.31733E+00	1.67715E-03	6.05742E+00
Y-91m	0.00000E+00	2.94110E+00	8.19728E-01	1.04730E-03	3.76188E+00
Y-91	1.26800E+01	8.58308E-01	4.13896E+00	2.32876E-03	1.76796E+01
Sr-92	0.00000E+00	2.57518E+00	4.05440E-01	7.02357E-06	2.98063E+00
Y-92	0.00000E+00	6.91087E+00	1.29632E+00	1.86235E-04	8.20737E+00
Y-93	0.00000E+00	5.05576E+00	1.46743E+00	2.04213E-03	6.52524E+00
Zr-95	1.653899+00	9.99088E-04	5.61256E-01	2.79479E-06	2.20125E+00
Nb-95m	1.72016E+00	4.93084E-04	4.60199E-01	1.68922E-06	2.18086E+00
Nb-95	2.72212E+00	1.01431E-03	5.83751E-01	2.79089E-06	3.30689E+00
Zr-97	1.12879E-27	1.08275E-04	9.24027E-03	9.80370E-08	9.34864E-03
Nb-97	1.21520E-27	1.14682E-04	9.87488E-03	1.05530E-07	9.98960E-03
Nb-98	0.00000E+00	2.89202E-04	1.19590E-02	1.58257E-16	1.22482E-02
Mo-99	1.88183E-05	1.12081E-01	2.14073E+01	2.31930E-04	2.15196E+01
Tc-99m	1.94672E-05	1.52650E+01	2.46800E+01	2.00516E-03	3.99470E+01
Tc-101	0.00000E+00	1.88649E+05	6.33655E-06	0.00000E+00	2.52014E-05
Ru-103	2.29446E+00	2.40077E-03	1.30303E+00	6.74186E-06	3.59990E+00
Tc-104	0.00000E+00	2.99290E-04	8.12049E-05	2.94650E-35	3.80494E-04
Ru-105	0.00000E+00	9.67894E-03	4.46495E-01	4.21898E-07	4.56174E-01
Ru-106	1.60141E+00	4.09813E-04	2.38384E-01	1.11197E-06	1.84020E+00
Rh-106	1.60141E+00	4.09813E-04	2.38384E-01	1.11197E-06	1.84020E+00
Te-129m	3.91072E+00	5.15091E-01	2.23808E+00	1.33601E-03	6.66522E+00
Te-129	2.46783E+00	3.24264E-01	1.41177E+00	8.42827E-04	4.20471E+00
I-129	1.68343E-06	1.34848E-06	1.07673E-05	1.07673E-09	1.38094E-05
Te-131m	5.49768E-15	3.34942E-01	2.05763E-01	4.38708E-04	5.41144E-01
I-131	2.17482E+00	3.77431E+01	1.02743E+01	8.85583E-02	1.42750E+02
Te-131	1.22654E-15	7.47231E-02	4.59050E-02	9.78749E-05	1.20726E-01
Te-132	1.14346E-06	6.87227E-02	9.81369E-02	1.35304E-04	1.66996E-01
I-132	1.17780E-06	1.11330E+01	1.77977E+00	1.47565E-04	1.29129E+01
I-134	0.00000E+00	8.75434E-01	1.40171E-01	6.74317E-13	1.01560E-01
I-133	9.61304E-19	1.21167E+02	5.65057E+01	1.21723E-01	1.77794E+02
Xe-133m	1.49775E-07	2.74539E+00	3.98745E+00	6.42260E-03	6.73927E+00
Xe-133	2.46914E-01	6.21781E+01	1.71109E+02	1.65710E-01	2.33700E+02
I-135	9.61304E-19	1.21167E+02	5.65057E+01	1.21723E-01	1.77794E+02
Xe-135m	1.85923E-19	2.34345E+01	1.09286E+01	2.35420E-02	3.43867E+01
Xe-135	1.70706E-18	1.13804E+02	7.27860E+01	1.83134E-01	1.86773E+02
Cs-135	3.87751E-05	4.26465E-06	1.87470E-05	2.66833E-08	6.18134E-05

TABLE 11.5-3 ESTIMATED PRINCIPAL NUCLIDES TO BE SHIPPED FOR EACH TYPE OF WASTE, IN CURIES PER YEAR, FOR OPERATION WITH EVAPORATORS AND ETCHED-DISK FILTERS (3499 MWt)

Nuclide	Reactor Water Cleanup Resins	Radwaste Demineralizer Resins	Condensate Demineralizer Resins[a]	Evaporator Concentrates	Total Annual Curies
Cs-134	1.48180E+01	4.15622E-01	2.16844E+00	1.10679E-03	1.74031E+01
Cs-136	1.34777E-01	2.28170E-01	7.70842E-01	5.62091E-04	1.13435E+00
Cs-137	4.26805E+01	1.11197E+00	5.86270E+00	2.96549E-03	4.96582E+01
Ba-137m	4.03758E+01	1.05193E+00	5.54613E+00	2.80535E-03	4.69767E+01
Cs-138	0.00000E+00	6.13834E-03	1.16369E-03	3.81325E-21	7.30203E-03
Ba-139	0.00000E+00	5.10282E-01	7.56031E-02	1.66680E-09	5.85885E-01
Ba-140	2.44702E+00	4.53902E+00	1.52215E+01	1.11698E-02	2.22187E+01
La-140	2.81654E+00	3.24415E+00	1.59568E+01	9.80443E-03	2.20273E+01
Ba-141	0.00000E+00	4.23285E-05	1.13901E-05	8.71513E-36	5.37186E-05
La-141	0.00000E+00	3.82517E-01	6.79274E-02	8.47010E-06	4.50453E-01
Ce-141	2.83846E+00	5.16454E-02	2.09002E+00	1.39330E-04	4.98027E+00
Ba-142	0.00000E+00	1.03381E-09	5.00343E-09	0.00000E+00	1.53415E-08
La-142	0.00000E+00	5.54537E-02	1.28712E-01	8.68227E-10	1.84166E-01
Ce-143	3.73270E-14	9.84920E-04	1.19133E-01	1.51206E-06	1.20120E-01
Pr-143	3.36046E-01	4.41148E-03	2.00167E+00	1.21255E-05	2.34214E+00
Ce-144	1.28730E+00	3.99895E-04	2.31491E-01	1.09679E-06	1.51919E+00
Pr-144	1.28735E+00	3.99912E-04	2.31501E-01	1.09684E-06	1.51925E+00
Nd-147	9.39654E-03	2.99215E-04	1.24501E-01	8.00680E-07	1.34197E-01
Np-239	4.89204E-06	4.45548E+01	4.75614E+01	7.90225E-02	9.21953E+01
Na-24	1.02563E-28	1.79796E+01	6.66214E+00	1.28545E-02	2.46546E+01
P-32	1.88577E+00	2.31703E+00	8.07594E+00	5.74655E-03	1.22845E+01
Cr-51	3.68994E+02	6.94206E-01	3.61455E+02	1.94491E-03	7.31145E+02
Mn-54	3.06319E+01	9.34598E-03	5.41727E+00	2.56280E-05	3.60585E+01
Fe-55	5.00015E+02	1.35535E-01	7.87846E+01	3.69124E-04	5.78936E+02
Mn-56	0.00000E+00	1.05957E-01	4.10384E+00	2.25117E-07	4.20980E+00
Co-58	4.48745E+01	2.51447E-02	1.41928E+01	7.02877E-05	5.90926E+01
Fe-59	4.09647E+00	3.64253E-03	1.99866E+00	1.02257E-06	6.09878E+00
Co-60	2.06817E+02	5.44352E-02	3.16425E+01	1.47877E-04	2.38514E+02
Ni-63	5.32216E-01	1.36400E-04	7.94843E-02	3.705470-07	6.12838E-01
Cu-64	2.53975E-32	4.21139E-01	3.14881E+01	2.70328E-04	3.19096E+01
Ni-65	0.00000E+00	6.09019E-04	2.34736E-02	1.09315E-09	2.40826E-02
Zn-65	8.32162E+01	2.74891E+00	1.40248E+01	7.30284E-03	9.99972E+01
Zn-69	0.00000E+00	2.61347E-02	4.09250E-03	1.45818E-13	3.02272E-02
Zn-69m	0.00000E+00	1.51306E-13	6.90983E-12	0.00000E+00	7.06113E-12
Ag-110m	4.17246E-01	1.32888E-04	7.68785E-02	3.64906E-07	4.94258E-01
W-187	2.65465E-18	7.40498E-03	7.49820E-01	9.18594E-06	7.57234E-01
Total	1.40723E+03	6.19777E+02	1.20444E+03	8.63634E-01	3.23231E+03

[a] This column also includes the floor-drain filter backwash, etched-disk filter backwash, waste-collector filter backwash, fuel pool filter backwash, and waste-surge-tank sludge letdown activities.

[b] 0.00000E-1 = 0.00000 x 10^{-1}

TABLE 11.5-4 ESTIMATED ANNUAL VOLUME OF SOLIDS TO BE SHIPPED FROM PROCESSING THROUGH THE EXTRUDER SYSTEM

System	Estimated Annual Shipped Solidified Volume[a] (gal)	Annual Number of Drums Shipped[a]
RWCU demineralizer resins Condensate filter-demineralizer resisns Waste collector and floor drain etched-disk backwash solids Fuel pool filter backwash	6,584	133
Radwaste demineralizer resins	11,286	228
Evaporator bottoms	5,148	104
Total	23,018	465

[a] These volumes are the solidified product volumes as shipped in 55-gal drums assumed to be 90 percent full and assumed to have a final waste-to-asphalt weight ratio of 50 percent/50 percent. They assume operation of the evaporators and the etched-disk filter/oil-coalescer trains and a dry (centrifuge) feed to the extruder.

11.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

A program is provided to monitor the radiation and radionuclides in the environs of the plant. The program provides (1) representative measurements of radioactivity in the highest potential exposure pathways, and (2) verification of the accuracy of the effluent monitoring program and modeling of environmental exposure pathways. The program is (1) contained in the ODCM, (2) conforms to the guidance of Appendix I to 10 Part CFR 50, and (3) includes the following:

1. Monitoring, sampling, analysis, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters in the ODCM,
2. A Land Use Census to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census, and,
3. Participation in an Interlaboratory Comparison Program to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring.

11.7 ONSITE STORAGE FACILITY

11.7.1 Introduction

The onsite storage facility is essentially an above-grade structure for holding low-level radioactive waste. It provides interim storage capacity for an amount of waste estimated to be generated in 5 years of plant operation. This surge capacity is primarily intended to be used to allow Fermi 2 to continue operating during a period when no offsite disposal facilities are available. Under normal conditions, when offsite disposal is available, a portion of the storage facility will be used as a staging area for waste. The onsite storage facility also includes space for a dry active waste compactor, offices, a control room, and rooms for housing the radwaste solidification system's asphalt storage tank and pumps. Provision is also made to allow processing of radwaste by transportable vendor-supplied equipment inside the facility.

11.7.1.1 Design Objectives

The onsite storage facility provides a protective barrier around the stored waste to

a. Protect the waste containers from the effects of the environment

b. Prevent an uncontrolled release of the waste to the environment

c. Provide shielding from the radiation emitted by the waste.

The waste will be retrievable from the facility. Waste will not be stored permanently in the facility. Handling of the waste within the facility can normally be done remotely with a crane or, when radiation levels allow, with a hand truck or a forklift vehicle.

The waste containers will be stored inside the structure, which protects them from the external environment. The storage facility has full-length trench drains in each storage cell to prevent collection of water on the facility floor.

All potential pathways for the release of radioactivity to the environment are controlled and monitored in accordance with 10 CFR 50, Appendix A, Criteria 60-64. In particular, all potentially contaminated drains within the facility are collected and routed to the liquid radwaste system. All ventilation exhaust from the onsite storage facility is filtered and monitored for radioactivity.

11.7.1.2 Description of Waste Stored

Normally, the radioactive wastes to be stored in this facility are of three general types: dry active wastes, processed wastes, and miscellaneous unprocessed wastes. Storage containers for processed waste could be either liners, high-integrity containers, or drums. High integrity containers will be used for processed waste which is potentially corrosive. Containers for dry active wastes could be drums, low specific activity boxes, or other appropriate containers. Waste with the potential for gas generation is stored in vented containers, or the container shall be vented at least every 5 years.

The dry wastes, which are generally of low radioactivity, can normally be handled by direct contact. These wastes normally are collected in containers or bags located in various zones around the plant. The filled containers are closed and then transferred to the onsite storage facility. These wastes are of two types: compressible and noncompressible. The compressible wastes are normally processed and packaged. The noncompressible wastes are manually packaged into containers meeting transportation criteria and stored until shipment.

This facility is also used for the storage of mixed, hazardous and radioactive waste materials in accordance with applicable regulations and permit requirements.

11.7.1.3 Design Safety Features

To reduce the possible exposure of personnel during maintenance, the following concepts have been incorporated into the design of the onsite storage facility:

a. Lighting will be provided via the bridge crane. No lights have to be replaced over the high level radwaste storage cells

b. The container processing room has been provided with adequate shielding to minimize exposure during these operations

c. Epoxy coating has been provided on all floors and walls where potential contamination could occur

d. Access to the bridge crane and its cables will normally be over the truck bay to reduce exposure to maintenance personnel

e. Normal operations involving the storage containers and bridge crane can be performed remotely.

11.7.2 Onsite Storage Facility

11.7.2.1 Location

The onsite storage facility is located at the northeast corner of the existing radwaste building (see Figure 11.7-1). The facility's control room, compactor area, offices, and asphalt tank rooms are located adjacent to the north wall of the radwaste building and are attached to the onsite storage facility (see Figures 11.7-1 and 11.7-2). The entire complex is located within the site-protected area.

11.7.2.2 Design Features

11.7.2.2.1 Structural and Architectural

All surfaces in the onsite storage facility are sloped to drainage ditches or drains that are connected with the liquid radwaste collection systems. Rainwater is prevented from entering the facility by a rise in the grade at the entrance of the facility and a drainage ditch that connects to the onsite sewer system. Drains from the heating, ventilating, and air conditioning (HVAC) system are connected to the radwaste collection system.

The onsite storage facility is a non-safety-related structure and is designed and constructed in accordance with the following codes and standards:

a. ACI-318-77: American Concrete Institute, Building Code Requirements for Reinforced Concrete

b. AISC-1978: American Institute of Steel Construction, Specification for the Design Fabrication and Erection of Structural Steel for Buildings

c. ANSI-58.1-72: American National Standards Institute, Building Code Requirements for Minimum Design Loads in Buildings and Other Structures. The wind loading will be based on the 50-year mean recurrence interval

d. UBC-79: Uniform Building Code. The main plant requirements for the operating-basis and safe-shutdown earthquakes will not be considered, in accordance with NRC Generic Letter 81-38. The onsite storage facility is designed to comply with UBC-79 requirements for Seismic Zone 1

e. OSHA: Occupational Safety and Health Administration requirements

f. ACI-531-79: American Concrete Institute, Building Code Requirements for Concrete Masonry Structures

g. NRC Regulatory Guide 1.143: Pipes, joints, and fittings of the piping from the main radwaste system to the piping connection for the portable solidification system.

The onsite storage facility is constructed of the following non-combustible materials:

a. Exterior - reinforced-concrete and reinforced-concrete block walls, reinforced-concrete roof, insulated metal siding, and hollow metal doors

b. Interior - reinforced-concrete walls.

The rooms housing the asphalt storage tank and pumps are constructed of concrete block walls and have approved fire-rated doors (see Figure 11.7-2). Both rooms are accessible only from an outside entrance. A high wall with a door sill that can contain the full contents of a tank rupture is located in the asphalt storage tank room. There are no drains in this room, nor are there any in the adjacent pump room.

To ease any potential problems with decontamination, all floors in the facility are finished with two layers of epoxy coating. The walls are coated to a level of 2 ft above the floor, with the exception of the truck-bay area and the container processing room, where the coating extends to the top of the interior wall.

11.7.2.2.2 Shielding

Shielding has been provided for the onsite storage facility to ensure that the radiation doses resulting from its use and operation will be as low as reasonably achievable (ALARA). In general, the criteria to which shielding is designed are as follows: less than 1.0 mrem/hr in working areas within the facility; less than 0.1 mrem/hr in areas outside the facility; and less than 1.0 mrem/yr in areas at or beyond the boundary of the restricted area. The shielding design assumed the entire storage space to be filled with drums of processed waste, each containing a conservative design-basis source. The shielding design takes into full account such considerations as

a. Direct and scattered radiation paths

b. Ducts and other voids or penetrations in shield walls

c. Multiple radiation sources and source transport paths that may contribute to the dose rate in any given area.

The major components of the shielding design include

a. The facility's outer shield walls, which protect the yard area from direct radiation

b. The facility's roof slab, which protects the yard area from air scatter and the HVAC equipment room from direct radiation

c. The north and south truck-bay shield walls, which protect truck-bay workers from direct radiation

d. The low roof of the truck bay which protects truck-bay workers from the scatter off the main roof slab

e. The shielding around the container processing room, which protects truck-bay workers during the associated operations

f. The storage cell walls, which protect workers during any necessary maintenance in adjoining storage cells

g. The shielding around the dry-active-waste compactor area, which protects surrounding areas from potential sources in this area.

11.7.2.2.3 Radiation Monitoring

Area radiation monitors are provided in the truck-bay area and near the dry-active-waste compactor (see Figure 11.7-2). If predetermined radiation setpoints are exceeded, alarms will be sounded both locally and in the control room of the onsite storage facility.

Effluent radiation monitoring is provided by an off-line noble gas, particulate, and iodine monitor. This system takes a representative sample from the exhaust duct of the HVAC system. The HVAC system is designed to hold the building at a minimum of 1/4-in. negative water gage, thus ensuring that no unmonitored releases can occur. Readings of the noble gas channel will be displayed in the main control room. If predetermined setpoints are exceeded, an alarm will sound.

11.7.2.2.4 Fire Protection

The onsite storage facility is structurally a separate building and is, therefore, a separate fire-protection area. Only a portion of the facility is attached to any other building. The walls, floor, and ceiling of the onsite storage facility are of reinforced concrete or concrete block.

Fire-detection equipment is designed to annunciate and alarm locally and in the control room of the onsite storage facility. Fire-suppression equipment consists of a hydraulically designed sprinkler system. Automatic sprinkler system protection is provided in all areas of the onsite storage facility except the control room, office area, corridor, and empty-drum storage area. Combustible loading in these areas does not justify a suppression system. A manual hose station with enough hose to reach all areas in the onsite storage facility, except the asphalt storage and pump rooms, is located in the truck-bay area. An additional hose reel will be used to access the asphalt storage and pump rooms from the truck bay.

Water is supplied from the existing fire protection system by a 6-in.-diameter header pipe. Fire-suppression water will be collected in the liquid drain trenches and routed to the radwaste treatment system. Inadvertent operation of the automatic fire- suppression system will have no adverse effect upon the ability to shut down the plant.

The HVAC system for the onsite storage facility will automatically shut down on sensing smoke in the outside air supply and exhaust air ducts. Ionization detection is provided in the control room, office area, empty-drum storage area, HVAC room, and asphalt storage and pump rooms. Combustible materials in the storage areas are normally kept in storage containers as described in Section 11.7.1.2, and are protected by an automatic sprinkler system. In addition, the sprinkler system alarms upon activation.

Fire-protection equipment is listed by Underwriters Laboratories. Fire-protection and fire-detection drawings were approved by Edison and its insurer.

Significant quantities of potential combustibles which are stored in the facility are normally kept in storage containers as described in Section 11.7.1.2, which are segregated into two distinct areas (see Figures 11.7-2 and 11.7-3, Sheets 1 through 3). This configuration reduces the probability of ignition to insignificant levels. A portion of the dry-active-waste storage area is used for trash sorting before further processing.

Fire protection for the truck bay is provided by the sprinkler system. The truck-bay area is separated from the storage areas by reinforced-concrete walls. The fire protection system for the onsite storage facility was designed using NFPA-13 for guidance.

The rooms housing the asphalt storage tank and pumps contain 3-hr fire-barrier walls and doors, even though no plant safety-related equipment is located therein. They also contain an automatic fire-detector and sprinkler system. The HVAC systems for these rooms are completely separate from the rest of the storage facility, with no interactions possible, and fusible links automatically close the fire dampers in the HVAC systems in the rooms in case of fire.

The onsite storage facility is separated from the radwaste building with a 3-hr fire barrier except for the door opening to the access aisle which is a nonrated metal door. However, the door leads to a corridor that is a low-combustible area.

11.7.2.2.5 Flood Protection

The onsite storage facility is located above the maximum flood elevation of 586.9 ft. The drum storage area is at Elevation 587.0 ft. This is 4 ft above the plant grade elevation of 583.0 ft. Therefore, flooding is not considered a design-basis event.

11.7.2.2.6 Tornado Protection

The minimum thickness of concrete walls below Elevation 624 ft is 54 in.; above Elevation 624 ft, it is 28 in. The minimum thickness of the concrete slab for the roof is 24 in. It is unlikely that a tornado would damage a building with this structural integrity to the extent that the building's contents would be scattered. Therefore, a tornado is not considered a design-basis event.

11.7.2.2.7 Facility HVAC Systems

The HVAC system in the onsite storage facility is composed of (1) the heating and ventilating system for the onsite storage facility; (2) the HVAC system for the onsite storage facility control room and offices; (3) the heating and ventilating system for the asphalt storage pump room; (4) the heating and ventilating system for the asphalt storage tank room; and (5) the heating and ventilating system for the HVAC equipment room. Each system is described below.

11.7.2.2.7.1 Onsite Storage Facility Heating and Ventilating System

The heating and ventilating system for the onsite storage facility is designed to maintain a suitable environment for equipment and for proper air flow from normally accessible areas to potentially contaminated areas. The system is also designed to maintain the facility at a 1/4-in. water gage negative pressure with respect to the ambient air to minimize the release of potentially contaminated air to the outside. The exhaust air is filtered to remove any radioactive particulates and is monitored before its release to the environs.

The system is designed to maintain a minimum temperature of 50°F in all areas and to limit the maximum temperatures to 104°F in the truck-loading area, the empty-drum area, the compactor area, and the aisle, and to 110°F in the remaining areas.

The system provides 100-percent outside air by two 50 percent- capacity supply systems, each consisting of an air-intake louver, a prefilter, a medium-efficiency filter, an electric blast coil, a fan, and associated controls. The air is exhausted through prefilters and high-efficiency particulate air (HEPA) filters and is monitored before its release to the outdoors. Electric unit heaters are provided to offset the heat loss due to the infiltration of air in the truck-loading area. All the major equipment of the system is located in the HVAC equipment room.

11.7.2.2.7.2 Control Room and Offices HVAC System

The HVAC system for the control room and offices is designed to maintain a suitable environment for the comfort of personnel and for proper functioning of the equipment. A minimum of 20 percent outside air is provided to maintain a positive pressure with respect to the outside and to remove odors.

The HVAC system is designed to maintain a temperature of 75°F ± 2°F year round. It consists of (1) a packaged cooling unit comprising an air-cooled condensing unit, a filter, a DX coil, and a supply fan; and (2) zone electric heating coils for winter heating.

The packaged cooling unit is located on the roof of the asphalt storage tank room, and the electric heating coils are located in the supply ductwork.

11.7.2.2.7.3 Asphalt Storage Tank Room, Asphalt Storage Pump Room, and HVAC Equipment Room Heating and Ventilating Systems

These three heating and ventilating systems are designed to maintain a suitable environment for the equipment housed in each room.

The heating and ventilating system for the asphalt storage tank room is designed to limit summer and winter temperatures to a maximum of 110°F and a minimum of 50°F, respectively. The system consists of an air-intake louver, an exhaust fan, control dampers, and unit heaters.

The heating and ventilating systems for the asphalt storage pump room and the HVAC equipment room are designed to limit summer and winter temperatures to a maximum of 104°F and a minimum of 50°F, respectively. Each system consists of an air-intake louver, a supply fan, control dampers, and unit heaters. The heating and ventilating system for the HVAC equipment room provides 1000-cfm outside air to maintain the room at a positive pressure with respect to the ambient air.

The equipment for each of these systems is located in its respective room.

11.7.2.2.8 Provisions for Liquid Drainage

The onsite storage facility is provided with an extensive system of drains and trenches. All surfaces in the facility are sloped so that any spillage is directed toward one or more of the drains. Because of this network, permanent curbs are not provided.

Drains in potentially contaminated areas of the onsite storage facility are routed directly to the floor drain collector subsystem of the liquid radwaste system. These include drains in the drum-storage areas, the truck-bay area, the HVAC equipment room, and the drum-compactor area. These drains are adequately sized for all normally expected influents and will also drain water from the fire-suppression system.

11.7.2.2.9 Container-Handling Systems

Within the storage structure proper, containers are handled by a 10-ton electric overhead traveling bridge crane, by forklift truck or, when radiation levels allow, by hand truck. The bridge crane is remotely operated from the control room located in the annex structure. The crane system is designed for precise placement of the containers. The bridge and trolley is accurately positioned by the use of a closed-circuit television (CCTV) monitoring system and a coordinate target system. Dedicated TV cameras mounted on the trolley are directed at the indices of each of two perpendicular coordinates: One coordinate hangs from a crane rail, and the other is attached to a wall. This system enables the operator to accurately position the bridge and trolley by viewing the TV monitor and lining up cross hairs on the camera system with the appropriate coordinate. Additional dedicated TV cameras are mounted in the drum accumulator-conveyor (see Subsection 11.7.3.1) and in the container processing room.

Downward-viewing TV cameras mounted on the bridge crane and incandescent lights provide a view of the area below the bridge on three control-console monitors. In addition, a solid-state digital grab elevation readout is located on the control console. The readout tells the operator the height of the grab above a fixed reference point.

The drum grab is designed to lift drums weighing up to 6000 lb and has the capability to handle closed-head drums. It is supplied with a motor-operated jaw actuator for positive load-release control. For the jaw to operate, the cable has to be slack (no load). This ensures positive control.

For personnel safety and to assist positioning accuracy, containers must be raised to the full up position before high-speed operation is possible with the bridge or trolley. In this position, the container is between the bridge beams. It will clear all obstacles cleared by the crane and is supported to eliminate swinging.

The bridge crane is capable of placing containers into any storage bay, the pallet room, the container processing room, onto the conveyor, and onto a truck.

Crane bearings inside gear cases and high-speed gearing bearings are splash lubricated. Other bearings are lifetime lubricated. A weight-type hoist limit switch is provided for the upper hoist limit, and a screw-type limit switch is provided for upper and lower limits. A tipped drum uprighting attachment will be used if necessary. Two bridge motors with separate bridge circuitry are provided so that if one motor fails, the other can be used as a backup. Eye-bolts are attached to the bridge to allow towing of the crane by a building-mounted winch if both motors become defective. Magnetic-particle testing has been used by the manufacturer to determine the presence of discontinuities at or near the surface of the crane hook, lifting eyes, and all weldments.

11.7.2.2.10 Compaction

To decrease the volume of solid waste, the onsite storage facility contains a high-efficiency, in-drum, ram-head compactor system with a filtration and ventilation system.

The ventilation system controls any contaminated particles that may be released while the packaging equipment is being operated. The compacting press has an air exhaust system, consisting of a hood, a prefilter and absolute filter, and an exhaust fan.

This system is so arranged that when the ram descends to compress waste material, the air exhaust system is in position to filter the air from the drum as the material is compressed.

When the compactor is used, the compressible trash, which is made up of low-activity material, including glass, paper, rags, mop heads, booties, gloves, and towels, is normally transported to the compactor room in plastic bags. The trash is then placed in the drums and compacted. When a drum is filled, the top is fastened onto the drum, and a forklift truck or, when radiation levels allow, a hand truck is used to transport the drum from the compactor room to drum-staging or drum-storage areas.

11.7.2.2.11 Temporary Processing

Permanent piping is routed from the radwaste system to the onsite storage facility to allow vendor processing and/or solidification of wet waste in the truck-bay area and adjoining rooms.

All pipes run in a shielded pipe tunnel beneath the storage facility and conform to ANSI B31.1. An access hatch to the pipe tunnel beneath the storage facility is located in the truck bay area. The radwaste pipelines terminate in the truck bay (see Figure 11.7-2). A blind flange is at the termination of each line. Each pipeline is capable of being flushed as necessary with condensate. Water decanted from processed waste in the truck bay will be returned through the pipelines to the liquid radwaste system in the radwaste building. When vendor processing is utilized, the wet waste will be pumped through the pipelines to commercial process equipment provided by the vendor. The permanent radwaste piping will be connected at the flange fittings to the equipment provided by the vendor. Details concerning the vendor-supplied mobile processing equipment are given in Subsections 11.2.10 and 11.5.6.

11.7.3 Operations

11.7.3.1 Storage

The asphalt solidification system in the radwaste building dewaters and solidifies the radwaste in 55-gal drums; these drums can be moved from the radwaste building to the onsite storage facility by the method described in Section 11.5.

Drums of compacted waste are normally brought into the facility by a forklift truck or, when radiation levels allow, by a hand truck. The crane can then lift each drum and perform essentially the same functions as with the drums of solidified waste. Alternatively, the forklift or hand truck can be used to place the drums of compacted waste into storage.

The facility is designed for one-on-one stacking of 55-gal drums, up to eight layers in height, with steel grating between each layer. Tests performed for Sargent & Lundy Engineers indicate that the maximum compressive load that an 18-gage 55-gal DOT-17H drum can carry before failure is approximately 6000 lb. During storage, a 17H drum on the bottom layer (with seven layers above) will be subjected to a maximum compressive load of 3395 lb, which is only 57 percent of the failure load. Drum manufacturers' data indicate that the maximum compressive load a 55-gal DOT-17E drum can withstand before failure is 10,000 lb. During storage, a 17E drum on the bottom layer will be subjected to a maximum compressive load of 4970 lb. Thus, the maximum load that a 17E drum on the bottom layer will be subjected to is only 50 percent of the failure load. This provides confidence that eight-high drum stacking is safe and justifiable for 55-gal drums. The dry active waste can be stored in 55-gal drums having the same dimensional, physical, and strength characteristics as Department of Transportation (DOT) type 17H drums. The solidified waste will be stored in drums having the same dimensional, physical, and strength characteristics as DOT type 17E drums. In such cases, eight-drum stacking is possible. When other storage containers (liners, HICs, non-standard drums, etc.) are utilized, eight-high stacking would not be used.

The storage facility is separated into cubicles by inner walls. This allows the potential segregation of waste containers by radioactivity level and/or waste type. Compacted dry active waste can be stored separately from processed waste. Also, sample drums from each batch of solidified radwaste resins can be stored in the test and sample area of the onsite storage facility (see Figure 11.7-2).

A record board is located in the control room of the onsite storage facility, which can be used to record the position of all containers stored in the facility. The board consists of a plan view of the storage areas, with container setdown positions identified by alphanumeric designations that correspond to the bridge crane coordinate grid system. The operator can place a tag on the board for each container. The tag can contain such information as container number, weight, radiation level, and date of storage, etc.

11.7.3.2 Loading

Retrieving containers of processed waste from storage for offsite disposal is also performed with the bridge crane. Retrieval of drums of compacted trash will be done by either a forklift truck, a hand truck, or the bridge crane. Containers of processed waste are picked up from storage and loaded into a truck (for drums, one method is by use of a circular shipping pallet) for ultimate offsite disposal. Drums of compacted trash are placed onto transport vehicles by the bridge crane, forklift truck, or hand truck.

If a drum of asphalted waste were accidentally dropped while being manipulated from the bridge crane, no airborne radioactive material would be released because the waste, being solidified in asphalt, is inherently bound within this matrix. The bridge crane is designed to have the capability of righting a fallen drum.

11.7.4 Radiological Assessment: ALARA Doses

Design features included to ensure that doses due to external radiation sources are ALARA are described in Subsection 11.7.2.2.1.

Control of potential airborne contamination is provided by an HVAC design that ensures that air will flow from areas of lesser potential contamination to areas of greater potential contamination. Specifically, air will tend to flow

a. From outside the facility to inside the facility

b. From the truck-bay to the drum-storage area

c. From the control room and offices to the compactor area for dry active waste.

Measures have been taken to provide airflow barriers in the two openings between the two buildings so as to minimize any differential flow.

The exhaust of the dry-active-waste compactor is filtered and routed directly to the facility's exhaust to minimize airborne contamination.

All drain lines that are potential pathways for airborne cross-contamination are trapped and provided with fill lines.

Control of surface contamination is provided by segregating clean areas (the control room and offices) from potentially contaminated areas (the drum-storage, truck-bay, and dry-active-waste compactor areas).

All lines and equipment in the facility that can carry radioactive sources are capable of being flushed after use.

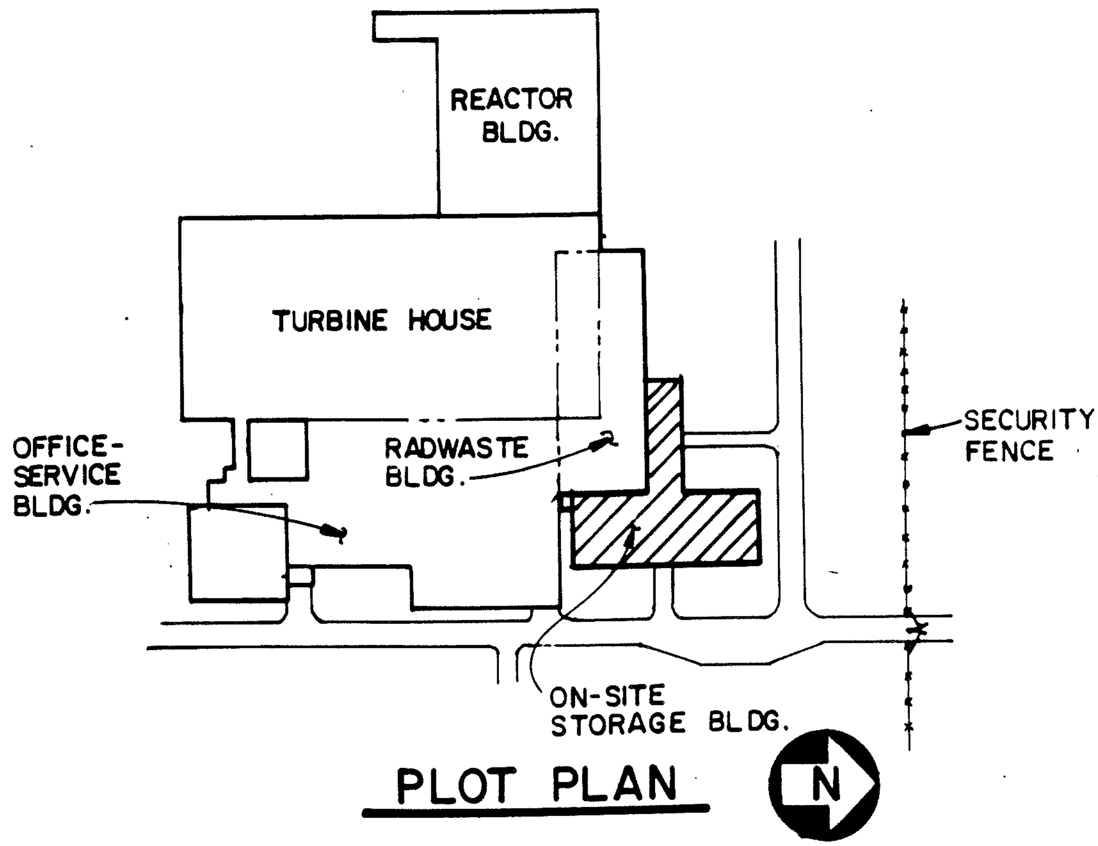
11.7.4.1 Onsite Doses

The building shielding is sufficient to reduce the dose rates from the drums to persons at the site to acceptably low levels (see Subsection 11.7.2.2.2). The potential for significant airborne or surface contamination is very remote, and the overall design of the facility is in accordance with the ALARA philosophy.

11.7.4.2 Offsite Doses

The design of the facility ensures that the annual dose to the unrestricted area will be below 1.0 mrem/yr (see Subsection 11.7.2.2.2), in compliance with 40 CFR 190.

Although no radioactivity is expected to be released from this facility under normal conditions, the single controlled atmospheric release path is monitored (see Subsection 11.7.2.2.3) in accordance with 10 CFR 50, Appendix A.



Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.7-1

ONSITE STORAGE FACILITY
PLOT PLAN

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Refer to Plant Drawing A-2438

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.7-2

ONSITE STORAGE FACILITY FLOOR PLAN

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Refer to Plant Drawing A-2438

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.7-3, SHEET 1

ONSITE STORAGE FACILITY CROSS SECTION

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Refer to Plant Drawing A-2438

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.7-3, SHEET 2

ONSITE STORAGE FACILITY CROSS SECTION

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Refer to Plant Drawing A-2438

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 11.7-3, SHEET 3

ONSITE STORAGE FACILITY CROSS SECTION

11.8 ISFSI STORAGE PAD

The Independent Spent Fuel Storage Installation (ISFSI) storage pad provides a level resting surface for dry fuel storage casks. The pad is a 141' by 141' square reinforced concrete structure that is two feet thick designed to accommodate sixty four dry storage casks. The pad is compliant with ACI 349, "Code Requirements for Nuclear Safety-Related Concrete Structures," 2001, and designed in accordance with NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities." The pad is surrounded by a fence with signage identifying the location as a radiologically controlled area. The pad is also surrounded by a subsurface drainage system to minimize the effects of freeze and thaw cycles on the soil under the pad to preclude soil displacement. Additional information regarding the ISFSI storage pad is available in the Holtec Final Safety Analysis Report for their HI-STORM 100 Cask System to which Fermi 2 is a declared general licensee in accordance with 10CFR72.

I. INTRODUCTION

This Appendix was prepared to demonstrate compliance of the Enrico Fermi Atomic Power Plant Unit 2 with Section II of Appendix I of 10 CFR Part 50 (Reference 1). Applicable portions of Section II of Appendix I specifically set forth the following design objectives:

A. The calculated annual total quantity of all radioactive material above background to be released from each light-water-cooled nuclear power reactor to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.

B.1. The calculated annual total quantity of all radioactive material above background to be released from each light-water-cooled nuclear power reactor to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of 10 millirads for gamma radiation or 20 millirads for beta radiation.

B.2. Notwithstanding the guidance of paragraph B.1:

(a) The Commission may specify, as guidance on design objectives, a lower quantity of radioactive material above background to be released to the atmosphere if it appears that the use of the design objectives in paragraph B.1 is likely to result in an estimated annual external dose from gaseous effluents to any individual in an unrestricted area in excess of 5 millirems to the total body; and

(b) Design objectives based upon a higher quantity of radioactive material above background to be released to the atmosphere than the quantity specified in paragraph B.1 will be deemed to meet the requirements for keeping levels of radioactive material in gaseous effluents as low as practicable if the applicant provides reasonable assurance that the proposed higher quantity will not result in an estimated annual external dose from gaseous effluents to any individual in unrestricted areas in excess of 5 millirems to the total body or 15 millirems to the skin.

C. The calculated annual total quantity of all radioactive iodine and radioactive material in particulate form above background to be released from each light-water-cooled nuclear power reactor in effluents to the atmosphere will not result in an estimated annual dose or dose commitment from such radioactive iodine and radioactive material in particulate form for any individual in an unrestricted area from all pathways of exposure in excess of 15 millirems to any organ.

This Appendix also supplies the responses requested of Detroit Edison Company by NRC letter, R. C. DeYoung to H. Tauber, dated February 23, 1976. The information requested was in the form of two enclosures. Enclosure 1 provided guidance for use in the evaluation of Appendix I. Enclosure 2 requested additional information which would be used by NRC in their evaluation of Section II of Appendix I. Tables I-1 and I-2 provide cross references to the location of the information requested by Enclosures 1 and 2, respectively. References to the FSAR in Tables I-1 and I-2 refer to the original FSAR.

Detroit Edison chose to comply with 10 CFR 50, Appendix I, Section II.D, for Fermi 2 by choosing the option of showing compliance with the design objectives of RM-50-2 as an optional method of demonstrating compliance with the cost-benefit analysis of Section II.D.

Tables 4.7 and 4.8 of NUREG-0769, "Draft Environmental Statement Related to the Operation of Enrico Fermi Atomic Power Plant, Unit No. 2" demonstrate compliance with the design objectives of Appendix I and RM-50-2, respectively.

TABLE I-1 LOCATION OF ENCLOSURE 1 GUIDANCE[a.]

Item	Guidance	Location
1.	Licensees should provide an evaluation showing their facility capabilities to meet the requirements set forth in Section II of Appendix I to 10 CFR Part 50.	This Appendix is the evaluation.
2.	Radioactive source terms used in the evaluation should be consistent with the parameters and methodology set forth in Draft Regulatory Guide 1.BB and 1.CC (as appropriate). Note: For BWR's, gaseous releases from the containment building and auxiliary building should be combined with the reactor building release for pre-BWR/6 Mark III Containment designs.	Annex A provides the source term information.
3.	Meteorology/hydrology information used in the calculation of doses should be consistent with Draft Regulatory Guides 1.DD and 1.EE.	Annex B provides the meteorology dispersion information. The hydrology dispersion information is provided in Section III of this Appendix.
4.	Dose calculations should be consistent with Draft Regulatory Guide 1.AA.	Sections III and IV provide the description of the models used.

TABLE I-1 LOCATION OF ENCLOSURE 1 GUIDANCE[a]

Item	Guidance	Location
5.	Effluent release data from previous reactor operation should be provided, if available, for use in evaluating the source term calculations. Such data should include at least one full year of effluent release data tabulated by effluent release point, month, mode of operation (e.g., full power operation, refueling shutdown), excluding the first year of reactor operation.	Effluent release data are not available since Fermi 2 is not yet operational.
6.	The above evaluations should be accomplished by the information requested in Enclosure 2.. Exceptions from the information requested will be considered on a case-by-case basis.	Table I-2 provides a cross reference to the Enclosure 2 information.
7.	The staff is preparing standard Technical Specifications and will issue further guidance to licensees regarding changes to Technical Specifications to implement Appendix I objectives. Proposed revisions to Technical Specifications by licensees based on the limiting conditions for operation set forth in Section IV of Appendix I should be withheld pending further guidance from the staff.	Fermi 2 Technical Specifications are based on the BWR 4 STS effective in 1982.

[a] Draft Regulatory Guide 1.AA is now Regulatory Guide 1.109.
Draft Regulatory Guides 1.BB and 1.CC are now Regulatory Guide 1.112.
Draft Regulatory Guide 1.DD is now Regulatory Guide 1.111.
Draft Regulatory Guide 1.EE is now Regulatory Guide 1.113.

TABLE I-2 LOCATION OF ENCLOSURE 2 REQUESTED INFORMATION[a.]

Item	Request	Location
1.	Provide the information requested in Appendix D of Draft Regulatory Guide 1.BB or 1.CC, as appropriate.	Annex A.
2.	Provide, in tabular form, the distances from the centerline of the first nuclear unit to the following for each of the 22-1/2 degree radial sectors centered on the 16 cardinal compass directions: a) nearest milk cow (to a distance of 5 miles) b) nearest meat animal (to a distance of 5 miles) c) nearest milk goat (to a distance of 5 miles) d) nearest residence (to a distance of 5 miles) e) nearest vegetable garden greater than 500 ft^2 (to a distance of 5 miles) f) nearest site boundary. For radioactivity releases from stacks which qualify as elevated releases as defined in Draft Regulatory Guide 1.DD, identify the locations of all milk cows, milk goats, meat animals, residences, and vegetable gardens, in a similar manner, out to a distance of 3 miles for each radial sector.	Table 3.1 of Annex B.
3.	Based on considerations in Draft Regulatory Guide 1.DD, provide estimates of relative concentration (χ/Q) and deposition (D/Q) at locations specified in response to Item 2 above for each release point specified in response to Item 1 above.	Tables 3.3 through 3.8 of Annex B.
4.	Provide a detailed description of the meteorological data, models and parameters used to determine the χ/Q and D/Q values. Include information concerning the validity and accuracy of the models and assumptions for your site and the representativeness of the meteorological data used.	Sections 1 through 3 of Annex B.

TABLE I-2 LOCATION OF ENCLOSURE 2 REQUESTED INFORMATION[a.]

Item	Request	Location
5.	If an onsite program commensurate with the recommendations and intent of Regulatory Guide 1.23 exists. a) Provide representative annual and monthly, if available, joint frequency distributions of wind speed and direction by atmospheric stability class covering at least the most recent one-year period of record, preferably two or more years of record. Wind speed and direction should be measured at levels applicable to release point elevations, and stability should be determined from vertical temperature gradient between measurement levels that represent conditions into which the effluent is released. b) Describe the representativeness of the available data with respect to expected long-term conditions at the site.	a) Annex B and Reference 3 of Annex B b) Reference 2 of Annex B
6.	If recent onsite meteorological data are not available, or if the meteorological measurements program does not meet the recommendations and intent of Regulatory Guide 1.23: a) Provide …	Onsite meteorological data are available that meet Regulatory Guide 1.23 (Reference 2)
7.	Describe airflow trajectory regimes of importance in transporting effluents to the locations for which dose calculations are made.	References 2 and 3 of Annex B, ER Section 2.6.2.4.2, and FSAR. Sections 2.3.2.3 and 2.3.2.4.2 (References 3 and 4).

TABLE I-2 LOCATION OF ENCLOSURE 2 REQUESTED INFORMATION[a.]

Item	Request	Location
8.	Provide a map showing the detailed topographical features (as modified by the plant), on a large scale, within a 10-mile radius of the plant, and a plat of the maximum topographic elevation versus diatance from the center of the plant in each of the sixteen 22-1/2 degree cardinal compass point sectors (centered on the true north), radiating from the center of the plant, to a distance of 10 miles.	According to NRC Procedure RPOP-514 Revisions 2 and 3, copies of topographical maps submitted to NRC under separate cover. Figure 2.6-37 through Figure 2.6-38 (sheet 3) of ER. Figure 2.3-37 through Figure 2.3-38 (sheet 3) of FSAR.
9.	Provide the dates and times of radioactivity releases from intermittent sources by source location bases on actual plant operation and, if available, appropriate hourly meteorological data (i.e., wind direction and speed, and atmospheric stability) during each period of release.	Fermi is not yet operational.

[1.] Draft Regulatory Guide 1.AA is now Regulatory Guide 1.109.
Draft Regulatory Guides 1.BB and 1.CC are now Regulatory Guide 1.112.
Draft Regulatory Guide 1.DD is now Regulatory Guide 1.111.
Draft Regulatory Guide 1.EE is now Regulatory Guide 1.113.

II. SUMMARY AND CONCLUSIONS

This evaluation shows that the doses associated with the proposed operation of Fermi 2 at uprated power conditions (3486 MWt) meet the Appendix I objectives. Maximum individual doses have been estimated under normal operating conditions using site dispersion characteristics, 3499 MWt (102 percent of 3430 MWt), and a power uprate scale-up factor of 1.04 (Table 11.1-1).

For liquid effluents, the doses are:

A. 0.0048 mrem to the total body

B. 0.077 mrem to the bone (maximum dose to an organ).

For airborne releases, the doses are:

A. 4.93 mrad/year gamma air dose at the site boundary

B. 2.79 mrad/year beta air dose at the site boundary

C. 0.75 mrem/year total body dose to the maximum individual

D. 3.80 mrem/year skin dose to the maximum individual

E. 11.64 mrem/year thyroid dose to the maximum individual from radioactive iodine and radioactive material in particulate form.

The detailed breakdowns of doses are given in Tables III-2 and IV-3 for the liquid and gaseous effluents, respectively.

III. RADIATION EXPOSURE FROM LIQUID EFFLUENTS

Small amounts of liquid radwaste from Fermi 2 will be released to Lake Erie via discharge into the circulating water reservoir blowdown line which provides a minimum dilution flow of 10,000 gpm. The discharge point is shown in Figure III-1.

Dilution of the blowdown is provided by the material mixing characteristics of Lake Erie in the vicinity of the discharge. The estimated annual activity liquid releases (Table 5 of Annex A) were calculated in accordance with Regulatory Guide 1.112 (Reference 5).

A. Estimated Liquid Dilution Factors

For the evaluation of the maximum individual exposures from liquid effluents, two locations for dilution factor calculations were selected. These two locations were the nearest shoreline resident northeast and south of the site boundary. In addition, the dilution factor for the Monroe water intake approximately 2 miles south of the Fermi 2 discharge was also calculated, since it was assumed that the nearest shoreline resident to the south would drink water from this source.

The dilution calculations were based on the analysis presented previously in Section 5.1 of the ER and on Equation 17 of Regulatory Guide 1.113 (Reference 6). Although 3 decant pumps are available for use (Section 10.4.5.2), only 2 pumps are operated during liquid radwaste releases. The relative frequency of discharge flow (either 10,000 or 20,000 gpm) was taken from Table 3.4-1 of the ER, yielding a flow rate of 20,000 gpm 9 percent of the time on an annual basis. Lake Erie current direction frequencies were taken as 40 percent toward the south and 60 percent toward the north. For the dilution factor to the north, no additional dilution by Swan Creek was assumed.

In addition it was assumed that locations south of the discharge would be affected by all southerly flowing currents, and those to the north by all northerly flowing currents. The recirculation factor was calculated to be 0.020 with a travel time for the recirculated water (discharge to intake) of 0.672 hour. The dilution factors were calculated to be:

1. 45 at 1770 meters northeast of Fermi 2
2. 67 at 1530 meters south of Fermi 2
3. 77 at 3200 meters south of Fermi 2
4. 100 at distances greater than 3200 meters.

B. Estimated Radiation Exposure

The maximum individual for liquid exposure was assumed to be located, as discussed in Section III.A above, at 1770 meters northeast of Fermi 2 and 1530 meters south of Fermi 2. The resident south was assumed to drink potable water obtained from the Monroe water intake located 3200 meters south of Fermi 2. The resident north was assumed to obtain his potable water from the Detroit municipal water system, which will be unaffected by Fermi 2 operation. Table III-1 presents conservative usage factors for liquid exposures. The activities usage factors represent 2 hours per day for boating, swimming, and shoreline use, each for a period of 90 days per year for the teenager and child, while the adult will participate one hour per day in each activity. The ingestion rates are those recommended by Regulatory Guide 1.109 (Reference 7).

The liquid effluents given in Table 5 of Annex A were used as input into the NRC computer code LADTAP II (Reference 9), which uses Regulatory Guide 1.109 models. The usage factors of Table III-1, the minimum dilution flow of 10,000 gpm, and the appropriate dilution factors in Lake Erie were used. The doses to the individual are presented in Table III-2.

TABLE III-1 MAXIMUM INDIVIDUAL USAGE FACTORS FOR LIQUID EXPOSURES

	Activities							
	Adult		Teenager		Child		Infant	
Pathway	hr/day	hr/yr	hr/day	hr/yr	hr/day	hr/yr	hr/day	hr/yr
Boating	1	90	2	180	2	180	0	0
Swimming	1	90	2	180	2	180	0	0
Shoreline	1	90	2	180	2	180	1	90

	Ingestion (kg/yr)			
	Adult	Teenager	Child	Infant
Fish	21	16	6.9	0
Invertebrate[a]	5	3.8	1.7	0
Water	730	510	510	330

[a] Includes crustacean and molluses.

TABLE III-2 MAXIMUM DOSES TO AN INDIVIDUAL RESULTING FROM FERMI 2 LIQUID EFFLUENTS (3499 MWt)

	Dose to a Child (mrem/year)	
Pathway	Total Body	Bone (Maximum Organ)
	Residents 1770 meter NE	
Fish ingestion	0.00343	0.07304
Invertebrate ingestion	0.00029	0.000385
Shoreline	0.00006	0.00006
Swimming	0.00004	0.00004
Boating	0.00003	0.00002
Total	0.0039	0.077
	Residents 1530 meters S	
Fish ingestion	0.00229	0.04911
Invertebrate ingestion	0.00021	0.00260
Drinking water	0.00223	0.00019
Shoreline	0.00004	0.00004
Swimming	0.00002	0.00002
Boating	0.00001	0.00001
Total	0.0048	0.052

IV. RADIATION EXPOSURES FROM GASEOUS EFFLUENTS

Gaseous source terms are based on the NRC GALE computer code and input data as presented in Annex A. The radioisotopic source terms are given in Table IV-1. The dose calculations are based on the NRC GASPAR computer code, using the models of Regulatory Guide 1.109.

For power uprate (3486 MWt), a scale-up factor of 1.04 was used to update the data in Table IV-1.

Dose contributions from the following pathways, where appropriate, were calculated:

1. Immersion in the plume
2. Ground contamination
3. Inhalation
4. Consumption of vegetables, meat, and milk.

The following data presented in Appendix A.IV was originally generated prior to plant operation and was scaled for power uprate. It is considered historical, and a more accurate presentation of the radioactive elements annually released from Fermi 2 can be found in the Annual Radioactive Effluent Release Report.

A. Gaseous Dispersion Factors

Annex B details the meteorological methodology and calculations. In summary, the data was based on a full year of site measurements (June 1, 1974, to May 31, 1975) taken and reduced in accordance with Regulatory Guide 1.23. Straightline air flow χ/Q's were calculated, with appropriate depletion and terrain correction factors in accordance with Regulatory Guide 1.111 (Reference 8). Table 3.2 of Annex B lists and describes the release points. Due to the characteristics of the release points, all three vent release points were considered as mixed-mode sources.

The containment building vent emits radioactivity from the containment, the auxiliary buildings, the gland seal, the condenser offgas system, and the mechanical vacuum pumps. The turbine building and radwaste building each releases radioactivity through its own vent. In addition, the following are assumed to be released from the containment building vent: 26.0 Ci/yr of argon-41, 9.9 Ci/yr of carbon-14, and 75 Ci/yr of tritium.

Figure III-1 shows the location of the three release points for gaseous effluents. Tables 3.3 through 3.8 of Annex B present the χ/Q and D/Q values for all of the locations listed in Table 3.1 of Annex B.

B. Gaseous Radiation Exposures

From examination of the χ/Q values, the landward site boundary direction that would result in the maximum beta and gamma air doses was determined to be the northwest direction at 915 meters. From the land use and meteorological information presented in Table 3.1 and Tables 3.3 through 3.8 of Annex B, the location of the worst plume dose was determined to be the residence at 1130 meters west-northwest of Fermi 2. The location of the worst consumptive pathway was determined by analyzing doses at two locations in detail, the garden at 1120 meters west-northwest, and the milk goat at 3180 meters northwest.

Table IV-2 summarizes the χ/Q and D/Q data used in GASPAR. Standard usage factors as specified in Regulatory Guide 1.109 were assumed. For the goat milk pathway, the χ/Q and D/Q values obtained for the grazing season were used. It has been determined that the goat is fed almost entirely on supplemental feed and is not grazing on open pasture. For conservatism, it was assumed that only 50 percent of the goat's diet was supplemental feed.

Additionally the goat milk-infant pathway need not be evaluated, since the youngest family member of the goat's owner is approximately 2 years old.

GASPAR does not calculate the effects of radiation exposure from a finite cloud emanating from an elevated release. The gamma air dose and total body and skin doses must incorporate the combined effects of both elevated and ground-level releases occurring during mixed-mode release. GASPAR accounts for the gamma ground level and total beta exposures (both elevated and ground). The elevated gamma doses are accounted for by the use of the NUS computer code FIDOS (FInite DOSe).

FIDOS calculates the gamma air dose from a finite cloud. The basis for the calculation is Equation B-1 of Regulatory Guide 1.109. As can be noted in Equation B-1, the gamma air dose is a direct function of both the energies emitted by each nuclide and the air absorption factor. In order to avoid handling each specific gamma energy emitted by each nuclide, the gamma energies were combined into groups. Decay was calculated during travel from the release point to the receptor location for each nuclide as a function of the wind speed within each stability class. The cloud inventory, the release height, and the receptor location are used as input combined with the joint frequency distributions described in Section 2.3 of Annex B.

The gamma air dose as calculated by FIDOS was corrected by the ratio of the energy absorption coefficient for tissue to that of air and by the application of a shielding factor of 0.7 to derive the total body dose. The skin dose was computed by combining the ground level-gamma and total beta contributions obtained from GASPAR with the elevated gamma contribution from FIDOS as corrected for tissue absorption and shielding.

Table IV-3 presents the results of the dose evaluation. As can be seen in the table, the doses are within the limits specified by Section II of Appendix I.

TABLE IV-1 ANNUAL GASEOUS EFFLUENTS FROM EACH RELEASE POINT (3499 MWt)

		Release Point	
Isotope	Containment Building (Ci)	Turbine Building (Ci)	Radwaste Building (Ci)
H-3	7.49×10^{1}	(a)	(a)
C-14	9.88	(a)	(a)
Ar-41	2.6×10^{1}	(a)	(a)
Kr-83m	5.31×10^{1}	0	0
Kr-85m	9.88×10^{1}	7.08×10^{1}	0
Kr-85	2.91×10^{2}	0	0
Kr-87	3.29×10^{2}	1.35×10^{2}	0
Kr-88	3.29×10^{2}	2.39×10^{2}	0
Kr-89	1.35×10^{3}	0	0
Xe-131m	7.28	0	0

TABLE IV-1 ANNUAL GASEOUS EFFLUENTS FROM EACH RELEASE POINT (3499 MWt)

Isotope	Release Point Containment Building (Ci)	 Turbine Building (Ci)	 Radwaste Building (Ci)
Xe-133m	4.16	0	0
Xe-133	2.72×10^{3}	2.60×10^{2}	1.04×10^{1}
Xe-135m	1.33×10^{2}	6.76×10^{2}	0
Xe-135	7.89×10^{2}	6.56×10^{2}	4.68×10^{1}
Xe-137	1.56×10^{3}	0	0
Xe-138	1.26×10^{3}	1.46×10^{3}	0
I-131	4.20×10^{-1}	1.98×10^{-1}	5.20×10^{-2}
I-133	1.57	7.91×10^{-1}	1.87×10^{-1}
Cr-51	6.24×10^{-4}	1.35×10^{-2}	9.36×10^{-5}
Mn-54	6.24×10^{-3}	6.24×10^{-4}	3.12×10^{-4}
Fe-59	8.32×10^{-4}	5.20×10^{-4}	1.56×10^{-4}
Co-58	1.25×10^{-3}	6.24×10^{-4}	4.68×10^{-5}
Co-60	2.08×10^{-2}	2.08×10^{-3}	9.36×10^{-4}
Zn-65	4.16×10^{-3}	2.08×10^{-4}	1.56×10^{-5}
Sr-89	1.87×10^{-4}	6.24×10^{-3}	4.68×10^{-6}
Sr-90	1.04×10^{-5}	2.08×10^{-5}	3.12×10^{-6}
Zr-95	8.32×10^{-4}	1.04×10^{-4}	5.20×10^{-7}
Sb-124	4.16×10^{-4}	3.12×10^{-4}	5.20×10^{-7}
Cs-134	8.32×10^{-3}	3.12×10^{-4}	4.68×10^{-5}
Cs-136	6.24×10^{-4}	5.20×10^{-5}	4.68×10^{-6}
Cs-137	1.14×10^{-3}	6.24×10^{-4}	9.36×10^{-5}
Ba-140	8.43×10^{-4}	1.14×10^{-2}	1.04×10^{-6}
Ce-141	2.08×10^{-4}	6.24×10^{-4}	2.71×10^{-5}

[a] Isotope was assumed to be released only from the containment building.

TABLE IV-2 SELECTED χ/Q AND D/Q VALUES BASED ON ANNUAL DATA

Uses	Direction, Distance	Containment Building		Turbine Building		Radwaste Building	
		χ/Q	D/Q	χ/Q	D/Q	χ/Q	D/Q
Site Boundary	NW 915 meters	7.630×10^{-7}	2.010×10^{-8}	4.186×10^{-6}	5.395×10^{-8}	1.772×10^{-6}	3.238×10^{-8}
Residence and Garden	WNW 1130 meters	5.922×10^{-7}	1.376×10^{-8}	2.394×10^{-6}	3.215×10^{-8}	1.368×10^{-6}	2.222×10^{-8}
Milk Goat[(a)]	NW 3180 meters	6.581×10^{-8}	1.075×10^{-9}	1.759×10^{-9}	1.853×10^{-9}	1.146×10^{-7}	1.343×10^{-9}
Residence	NW 3180 meters	1.138×10^{-7}	1.534×10^{-9}	3.257×10^{-7}	2.829×10^{-9}	1.988×10^{-7}	1.985×10^{-9}

(a) χ/Q and D/Q data are based on the grazing season.

TABLE IV-3 MAXIMUM DOSES TO AN INDIVIDUAL RESULTING FROM FERMI 2 GASEOUS EFFLUENTS (3499 MWt)

	Location			
	1130 meters NW Child (mrem/yr)		3180 meters WNW Child (mrem/yr)	
Sources	Total Body Dose	Organ Dose[a]	Total Body Dose	Organ Dose[a]
A. Radioiodines and Particulates				
Ground	0.355	0.354	0.037	0.037
Ingestion of Vegetables	0.220	10.634	NOT APPLICABLE	
Inhalation	0.002	0.656	0.0003	0.099
Ingestion of Goat Milk	NOT APPLICABLE		0.022	3.319
Total	0.576	11.64	0.059	3.456
B. Noble Gas Plume	0.75	3.80	NC[b]	NC[b]

C. Air Doses

	Site Boundary (915 meters NW)
Annual (mrad/yr)	2.79 β beta
Annual (mrad/yr)	4.93 γ gamma

[a] For radioiodine and particulates the maximum organ dose occurs to the thyroid while the maximum organ dose from noble gas plume exposure occurs to the skin.

[b] NC = not necessary to calculate by inspection of χ/Q values in Tables 3.3 through 3.8 of Annex B.

11A EVALUATION OF FERMI 2 TO DEMONSTRATE COMPLIANCE WITH SECTION II OF APPENDIX I TO 10 CFR PART 50

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix I, U.S. Nuclear Regulatory Commission, April 1975.
2. "Onsite Meteorological Programs (Safety Guide 23)," Regulatory Guide 1.23, U.S. Atomic Energy Commission, February 1972.
3. Enrico Fermi Atomic Power Plant Unit 2, Applicant's Environmental Report, Operating License Stage, Docket 50-341, Supplement 1, dated June 1975.
4. Enrico Fermi Atomic Power Plant Unit 2, Final Safety Analysis Report, Docket 50-341, updated through Amendment 5, dated September 1976.
5. "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light Water Reactors," Regulatory Guide 1.112, U.S. Nuclear Regulatory Commission, April 1976.
6. "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," Regulatory Guide 1.113, U.S. Nuclear Regulatory Commission, May 1976.
7. "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Regulatory Guide 1.109, U.S. Nuclear Regulatory Commission, March 1976.
8. "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Regulatory Guide 1.111, U.S. Nuclear Regulatory Commission, March 1976.
9. Oak Ridge National Laboratory, Users Manual for LADTAP II - A Computer Program for Calculating Radiation Exposures of Nuclear Reactor Liquid Effluents, NUREG/CR-1976, May 1980.

Figure Intentionally Removed
Refer to Plant Drawing A-2100

Fermi 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE III-1

RELEASE POINT LOCATIONS

CHAPTER 11 APPENDIX A

ANNEX A

DATA NEEDED FOR RADIOACTIVE

SOURCE TERM CALCULATIONS

FOR FERMI 2

TABLE OF CONTENTS

ANNEX A DATA NEEDED FOR RADIOACTIVE SOURCE TERM CALCULATIONS FOR FERMI 2

Following are the data requested in Appendix A to Regulatory Guide (RG) 1.112. This RG states that the information presented should be taken from the contents of the Safety Analysis Report (SAR) and the Environmental Report (ER). However, RG 1.112 (Reference 1) was issued subsequent to the submittal of the Enrico Fermi Atomic Power Plant Unit 2 (Fermi 2) FSAR (Reference 2) and ER (Reference 3). Regulatory Guide 1.112 provided new guideline values (through reference to NUREG-0016) (Reference 4) to be used when projecting the effectiveness of a given BWR radwaste system to reduce the quantity of radionuclides in plant effluents. These new guidelines are based on surveys of operating plants and represent average or expected conditions. Although the RG 1.112 values may vary from the expected values reported in the Fermi 2 FSAR, that does not mean that the Fermi 2 radwaste system will not perform as projected. This is based on the fact that the RG 1.112 value for each parameter is a single value which should best be represented by a range of values and therefore the possibility of a radwaste system parameter actually being greater or less than that predicted by RG 1.112 is to be expected.

On September 9, 1992, the NRC issued Amendment 87 to the Fermi 2 Operating License authorizing a change in the thermal power limit for 3293 MWt to 3430 MWt. Subsequently, on February 10, 2014, the NRC issued Amendment 196 to the Fermi 2 operating license authorizing a change in the thermal power limit from 3430 MWt to 3486 MWt. This Annex has been revised to reflect the changes that resulted from the power uprates.

The item in parentheses following the requested information is the section, page, table, or figure number of the original FSAR and/or ER or UFSAR wherein the information is presented. Also, when parameters reported in the FSAR, ER, and/or UFSAR differ from guideline values given in RG 1.112, the RG values will also be listed and followed by "(RG)". Values given in RG 1.112 were used in the generation of source terms.

1. GENERAL

   a. The maximum core thermal power evaluated for safety consideration in the UFSAR

      Response

      3430 MWt x 1.02 = 3499 MWt (UFSAR Section 1.1)

   b. The quantity of tritium released in liquid and gaseous effluents

      Response

Tritium Released (Ci/yr)

	FSAR		RG
Liquid	52.5	(UFSAR Subsection 11.2.6)	11
Gaseous	52.5	(UFSAR Table 11.3-1)	75

2. NUCLEAR STEAM SUPPLY SYSTEM

a. Total steam flow rate

Response

1.52×10^7 lb/hr at 3499 MWt (UFSAR Subsection 11.3.2.2)

b. Mass of reactor coolant in the reactor vessel at full power (3486 MWt)

Response

5.52×10^5 lb (ER page 3A-3)

3. REACTOR COOLANT CLEANUP SYSTEM

a. Average flow rate

Response

1.33×10^5 lb/hr (ER page 3A-4)

b. Demineralizer type and size

Response

Type - powdered resin and filter aid material (ER page 3A-4)

Size - approximately 135 ft^2 of flow area, 20 lb of dry resin and filter aid material

There are two 50 percent units (UFSAR Table 5.5-2).

c. Replacement frequency

Response

The resin in each demineralizer is replaced about once per week (ER page 3A-4).

d. Backwash volume and activity

Response

Approximately 1100 gallons per backwash (based on data in UFSAR Figure 11.2-15)

Specific activity is 20 percent of reactor coolant (UFSAR Figure 11.2-15).

4. CONDENSATE DEMINERALIZERS

a. Average flow rate

Response

10.8×10^6 lb/hr at 3499 MWt (UFSAR Subsection 10.4.6.1.1)

b. Demineralizer type

Response

Powdered resin (UFSAR Subsection 10.4.6)

c. Number and size of demineralizers

Response

Number - 8 parallel operating demineralizers (UFSAR Subsection 10.4.6.2)

Size - approximately 890 ft^2 of filter surface flow area for non-pleated filters; approximately 17000 ft^2 of filter surface flow area for pleated filters

d. Replacement frequency

Response

10 days per vessel (ER page 3A-4)

e. Indicate whether ultrasonic resin cleaning is used and the waste liquid volume associated with its use

Response

Ultrasonic resin cleaning will not be used.

f. Backwash volume and activity

Response

5300 gallons per backwash (based on data in UFSAR Figure 11.2-15)

Specific activity is 5×10^{-6} μCi/ml (UFSAR Figure 11.2-15)

5. LIQUID WASTE PROCESSING SYSTEMS

a. For each liquid waste processing system, provide, in tabular form, the following information:

(1) Sources, flow rates, and expected activities [fraction of primary coolant activity (PCA) for all inputs to each system]

Response

This information as given in the UFSAR is presented in Table 1 of this Annex. Presented in Table 2 of this Annex are the RG 1.112 guideline values for sources to the liquid radwaste system. A power uprate scale-up factor of 1.02 was applied to obtain the sources at uprated conditions.

(2) Holdup times associated with the collection, processing, and discharge of all liquid streams

Response

In calculating the releases of radionuclides reported in the Fermi 2 UFSAR, no credit was taken for decay resulting from holdup within the process system. Holdup times based on the data presented in Table 1 have been calculated per RG 1.112 and are shown in Table 3 of this Annex. Holdup times based on RG 1.112 expected source volumes (Table 2) have also been calculated and are also presented in Table 3.

(3) Capacities of all tanks and processing equipment considered in calculating holdup times

Response

This information is presented in Table 4 of this Annex.

(4) Decontamination factors for each processing step

Response

Decontamination factors (DF) as projected in the FSAR are given in Table 4. Also given in Table 4 are the RG 1.112 guideline values for process equipment DF's.

(5) The fraction of each processing stream expected to be discharged over the life of the plant

Response

This data is presented in Table 4.

(6) For waste demineralizer regeneration, show the time between regenerations, regenerant volumes and activities, treatment of regenerants, and fractions of regenerant discharged. Include parameters used in making these determinations.

Response

There will be no demineralizer regeneration waste. All demineralizers will utilize either disposal deep beds or Powdex beds.

(7) Liquid source term by radionuclide (in Ci/yr) for normal operation, including anticipated operational occurrences

Response

Liquid source terms based on RG 1.112 guideline values are presented in Table 5 of this Annex.

b. Provide piping and instrumentation diagrams and process flow diagrams for the liquid radwaste systems along with all other systems influencing the source term calculations

Response

The requested figures are presented in both the FSAR and the ER. The source term calculations for the floor drain and chemical systems included only the use of filters and demineralizers.

Diagram	FSAR Figure 11.2-1	ER Figure 3.5-1
Waste Collector System	Sheet 1	Sheet 3
Floor Drain Collector System	Sheet 2	Sheet 4
Evaporator Feed	Sheets 4 and 5	Sheet 5

Diagram	FSAR Figure 11.2-1	ER Figure 3.5-1
Chemical Waste System	Sheet 6	Sheet 6
Waste Sludge System	Sheet 7	Sheet 7
Sump Pump	Figure 11.2-2 Sheets 4 and 5	Sheets 1 and 2

6. MAIN CONDENSER AND TURBINE GLAND SEAL AIR REMOVAL SYSTEMS

a. The holdup time for offgases from the main condenser air ejector prior to processing by the offgas treatment system

Response

From the air ejector to the discharge from the chiller unit just upstream of the first charcoal bed, the holdup time is 0.066 hour (UFSAR Subsection 11.3.2.7.3.1).

b. A description and the expected performance of the gaseous waste treatment systems for the offgases from the condenser air ejector and mechanical vacuum pump.

Include the expected air inleakage per condenser shell, the number of condenser shells, and the iodine source term from the condenser.

Response

Radiogases in the condenser offgas are reduced in concentration by the natural decay process. Most of the decay occurs in the six charcoal adsorbers; however, the short-lived radionuclides, such as N-16, decay off almost entirely prior to the offgas stream entering the charcoal units.

Noncondensable gases, including air inleakage and fission gases, are removed from the main condenser by air ejector (not part of the condenser offgas system). These gases then enter the offgas system where additional steam is injected into the air ejector discharge stream to dilute the hydrogen below 4 percent by volume. The mixture passes through a moisture separator before it is superheated in a preheater to remove water droplets and to decrease humidity. It enters the catalytic recombiner where free hydrogen and oxygen are converted into water vapor. The offgas effluent from the recombiner is passed through a condenser cooled by reactor condensate to remove the bulk moisture, and then through an aftercooler and a precooler for drying.

The gas then enters a 2.2-minute delay pipe which is followed by a sand filter. The gas is then cooled to +14°F and enters the ambient temperature charcoal adsorbers. Chilling and drying the air improve charcoal adsorber performance. Adsorber system discharge is filtered, mainly to remove any charcoal fines that may have been carried out of the last charcoal bed. The gas is then pumped into the offgas discharge piping. The system vacuum pump is used to maintain a slightly negative pressure throughout the system, ensuring that any leakage would be into the system. The effluent from the offgas system is discharged from the plant after dilution in the reactor building ventilation system exhaust. A more detailed discussion of the condenser offgas system is presented in Section 11.3 of the UFSAR.

For the one-shell condenser, the expected inleakage is approximately 6 SCFM; however, the system was designed assuming a 40-SCFM inleakage. The RG 1.112 guideline value for condenser inleakage is 10 ft^3/min per shell; therefore, for Fermi 2 an inleakage of 10 ft^3/ min is used when evaluating this system for Appendix I compliance.

Based on the design value of 40 SCFM inleakage; however, the condenser offgas system is expected to perform as follows:

(1) Holdup time for kryptons, 24 hours

(2) Holdup time for xenons, 16 days

(3) A DF of about 1160 for radiogases of kryptons and xenons (inlet concentration/outlet concentration)

(4) A DF of about 90 over that provided by 30-minute delay.

The above values are not used in the Appendix I calculations, but are utilized as the design basis (see Section 11.3).

The iodine source term from the condenser was not supplied in the FSAR or ER. The RG 1.112 guideline value for the iodine source term from the main condenser to the offgas system for expected conditions is 5 Ci/yr of I-131.

The mechanical vacuum pumps discharge via a 2-minute delay pipe. These pumps are expected to be used only during operation below 5 percent reactor power, and the source term from the condenser to the vacuum pumps is expected to be negligible. However, presented below are the expected quantities of radionuclides released from the condenser via the mechanical vacuum pumps as projected by the Fermi 2 FSAR and RG 1.112.

	Fermi 2 FSAR Estimate (FSAR Table 11.3-1)	RG 1.112 Guideline Values
Xe-133	24 Ci/yr	2393 Ci/yr
XE-135	negligible	364 Ci/yr
I-131	negligible	0.03 Ci/yr

c. The mass of charcoal in the charcoal delay system used to treat the offgases from the main condenser air ejector, the operating and dew point temperatures of the delay system, and the dynamic adsorption coefficients for Xe and Kr

Response

(1) 60 tons of charcoal

(2) 70°F operating temperature

(3) -4°F dew point

(4) The dynamic adsorption coefficients for krypton and xenon are as follows:

Dynamic Adsorption Coefficients

	Fermi 2 FSAR	RG 1.112
Kr	36	25
Xe	610	440

This data is presented in Section 11.3 of the FSAR.

d. A description of the cryogenic distillation system, the fraction of gases partitioned during distillation, the holdup in the system, storage following distillation, and the expected system leakage rate

Response

Not applicable

e. The steam flow to the turbine gland seal and the source of the steam (primary or auxiliary)

Response

1.51×10^4 lb/hr of primary steam; the steam flow rate is consistent with RG 1.112 assumptions

f. The design holdup time for gas vented from the gland seal condenser, the iodine partition factor for the condenser, and the fraction of radioiodine released through the system vent. A description of the treatment system used to reduce radioiodine and particulate releases from the gland seal system.

Response

(1) 0.032 hour holdup

(2) 100 is the iodine partition factor expressed as DF; this is consistent with RG 1.112.

(3) 100 percent of the iodine exiting the 2-minute delay pipe is discharged via the reactor building vent.

(4) No treatment system is necessary downstream of the gland seal condenser and 2-minute delay pipe to further reduce the quantity of radioiodine or particulates released from this system.

g. Piping and instrumentation diagrams and process flow diagrams for the gaseous waste treatment system along with all other systems influencing the source term calculations

Response

The requested figures are presented in both the FSAR and the ER:

Diagram	FSAR Figure	ER Figure
Offgas System P&ID (2 sheets)	11.3-1	3.5-3
Flow Diagram of the Condenser Offgas System	11.3-2	3.5-4

7. VENTILATION AND EXHAUST SYSTEM

For each plant building that houses a main condenser evacuation system, a mechanical vacuum pump, a turbine gland seal system exhaust, or a system that contains radioactive materials, provide the following:

a. Provisions incorporated to reduce radioactivity releases through the ventilation or exhaust systems

Response

(1) Reactor/Auxiliary Building Ventilation System (UFSAR Subsection 9.4.2)

Fermi 2 utilizes a Mark 1 containment design. One ventilation system is provided for both the reactor and auxiliary building portion of the complex. Under normal operating conditions the radionuclide concentration in the ventilation exhaust from these areas is expected to be negligible.

(2) Radwaste Building Ventilation System (UFSAR Subsection 9.4.3)

Under normal operating conditions the radwaste building exhaust is discharged through HEPA filters to remove particulate radioactive material.

(3) Turbine Building Ventilation System (UFSAR Subsection 9.4.4)

Filtration of the turbine building ventilation effluent is not necessary.

b. Decontamination factors assumed and the bases (include charcoal adsorbers, HEPA filters, and mechanical devices)

Response

Although HEPA filters are being installed in the exhaust stream of the radwaste building ventilation system to remove particulate radioactive material, no credit was assumed for this equipment in the Fermi 2 UFSAR. Regulatory Guide 1.112 does allow a DF of 100 on particulates for this equipment. Charcoal filters in the ventilation exhaust are not necessary.

c. Release rates for radioiodines, noble gases, and radioactive particulates and their bases

Response

This information is presented in Table 6 of this Annex for both the expected conditions as given in Table 11.3-1 of the FSAR and the guideline values given in RG 1.112.

d. Release point descriptions, including height above grade, height above and location relative to adjacent structures, expected average temperature difference between gaseous effluents and ambient air, flow rate, exit velocity, and size and shape of flow orifice.

Response

There are three ventilation release points: reactor building vent, turbine building vent, and the radwaste building vent. The reactor building vent is the release point for the following:

(1) Offgas system

(2) Turbine gland seal exhaust

(3) Mechanical vacuum pump

(4) Reactor/auxiliary building ventilation system.

The turbine building ventilation system exhaust is discharged via the turbine building vent, and radwaste building ventilation system exhaust is discharged via the radwaste building vent.

The reactor building vent is cylindrical in shape, extends 22.5 feet above the top of the reactor building and is 7 feet 2 inches in diameter. The vent centerline is approximately 8 feet 3 inches from the south wall of the reactor building. The top of the vent is at elevation 751 feet (mean tide, N. Y., 1935) and the grade is 583 feet. The exhaust from this vent is 112,000 ft^3/min at a velocity of 2750 ft/min (FSAR Subsection 11.3.7, Table 3.2, Annex B).

The turbine building vent is rectangular in shape, extends 8 feet above the upper roof of the turbine building and has a cross-sectional area of approximately 420 ft^2. The vent centerline is approximately 67 feet from the south wall and 73 feet from the east wall of the turbine building. The top of the vent is at elevation 719.5 feet (mean tide, N.Y., 1935). The exhaust from the vent is approximately 390,000 ft^3/min at a velocity of 830 ft/min (FSAR Subsection 11.3.7, Table 3.2, Annex B).

The radwaste building vent is rectangular in shape, extends 54 feet above the lower roof of the turbine building, and has a cross-sectional area of approximately 20 ft^2. The vent centerline is approximately 383 feet from the south wall and 78 feet from the east wall of the turbine building. The top of the vent is at elevation 729 feet (mean tide, N.Y., 1935). The exhaust from the vent is approximately 35,100 ft^3/min at a velocity of 1755 feet/min (UFSAR Figure 9.4-5, Table 3.2, Annex B).

e. For the containment building, the expected purge and venting frequencies and duration and the continuous purge rate (if used)

Response

Fermi 2 is of the Mark I containment design. Following reactor startup, excess air from the reactor drywell will be exhausted along the wall above the refueling floor and discharged by the reactor/auxiliary building ventilation exhaust system (UFSAR Subsection 9.4.2).

Also the drywell atmosphere is controlled by the drywell cooling system (UFSAR Subsection 9.4.5) and will not normally require purging. No significant releases of radionuclides are expected from the Fermi 2 drywell.

11A.ANNEX A DATA NEEDED FOR RADIOACTIVE SOURCE TERM CALCULATIONS FOR FERMI 2

REFERENCES

1. "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light Water Reactors," Regulatory Guide 1.112, U.S. Nuclear Regulatory Commission (April 1976).
2. Enrico Fermi Atomic Power Plant Unit 2, Final Safety Analysis Report, Docket 50-341 updated through Amendment 5, dated September 1976.
3. Enrico Fermi Atomic Power Plant Unit 2, Applicant's Environmental Report, Operating License Stage, Docket 50-341, updated through Supplement 1, dated June 1976.
4. "Calculation of Release of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors," NUREG-0016, U.S. Nuclear Regulatory Commission, April 1976.

TABLE 1 EXPECTED DAILY AVERAGE INPUTS TO THE FERMI 2 LIQUID RADWASTE SYSTEM AS GIVEN IN THE UFSAR

Subsystem	Source	Flow Rates[a] of Sources (gpm)	Fraction of Primary Coolant Activity
Waste collector	Drywell equipment drain sump	8,914	1.00
	Reactor building equipment drain sump	9,700	0.10
	Radwaste building equipment drain sump	2,884	0.10
	Turbine building equipment drain sump	7,865	0.001
	Effluent from waste surge tank	6,121	1.1×10^{-3}
Subtotal		35,484	
Floor drain collector	Turbine building oil separator effluent	3,122	0.001
	Drywell floor drain sump	1,821	0.001
	Reactor building floor drain sumps	5,203	0.001
	Personnel decontamination	102	0.001
	Cask-cleaning drains	14	0.001
	Radwaste building floor drain sumps	2,601	0.001
	Drains from loadout building	204	0.001
	Turbine building floor drain sumps	2,081	0.001
	Chemical waste tank effluent	377	0.02
Subtotal		15,525	
Total		51,009	

[a] Based on the UFSAR Figure 11.2-15.

TABLE 2 EXPECTED DAILY AVERAGE INPUTS TO THE FERMI 2 RADWASTE SYSTEM USING REGULATORY GUIDE 1.112 VALUES

Source	Flow Rates of Sources (gpm)	Fraction of Primary Coolant Activity
Equipment Drains		
Drywell	3,400	1
Containment, auxiliary building, and fuel pool	3,700	0.1
Radwaste building	1,100	0.1
Turbine building	3,000	0.001
Subtotal	11,200	
Floor drains		
Drywell	700	0.001
Containment, auxiliary building and fuel pool	2,000	0.001
Radwaste building	1,000	0.001
Turbine building	2,000	0.001
Subtotal	5,700	
Other		
Cleanup phase separator decant	640	0.002
Laundry drains	1,000	(a)
Lab drains	500	0.02
Condensate backwash[b]	8,100	10^{-6}
Chemical lab waste	100	0.02
Subtotal	14,840	
Total	31,740	

a. Listed in GALE code.
b Filter/demineralizer (Powdex) condensate demineralizer.

TABLE 3 HOLDUP TIMES ASSOCIATED WITH THE COLLECTION, PROCESSING, AND DISCHARGE OF LIQUID RADWASTE

	Holdup Times (days)[a]	
Subsystem	Collection	Processing and discharging
Waste collector	0.319	0
Floor drain collector	0.520	0

[a] In calculating the releases of radionuclides reported in the Fermi 2 UFSAR and ER, no credit was taken for decay resulting from holdup within the processing system.

TABLE 4 LIQUID RADWASTE SYSTEM PROCESS PARAMETERS

Subsystem	Number and Volume of Tanks	Process Equipment and Throughput Capability	Decontamination Factor		Fraction of Each process Stream Discharged
			Soluble	Insoluble	
Waste collector	1 waste collector tank, 23,400 gallons	Etched-disk filter, 216,000 gpd	1	10	0.01
		3 oil coalescers, 216,000 gpd (total)	1	10	--
Floor drain collector	1 floor drain collector tank, 20,000 gallons	Etched-disk filter, 72,000 gpd	1	10	0.01
	1 evaporator feed/surge tank, 25,000 gallons	3 oil coalescers, 72,000 gpd (total)	1	10	--
	2 distillate tanks, 5100 gallons	2 radwaste evaporators, 43,200 gpd (each)	1,000	10,000	--
	1 chemical waste tank, 5,200 gallons	--	--	--	--
Shared equipment[a]	2 waste sample tanks, 24,300 gallons	2 radwaste demineralizers, 201,600 gpd	100(10)[b]	100(10)	--
	1 waste sample tank, 21,000 gallons	--	--	--	--

[a] The liquid radwaste system shares interchangeably the radwaste demineralizer and waste sample tanks between the floor drain and waste collector subsystems.

[b] Number in parentheses is for a second demineralizer in series.

TABLE 5 LIQUID EFFLUENTS FROM FERMI 2 (3499 MWt)

NUCLIDE	HALF-LIFE (Days)	CONC. IN REACTOR COOLANT (uCi/cc)	HIGH PURITY (Ci)	LOW PURITY (Ci)	CHEMICAL (Ci)	TOTAL LWS (Ci)	ADJUSTED TOTAL (Ci/Yr)	DETERGENT WASTES (Ci/Yr)	TOTAL (Ci/Yr)
CORROSION AND ACTIVATION PRODUCTS:									
NA24	6.25E-01	9.62E-03	0.00111	0.00000	0.00000	0.00111	0.00460	0.00000	0.00460
P32	1.43E+01	2.03E-04	0.00003	0.00000	0.00000	0.00003	0.00011	0.00000	0.00011
CR51	2.78E+01	6.09E-03	0.00083	0.00000	0.00000	0.00083	0.00345	0.00000	0.00345
MN54	3.03E+02	7.11E-05	0.00001	0.00000	0.00000	0.00001	0.00004	0.00000	0.00004
MN56	1.08E-01	4.23E-02	0.00243	0.00000	0.00000	0.00243	0.01007	0.00000	0.01007
FE55	9.50E+02	1.02E-03	0.00014	0.00000	0.00000	0.00014	0.00058	0.00000	0.00058
FE59	4.50E+01	3.05E-05	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000	0.00002
CO58	7.13E+01	2.03E-04	0.00003	0.00000	0.00000	0.00003	0.00011	0.00000	0.00011
CO60	1.92E+3	4.06E-04	0.00005	0.00000	0.00000	0.00005	0.00023	0.00000	0.00023
NI65	1.07E-01	2.54E-04	0.00001	0.00000	0.00000	0.00001	0.00006	0.00000	0.00006
CU64	5.33E-01	2.87E-02	0.00320	0.00000	0.00000	0.00320	0.01329	0.00000	0.01329
ZN65	2.45E+02	2.03E-04	0.00003	0.00000	0.00000	0.00003	0.00011	0.00000	0.00011
ZN69M	5.75E-01	1.92E-03	0.00022	0.00000	0.00000	0.00022	0.00091	0.00000	0.00091
ZN69	3.96E-02	0.00E+00	0.00019	0.00000	0.00000	0.00019	0.00076	0.00000	0.00076
W187	9.96E-01	2.94E-04	0.00003	0.00000	0.00000	0.00003	0.00015	0.00000	0.00015
NP239	2.35E+00	7.00E-03	0.00092	0.00000	0.00000	0.00092	0.00380	0.00000	0.00380
FISSION PRODUCTS:									
BR83	1.00E-01	5.28E-03	0.00029	0.00000	0.00000	0.00029	0.00120	0.00000	0.00120
BR84	2.21E-02	5.37E-03	0.00007	0.00000	0.00000	0.00007	0.00030	0.00000	0.00030
BR85	2.08E-03	2.14E-03	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001
RB89	1.07E-02	3.61E-03	0.00024	0.00000	0.00000	0.00024	0.00098	0.00000	0.00098
SR89	5.20E+01	1.02E-04	0.00001	0.00000	0.00000	0.00001	0.00006	0.00000	0.00006
SR91	4.03E-01	3.76E-03	0.00040	0.00000	0.00000	0.00040	0.00163	0.00000	0.00163
Y91M	3.47E-02	0.00E+00	0.00021	0.00000	0.00000	0.00021	0.00084	0.00000	0.00084
Y91	5.88E+01	4.06E-05	0.00001	0.00000	0.00000	0.00001	0.00002	0.00000	0.00002
SR92	1.13E-01	8.50E-03	0.00051	0.00000	0.00000	0.00051	0.00209	0.00000	0.00209
Y92	1.47E-01	5.22E-03	0.00067	0.00000	0.00000	0.00067	0.00278	0.00000	0.00278
Y93	4.25E-01	3.77E-03	0.00041	0.00000	0.00000	0.00041	0.00166	0.00000	0.00166
NB98	3.54E-02	3.09E-03	0.00006	0.00000	0.00000	0.00006	0.00028	0.00000	0.00028
MO99	2.79E+00	2.00E-03	0.00026	0.00000	0.00000	0.00026	0.00109	0.00000	0.00109
TC99M	2.50E-01	1.82E-02	0.00173	0.00000	0.00000	0.00173	0.00715	0.00000	0.00715
TC101	9.72E-03	6.56E-02	0.00038	0.00000	0.00000	0.00038	0.00161	0.00000	0.00161

TABLE 5 LIQUID EFFLUENTS FROM FERMI 2 (3499 MWt)

NUCLIDE	HALF-LIFE (Days)	CONC. IN REACTOR COOLANT (uCi/cc)	HIGH PURITY (Ci)	LOW PURITY (Ci)	CHEMICAL (Ci)	TOTAL LWS (Ci)	ADJUSTED TOTAL (Ci/Yr)	DETERGENT WASTES (Ci/Yr)	TOTAL (Ci/Yr)
RU103	3.96E+01	2.03E-05	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001
TC104	1.25E-02	5.88E-02	0.00045	0.00000	0.00000	0.00045	0.00185	0.00000	0.00185
RU105	1.85E-01	1.78E-03	0.00015	0.00000	0.00000	0.00015	0.00058	0.00000	0.00058
RH105M	5.21E-04	0.00E+00	0.00015	0.00000	0.00000	0.00015	0.00058	0.00000	0.00058
RH105	1.50E+00	0.00E+00	0.00001	0.00000	0.00000	0.00001	0.00005	0.00000	0.00005
TE129M	3.40E+01	4.06E-05	0.00001	0.00000	0.00000	0.00001	0.00002	0.00000	0.00002
TE129	4.79E-02	0.00E+00	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001
TE131M	1.25E+00	9.86E-05	0.00001	0.00000	0.00000	0.00001	0.00005	0.00000	0.00005
I131	8.05E+00	4.02E-03	0.00054	0.00000	0.00000	0.00054	0.00226	0.00000	0.00226
I132	9.58E-02	5.25E-02	0.00278	0.00000	0.00000	0.00278	0.01152	0.00000	0.01152
I133	8.75E-01	5.22E-02	0.00633	0.00000	0.00000	0.00633	0.02621	0.00000	0.02621
I134	3.67E-02	7.97E-02	0.00178	0.00000	0.00000	0.00178	0.00736	0.00000	0.00736
CS134	7.49E+02	3.05E-05	0.00004	0.00000	0.00000	0.00004	0.00018	0.00000	0.00018
I135	2.79E-01	4.88E-02	0.00460	0.00000	0.00000	0.00460	0.01903	0.00000	0.01903
CS136	1.30E+01	8.09E-05	0.00011	0.00000	0.00000	0.00011	0.00046	0.00000	0.00046
CS137	1.10E+04	2.03E-05	0.00003	0.00000	0.00000	0.00003	0.00011	0.00000	0.00011
CS138	2.24E-02	7.34E-03	0.00100	0.00000	0.00000	0.00100	0.00415	0.00000	0.00415
BA139	5.76E-02	8.02E-03	0.00027	0.00000	0.00000	0.00027	0.00114	0.00000	0.00114
BA140	1.28E+01	4.05E-04	0.00005	0.00000	0.00000	0.00005	0.00023	0.00000	0.00023
LA140	1.67E+00	0.00E+00	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001
BA141	1.25E-02	7.34E-03	0.00005	0.00000	0.00000	0.00005	0.00023	0.00000	0.00023
LA141	1.62E-01	0.00E+00	0.00004	0.00000	0.00000	0.00004	0.00018	0.00000	0.00018
CE141	3.24E+01	3.04E-05	0.00000	0.00000	0.00000	0.00000	0.00002	0.00000	0.00002
BA142	7.64E-03	4.35E-03	0.00002	0.00000	0.00000	0.00002	0.00008	0.00000	0.00008
LA142	6.39E-02	4.04E-03	0.00018	0.00000	0.00000	0.00018	0.00072	0.00000	0.00072
CE143	1.38E+00	2.97E-05	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00001
PR143	1.37E+01	4.05E-05	0.00001	0.00000	0.00000	0.00001	0.00002	0.00000	0.00002
All Others		5.01E-05	0.00002	0.00000	0.00000	0.00002	0.00006	0.00000	0.00006
Total except H3		5.55E-01	0.03311	0.00000	0.00000	0.03311	0.13716	0.00000	0.13716
H3									27.053

TABLE 6 RADIONUCLIDE RELEASES IN CURIES PER YEAR FROM THE VARIOUS PLANT VENTILATION SYSTEMS (3499 MWt)

	Ventilation System					
	Reactor/Auxiliary Building[a]		Turbine Building		Radwaste Building	
Nuclide	FSAR Value	RG 1.112 Value	FSAR VALUE	RG 1.112 Value	FSAR Value	RG 1.112 Value
Kr-83	(b)	(b)	9.7	(b)	(b)	(b)
Kr-85m	(b)	6.2	18	71	(b)	(b)
Kr-87	(b)	6.2	55	200	(b)	(b)
Kr-88	(b)	6.2	58	240	(b)	(b)
Kr-89	(b)	(b)	45	(b)	(b)	(b)
Xe-133	(b)	140	25	290	(b)	10
Xe-135m	(b)	96	50	680	(b)	(b)
Ce-135m	(b)	96	50	680	(b)	(b)
Xe-135	(b)	71	66	660	(b)	47
Xe-137	(b)	(b)	74	(b)	(b)	(b)
Xe-138	(b)	15	170	1500	(b)	(b)
I-131	0.01	0.35	0.28	0.20	(b)	0.048
I-133	0.068	1.4	1.9	0.79	(b)	0.18
Co-60	(b)	0.021	(b)	2.10(-3)	(b)	0.094
Co-58	(b)	1.2(-3)[c]	(b)	6.20(-4)	(b)	4.7(-3)
Cr-51	(b)	6.2(-4)	(b)	0.014	(b)	9.4(-3)
Mn-54	(b)	6.2(-3)	(b)	6.2(-4)	(b)	0.047
Fe-59	(b)	8.3(-4)	(b)	5.2(-4)	(b)	0.016
Zn-65	(b)	4.2(-3)	(b)	2.1(-4)	(b)	1.0(-3)
Zr-95	(b)	8.3(-4)	2.3(-4)	1.0(-4)	(b)	5.2(-5)
Sr-89	(b)	1.9(-4)	1.8(-2)	6.2(-3)	(b)	5.2(-4)
Sr-90	(b)	1.0(-5)	1.2(-3)	2.1(-5)	(b)	3.1(-4)
Sb-124	(b)	4.2(-4)	(b)	3.1(-4)	(b)	5.2(-5)
Cs-134	(b)	8.3(-3)	8.9(-4)	3.1(-4)	(b)	4.7(-3)
Cs-137	(b)	0.01	1.4(-3)	6.2(-4)	(b)	9.4(-3)
Ba-140	(b)	8.3(-4)	5.1(-2)	0.011	(b)	1.0(-4)
Ce-141	(b)	2.1(-4)	2.2(-4)	6.2(-4)	(b)	6.2(-3)

[a] RG 1.112 sources are identified assuming the plant in question utilizes a Mark III containment. RG 1.112 data are based on data from facilities of Fermi 2 design. In order to be representative of Mark III containment, RG 1.112 divided the expected releases equally between the containment and the auxiliary building. For Fermi 2, whose reactor building and auxiliary building share the same exhaust line, the RG 1.112 values for each building were added back together.

[b] Negligible quantities of the radionuclide are expected to be released.

[c] 1.2(-3) = 1.2×10^{-3}

CHAPTER 11 APPENDIX A

ANNEX B

ATMOSPHERIC TRANSPORT AND DISPERISON

MODELING FOR THE 10 CFR PART 5O APPENDIX I

CALCULATIONS

TABLE OF CONTENTS

1.0 INTRODUCTION

This annex presents the atmospheric transport and dispersion modeling methodology; the meteorological joint frequency distributions; and the normalized effluent concentrations, χ/Q, and relative deposition rates, D/Q, required for the 10 CFR Part 50 Appendix I evaluations. All calculations and methods used are in complete compliance with Regulatory Guide 1.111 (Reference 1). The results presented are used for dose calculations from airborne effluents.

The modeling technique chosen was the Straight-line Airflow Model which is presented and specifically approved in Reference 1. Because of flat terrain and the use of only one data station, it was felt that long term modeling using the mixed mode adaptation of the straight-line airflow technique and the open terrain correction factor developed by the NRC would provide as conservative and valid an estimate of the dispersion as the other more sophisticated techniques.

The mixed mode analyses were performed for three sources at the Fermi 2 site: the containment building vent, the turbine building vent, and the radwaste building vent. In addition, a fourth set of calculations were performed for strictly ground level releases.

The data used were taken at the 60-meter tower at the Fermi 2 site for the period June 1, 1974 through May 31, 1975. As part of the 10 CFR Part 50 Appendix I evaluations, the long term temporal representativeness of this on-site data, based upon 10 years of NWS data, is presented in Reference 2. The degree to which this single year of data base at the 60-meter tower is representative of actual site conditions is further discussed in Reference 3. The discussion of the primary air flow regimes which govern dispersion at the Fermi 2 site can be found in References 2 and 3 and in Section 2.3.2.3 and Section 2.3.2.4.2 of the FSAR (Reference 4).

Section 2 presents a description of the methodology used to calculate χ/Q, D/Q and mixed mode joint frequency distributions. Section 3 presents the results of the calculations for the specific source specifications of the Fermi 2 plant. Joint frequency distributions of a strictly ground level source for the annual average and grazing period average are tabulated in Appendix A. The mixed mode joint frequency distributions used for calculation of the elevated plume dose for the containment building emitting in the mixed mode for these same periods are tabulated in Appendix B. This same information for the turbine building emitting in the mixed mode is tabulated in Appendix C and for the radwaste building vent emitting in the mixed mode in Appendix D.

2.0 DESCRIPTION OF MODELING TECHNIQIES

This section describes the assumptions and calculational methodology used to compute the annual average and grazing period average values of the source-normalized effluent concentration χ/Q and the source-normalized relative deposition rate per unit area D/Q, as well as the joint frequency distributions of wind speeds, directions, and stabilities for these two intervals.

The calculational techniques for χ/Q and D/Q using the Straight-line Airflow Model described in Regulatory Guide 1.111 (Reference 1) require specification of the frequency of time, over a specified period, that each particular meteorological condition existed. In addition, estimates of the wind speeds at the height of release are needed. The models used and justification for the wind speed values used in these analyses are discussed in the following sections.

2.1 Description of χ/Q Calculational Methodology

This section describes the modeling methodology used to calculate the source-normalized concentrations used in the radiological dose calculations for sources considered appropriate to a mixed mode analysis and a ground level analysis following recommendations in Regulatory Guide 1.111 (Reference 1). The applicability of a mixed mode analysis for a particular source depends upon the source's relationship to nearby structures. For effluents released from points above adjacent solid structures, but lower than twice the height of these structures, the effluent plume is treated in a manner consistent with a mixed mode analysis. For effluents released from points below the height of adjacent solid structures, a strictly ground level release is assumed.

The mixed mode analysis is essentially a Straight-line Airflow Model with modifications to permit weighting calculated downwind concentrations by the amount of time the plume is considered to be entrained (or not entrained) in the volumetric wake of the building.

The equation for this model, as presented by Sagendorf (Reference 5), is:

$$\left(\overline{\chi/Q'}\right)_D = 2.032 \sum_{ij} n_{ij} \left[N X \bar{u}_i \Sigma_{zj}(X)\right]^{-1} \exp\left[-h_e^2 / 2\sigma_{zj}^2(X)\right] \qquad (1)$$

where

- h_e is the effective release height;
- n_{ij} is the length of time (hours of valid data) weather conditions are observed to be at a given wind direction, windspeed class, i, and atmospheric stability class, j;
- N is the total hours of valid data;
- $\bar{u}_i$ is the midpoint of windspeed class, i, at a height, h_e (effective release height)
- $\sigma_{zj}(X)$ is the vertical plume spread without volumetric correction at distance, X, for stability class, j;
- $\Sigma_{zj}(X)$ is the vertical plume spread with a volumetric correction for a release within the building wake cavity, at a distance, X, for stability class, j; otherwise $\Sigma_{zj}(X) = \sigma_{zj}(X)$;
- $\left(\overline{\chi/Q'}\right)_D$ is the average effluent concentration, χ, normalized by source strength, Q', at distance, X, in a given downwind direction, D; and
- 2.032 is $(2/\pi)^{1/2}$ divided by the width in radians of a 22.5° sector.

For effluents released from points less than or equal to the height of adjacent solid structures, a ground-level release is assumed ($h_e = 0$).

For effluents released from vents or other points above adjacent solid structures, but lower than elevated release points, the effluent plume is considered as an elevated release whenever the vertical exit velocity of the plume, W°, is at least five times the mean horizontal windspeed, u_r, at the height of release; i.e., as modified from Johnson et al. (Reference 6):

$$W_o/\bar{u}_r \geq 5.0$$

In this case, the effective release height is determined from (Reference 5):

$$h_e = h_s + h_{pr} - h_t - c \qquad (2)$$

where

- c is the correction for low relative exit velocity (see equation 9)
- h_e is the effective release height
- h_{pr} is the rise of the plume above the release point, according to Sagendorf (Reference 5), whose treatment is based on Briggs (Reference 7); (see below)
- h_s is the physical height of the release point (the elevation of the stack base should be assumed to be zero); and
- h_t is the maximum terrain height (above the stack base) between the release point and the point for which the calculation is made (for this calculation h_t identically equals zero).

Because of flat terrain around the Fermi 2 site, the terrain height h_t was set equal to zero in all calculations reported herein. Plume rise was calculated using formulae from Briggs (Reference 7). For neutral or unstable conditions,

$$h_{pr} = 1.44 \left(\frac{W_o}{\bar{u}_r}\right)^{2/3} \left(\frac{X}{d}\right)^{1/3} d \qquad (3)$$

where

- h_{pr} plume rise
- W_o exit velocity
- X distance
- $\bar{u}_r$ wind speed
- d internal stack diameter

The result from this calculation is compared with that from

$$h_{pr} = 3 \left(\frac{W_o}{\bar{u}_r}\right) d \qquad (4)$$

and the lesser value is used.

For stable conditions the results from equation (3) or (4) are compared with the results from the following two equations:

$$h_{pr} = 4 \left(\frac{F_m}{S}\right)^{1/4} \qquad (5)$$

$$h_{pr} = 1.5\left(\frac{F_m}{\bar{u}_r}\right)^{1/3} S^{-1/6} \qquad (6)$$

where

F_m = momentum flux parameter

S = stability parameter.

and the smallest value of h_{pr} is used. F_m and S are defined as follows:

$$F_m = W_o^2\left(\frac{d}{2}\right)^2 \qquad (7)$$

$$S = \frac{g}{T}\frac{\delta\theta}{\delta z} \qquad (8)$$

where

g = acceleration of gravity

T = ambient air temperature

$\frac{\delta\theta}{\delta z}$ = vertical potential temperature gradient.

For the purposes of the calculations for the Fermi 2 site, S was defined as 8.75×10^{-4} for E stability; 1.75×10^{-3} for F stability; and 2.45×10^{-3} for G stability.

When the vertical exit velocity is less than 1.5 times the horizontal windspeed, a correction for downwash is subtracted from Equation (2) according to Gifford (Reference 8):

$$c = 3\left(1.5 - {W_o}/{\bar{u}_r}\right)d \quad \text{for} \quad 1 \leq {W_o}/{\bar{u}_r} \leq 1.5 \qquad (9)$$

and $c = 0$ otherwise

where

c is the downwash correction;

$\bar{u}_r$ is the mean windspeed at the height of release; and

W_o is the vertical exit velocity of the plume.

If ${W_o}/{\bar{u}_r}$ is less than 1.0 or unknown, a ground-level release is assumed ($h_e = 0$).

For cases where the ratio of plume exit velocity to horizontal windspeed is between one and five, a mixed release mode is assumed, in which the plume is considered as an elevated release during a part of the time and as a ground-level release ($h_e = 0$) during the remainder of the time. An entrainment coefficient, E_t, modified from Reference 7, is determined for those cases in which W_o/u_r is between one and five:

$$E_t = 2.58 - 1.58(W_o/\bar{u}_r) \text{ for } 1 \leq W_o/\bar{u}_r \leq 1.5 \qquad (10)$$

and

$$E_t = 0.3 - 0.06(W_o/\bar{u}_r) \text{ for } 1.5 \leq W_o/\bar{u}_r \leq 5.0 \qquad (11)$$

The release is considered to occur as an elevated release $100(1-E_t)$ percent of the time and as a ground release $100E_t$ percent of the time. Each of these cases is then evaluated separately and the concentration calculated according to the fraction of time each type of release occurs. Windspeeds representative of conditions at the plume heights are used for the times when the release is considered to be elevated. Wind speeds measured at the 10-meter level are used for those times when the effluent plume is considered to be a ground level release.

For the ground-level portion of the releases only ($h_e = 0$), an adjustment is made in Equation (2) that takes into consideration initial mixing of the effluent plume within the building wake. This adjustment, according to Yanskey et al. (Reference 9), is in the form of:

$$\Sigma_{zj}(X) = \left(\sigma_{zj}^2(X) + 0.5\,D_z^2/\pi\right)^{1/2} \leq \sqrt{3}\sigma_{zj}(X) \qquad (12)$$

where

D_z is the maximum adjacent building height either up- or downwind from the release point;

$\sigma_{zj}(X)$ is the vertical standard deviation of the materials in the plume at distance, X, for atmospheric stability class, j; and

$\Sigma_{zj}(X)$ is the vertical standard deviation of plume material as above, with the correction for additional dispersion within the building wake cavity, restricted by the condition that

$$\Sigma_{zj}(X) = \sqrt{3}\sigma_{zj}(X)$$

when

$$\left(\sigma_{zj}^2(X) + 0.5D_z^2/\pi\right)^{1/2} > \sqrt{3}\sigma_{zj}(X)$$

For the elevated portion of the releases, no credit is taken for any additional dispersion within the building wake cavity and $\Sigma_{zj}(X)$ is set equal to $\sigma_{zj}(X)$.

Adjustments were made to the normalized effluent concentrations because the Straight-line Airflow Model does not consider the effects of spatial and temporal variations in airflow in the region of the site. The terrain near the site is flat and open so adjustment factors for "sites in open terrain" were applied. The final calculations of χ/Q and D/Q for both strictly ground level release and mixed mode release were multipled by the open terrain correction factor as a function of distance as shown in Figure 2, in Reference 1.

A conceptual flow diagram summarizing the calculational methodology used to calculate χ/Q from the joint frequency distribution is presented in Figure 2.1.

2.2 Deposition Methodology for Calculating D/Q

This section describes the modeling methodology used to calculate the source-normalized relative deposition rate per unit area (D/Q) used in the radiological dose calculations for sources considered as strictly ground level and those considered acceptable to a mixed mode analysis.

The deposition rate per unit downwind distance divided by the source strength was determined from Figures 7 through 10 of Reference 1.

The criteria by which a meteorological condition caused the source to emit in the elevated mode were taken as the same as in the χ/Q calculational methodology. If an elevated release was appropriate, the plume rise was calculated in the same manner as for the χ/Q estimates. Generally this effective plume height was greater than 60 meters but less than 100 meters.

To interpolate relative deposition rate for release heights other than those presented in Figures 7 through 10 of Reference 1, a logarithmic relationship was used,

$$\log D_r(h) = a \log h + b \qquad (13)$$

where

$D_r(h)$ relative deposition rate for release height h

$$a = \frac{\log D_{r_1}(h_1) - \log D_{r_2}(h_2)}{\log h_1 - \log h_2} \qquad (14)$$

$$b = \frac{\log D_{r_2}(h_2)\log h_1 - \log D_{r_1}(h_1)\log h_2}{\log h_1 - \log h_2} \qquad (15)$$

For example, to find the relative deposition rate for a release height of 80 meters under unstable conditions at a downwind distance of one kilometer, first $D_r(100) = 5 \times 10^{-5}$ is found from Figure 10, Reference 1, and $D_r(60) = 6 \times 10^{-5}$ is found from Figure 9, Reference 1. Then, a and b are calculated as follows:

$$a = \frac{\log(5\times10^{-5}) - \log(6\times10^{-5})}{\log 100 - \log 60} = -0.35691$$

$$b = \frac{\log(6\times10^{-5})\log 100 - \log(5\times10^{-5})\log 60}{\log 100 - \log 60} = -3.58721$$

Finally, $D_r(80)$ is calculated:

$$\log D_r(80) = -0.35691 \log 80 - 3.58721$$

$$= 0.73356 - 5$$

$$D_r(80) = 5.41452 \times 10^{-5}$$

In order to calculate values for D_r for distances which are not shown on Figures 7 through 10 of Reference 1, (e.g., values for distances close to the release site under stable conditions for elevated releases) the portions of the curve which are presented were logarithmically extrapolated to a minimum value of 10^{-10}. Any values less than this were set equal to 10^{-10} and used in the calculations.

For the ground level portion of the mixed mode release, no interpolation for height was performed and the values from the curve in Figure 7 of Reference 1 were used. In accordance with recommendations in Reference 1, the final calculations of χ/Q and D/Q for strictly ground level release and mixed mode release were multiplied by the open terrain correction factor as a function of distance as shown in Figure 2, Reference 1.

A conceptual flow diagram summarizing the calculational methodology used to calculate D/Q from the joint frequency distribution is presented in Figure 2.2. Note the similarity between techniques for χ/Q and D/Q.

2.3 Description of Mixed Mode Joint Frequency Distribution for Gamma Doses

This section describes the methodology used to calculate the sets of joint frequency distributions used as input for the calculation of the gamma doses. Each set of joint frequency distributions consists of two combinations: a ground level release and an elevated release. For a ground level release, the frequency of occurrence of each wind speed-wind direction-stability class combination was calculated and was weighted by the percent of time that meteorological combination was considered to be entrained in the building wake cavity. For the elevated release a separate similar distribution was calculated but weighted by the percent of time that each meteorological condition caused the vent to emit in the elevated mode. The entrainment coefficient was calculated in the same manner as for the □/Q estimates. These two joint frequency distributions, taken separately, do not sum to unity. The first sums to the total frequency that the release was considered to be a ground level source, and the second to the total frequency that the release was considered elevated. Together, however, these distributions sum to unity.

Because the criteria for the determination of the entrainment coefficient are dependent upon wind speed only, the relative frequencies of occurrence for stability and wind direction are identical for the mixed mode ground level and mixed mode elevated distributions. However, the relative wind speed frequencies of occurrence are different. Because lower wind speeds tend to be categorized as elevated releases, the average speeds for the mixed mode ground level distribution tend to be higher than those for a strictly ground level release. Similarly, since higher winds tend to be categorized as ground level releases, the average speeds for the mixed mode elevated distribution tend to be lower than those expected from the power law extrapolation of the strictly ground level release.

Presentation of the final plume height attained for each meteorological combination for the elevated portion of the mixed mode source is difficult to include with the joint frequency distribution. For this reason, the most conservative approach possible was taken. That is, since the wind speeds categorized in the elevated joint frequency distribution were calculated at the height of release (e.g., 51.2 meters for the containment building), the radiological dose calculations were performed under the assumption that when an elevated release was considered to exist, the plume rise was zero.

The mixed mode joint frequency distribution tables for the annual average and grazing period average are presented in Appendices B, C, and D for each of the three different sources considered. Note that the grazing period frequencies of occurrence are normalized to the number of hours during that period, i.e., the sum of all frequencies adds to unity.

2.4 Meteorological Data

Meteorological data were taken on-site at 10 meters and at 60 meters from 1 June 1974 through 31 May 1975. A complete description of the on-site meteorological monitoring program, along with instrument accuracy and adequacy, can be found in Reference 4.

The degree to which this year of data base at the 60-meter tower is representative of actual site conditions is discussed in Reference 3. The discussion of the primary airflow regimes which govern dispersion at the Fermi 2 site can be found in References 2 and 4.

The mixed mode release analysis specified in Reference 1 requires that the wind speed be determined at the point of release. Because the measured wind velocities are at heights other than the point of release, a power law wind profile was used for interpolation (section 2.4.2).

2.4.1 Joint Frequency Distributions

The calculational methodology used to develop the joint frequency distributions (other than those used in gamma dose calculations) of meteorological variables used in the analyses is described below.

Joint frequency distributions give the frequency of time, over a specified period, that specified classes of wind speed, wind direction, and atmospheric stability co-existed.

Wind direction, as measured at the 10-meter level, was classified into sixteen 22.5-degree sectors centered on the cardinal compass points. Wind speed, as measured at the 10-meter level, was categorized into 12 classes as shown below:

Class Number	Wind Speed Range (mph)	Interval Medial Used in Calculations (mph)
1 (Calms)	$0.0 \leq u \leq 0.5$	0.5*
2	$0.5 \leq u \leq 2.5$	1.5
3	$2.5 \leq u \leq 4.5$	3.5
4	$4.5 \leq u \leq 6.5$	5.5
5	$6.5 \leq u \leq 8.5$	7.5
6	$8.5 \leq u \leq 11.5$	10.0
7	$11.5 \leq u \leq 14.5$	13.0
8	$14.5 \leq u \leq 18.5$	16.5
9	$18.5 \leq u \leq 23.5$	21.0
10	$23.5 \leq u \leq 30.5$	27.0
11	$30.5 \leq u \leq 39.5$	35.0
12	$39.5 < u$	42.0

* 0.5 was used for calms because the median is less than 1/2 the starting threshold of the instruments.

The joint frequency data used in the radiological dose calculations were derived from the data collected on the 60-meter tower. The meteorological data used in the joint frequency distribution derivation were collected over the period from 1 June 1974 through 31 May 1975. Tables of frequency of occurrence of wind speed by direction for each stability category are presented in Appendix A. For radiological dose evaluations during the grazing period, the data collected over the period 15 April 1975 through 31 May 1975 were sequenced around to the beginning of the 1 June 1974 through 15 October 1974 period and the resultant 6 month period categorized. The grazing period frequencies of occurrence are normalized to the number of hours during that period, i.e., the sum of all frequencies adds to unity.

2.4.2 Power Law Wind Profile

Mixing-Length Theory (Reference 10) predicts that the wind speed profile should follow a simple logarithmic pattern in the presence of purely mechanically generated turbulence over homogeneous terrain and in the absence of thermal stratification. This logarithmic profile fits observations well only when the temperature lapse rate is neutrally stable. Under these conditions, mechanical turbulence dominates and is neither augmented by thermally induced turbulence (unstable case) nor suppressed by thermal stratification (stable case). When the lapse rate is not neutral, the logarithmic law is not a good description of the wind profile. In order to describe the wind speed profile when the lapse rate is not neutral, various empirical methods have been suggested which incorporate corrections for stability. The most successful of these is the power law profile. This is stated as:

$$\frac{u_1}{u_2} = \left(\frac{z_1}{z_2}\right)^m \text{ where } 0 \leq m \leq 1 \qquad (16)$$

where

z_1 = height at elevation 1

z_2 = height at elevation 2

u_1 = wind speed at height z_1

u_2 = wind speed at height z_2

m = a non-dimensional variable which depends on thermal stability

This technique was used to interpolate wind velocities at the point of release at the Fermi 2 site from the on-site data.

To determine the behavior of m with lapse rate at the Fermi 2 site, equation (16) was solved for m in terms of the hourly-averaged wind speeds at the 10- and 60-meter levels:

$$m = \frac{\log u_{60} - \log u_{10}}{\log(60) - \log(10)} \qquad (17)$$

The calculated hourly values of m were then plotted on a scatter diagram as a function of the corresponding hourly average temperature difference between the 10- and 60-meter levels. The diagram shown in Figure 2.3 presents these data for the period 1 June 1974 through 31 May 1975. The number of occurrences of any particular set of values is given by the alphabetic rank of the letter plotted at the location of those values. The average value of m decreases with increasing temperature difference. The Pasquill stability categories are also shown in Figure 2.3 to allow easy comparison with the average value of m in each class. For the annual period considered, the average value of the power law exponent by stability class is given in Table 2.1.

To determine whether there was a seasonal dependence on the power law wind profile exponent for the Fermi 2 site data, the same type of analysis as that done in Figure 2.3 was done for the data for each of the four seasons. The seasonal behavior of the power law exponent is shown in Figure 2.4. From this analysis it can be seen that there is little variation in the average curve for the different seasons.

Because of the possibility of a parametric dependence of the power law exponent upon other meteorological variables, the scatter diagram technique was applied to the 10-meter level wind speed averages as well. These data are shown in Figure 2.5. The dependence of m upon wind speed for values greater than about seven mph is negligible. For wind speeds less than this, the average value of m increases relatively slowly down to a speed of about five mph and then rapidly for lower values. This is probably due to the parametric relationship between low wind speeds and high atmospheric thermal stability where the surface winds essentially decouple from the faster moving upper level flows. This does not invalidate the power law profile extrapolation technique.

In all elevated wind speed calculations, the 10-meter level wind speed was extrapolated to the elevated height using the power law profile with the exponent values shown in Table 2.1 by stability class.

TABLE 2.1. AVERAGE VALUES OF POWER LAW WIND PROFILE EXPONENT BY STABILITY CLASS.

Pasquill Stability Class	Average Value of Exponent	Standard Deviation of Average	Average Wind Speed (mph)	Percentage of Occurrence
A	0.141	0.157	8.95	9.17
B	0.176	0.154	9.94	2.08
C	0.174	0.117	10.08	2.40
D	0.209	0.131	10.04	30.29
E	0.277	0.172	8.79	40.46
F	0.414	0.186	6.82	10.31
G	0.435	0.274	5.41	5.30

3.0 FERMI 2 SITE SPECIFIC χ/Q AND D/Q VALUES

The methodology described in section 2 of this annex was applied to the 60-meter tower data base from June 1, 1974 through May 31, 1975 for the receptor locations shown in Table 3.1. This table describes the distance to the nearest receptor type in each 22 1/2 degree sector out to a distance of 5 miles (8.047 Km). The analyses were performed for the three separate sources whose release specifications are shown in Table 3.2.

The annual average values for the ground level and mixed mode χ/Q and D/Q for the containment building vent, the turbine building vent, and the radwaste building vent are presented in Tables 3.3, 3.5, and 3.7, respectively. The grazing period (April 15 through October 15) values for the ground level and mixed mode χ/Q and D/Q for the three sources are presented in Tables 3.4, 3.6, and 3.8.

TABLE 3.1 RECEPTOR LOCATIONS USED IN χ/Q AND D/Q EVALUATION FOR APENDIX I (SURVEYED MAY-JUNE 1976)

	Distance in Meters to First						
Direction	Site Boundary	Residence	Garden	Milk Goat	Meat Animal	Milk Cow	Nature of Site Boundary
N	1249**	1720	1800	*	2600 (Pig)	*	Farmland**
NNE	1646	1740	1740	*	4440 (Beef)	*	Swan Creek
NE	579	1770	1770	*	*	*	Lake Erie Shore-Woodlot
S	1417	1530	1530	*	*	*	Marsh
SSW	1542	1840	1840	*	*	*	Point Aux Peaux Road-Sparse Trees
SW	1920	2150	2150	*	*	*	Point Aux Peaux Road-Sparse Trees
WSW	1798	2300	2300	*	3490 (Beef)	*	Meadow
W	1390	1950	1950	*	*	6440	Toll Road and Edison Plant Entrance Road - Wood Lot
WNW	1082	1130	1130	7820	4100 (Pig)	*	Toll Road - Marsh
NW	915	1720	1720	3180	4750 (Beef)	4750	Toll Road - Meadow/Sparse Trees

TABLE 3.1 RECEPTOR LOCATIONS USED IN χ/Q AND D/Q EVALUATION FOR APENDIX I (SURVEYED MAY-JUNE 1976)

	Distance in Meters to First						
Direction	Site Boundary	Residence	Garden	Milk Goat	Meat Animal	Milk Cow	Nature of Site Boundary
NNW	990	1690	1690	*	4700 (Beef)	*	Toll Road - Meadow/Sparse Trees

* None found within 5-mile radius of site

** Presently under water 6/1/76

TABLE 3.2 RELEASE POINT SPECIFICATIONS FOR CONTAINMENT BUILDING AND TURBINE BUILDING SOURCES

	Containment Building Source	Turbine Building Source	Radwaste Building Source
Release Height Above Grade (meters)	51.20	40.08	44.50
Structure Height Used to Evaluate Volumetric Wake Size (meters)	47.50	40.08	40.08
Height of Vent Above Adjacent Structures (meters)	3.70	0	4.42
Vent Diameter (meters)	2.19	7.46[a]	1.54[a]
Vent Configuration[b]	Circular	Rectangular	Rectangular
ΔT Between Gaseous Effluent and Ambient Air (°C)	17	17	17
Exit Velocity from Vent (m/sec)	13.97	4.22	8.92

[a] Release vent is rectangular in cross section with area equivalent to a cylinder vent with this diameter.

[b] There are no deflectors or diffusers on vents.

TABLE 3.3 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND CONTAINMENT BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Ground Source	Mixed Mode Source
Site Boundary (Under H_2O)	1.249	N	3.679×10^{-6}	6.401×10^{-7}	3.794×10^{-8}	1.401×10^{-8}
Site Boundary (Swan Creek)	1.646	NNE	2.654×10^{-6}	6.078×10^{-7}	2.610×10^{-8}	9.808×10^{-9}
Site Boundary (Lake Shore)	0.579	NE	1.687×10^{-5}	2.279×10^{-6}	1.962×10^{-7}	5.461×10^{-8}
Site Boundary (Marsh)	1.417	S	2.707×10^{-6}	3.251×10^{-7}	1.758×10^{-8}	4.915×10^{-9}
Site Boundary Pnt Aux Peaux	1.542	SSW	1.619×10^{-6}	2.331×10^{-7}	1.126×10^{-8}	3.687×10^{-9}
Site Boundary Pnt Aux Peaux	1.920	SW	8.095×10^{-7}	1.850×10^{-7}	7.696×10^{-9}	3.726×10^{-9}
Site Boundary (Meadow)	1.798	WSW	1.036×10^{-6}	2.645×10^{-7}	1.131×10^{-8}	5.793×10^{-9}
Site Boundary Toll Rd.-Entrc	1.390	W	1.586×10^{-6}	3.570×10^{-7}	1.814×10^{-8}	8.318×10^{-9}
Site Boundary Toll Rd.- Marsh	1.082	WNW	3.221×10^{-6}	6.193×10^{-7}	3.773×10^{-8}	1.467×10^{-8}
Site Boundary Toll Rd.- Meadow	0.915	NW	5.372×10^{-6}	7.630×10^{-7}	6.133×10^{-8}	2.010×10^{-8}
Site Boundary Toll Rd.- Meadow	0.990	NNW	5.091×10^{-6}	7.159×10^{-7}	4.979×10^{-8}	1.499×10^{-8}
Residence	1.720	N	1.747×10^{-6}	3.505×10^{-7}	1.594×10^{-8}	6.470×10^{-9}
Residence	1.740	NNE	2.316×10^{-6}	5.418×10^{-7}	2.228×10^{-8}	8.508×10^{-9}
Residence	1.770	NE	2.248×10^{-6}	4.536×10^{-7}	1.927×10^{-8}	7.207×10^{-9}
Residence	1.530	S	2.209×10^{-6}	2.745×10^{-7}	1.392×10^{-8}	4.014×10^{-9}

TABLE 3.3 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND CONTAINMENT BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Ground Source	Mixed Mode Source
Residence	1.840	SSW	1.046×10^{-6}	1.645×10^{-7}	6.797×10^{-9}	2.422×10^{-9}
Residence	2.150	SW	6.257×10^{-7}	1.518×10^{-7}	5.703×10^{-9}	2.858×10^{-9}
Residence	2.300	WSW	5.904×10^{-7}	1.702×10^{-7}	5.894×10^{-9}	3.261×10^{-9}
Residence	1.950	W	6.725×10^{-7}	1.744×10^{-7}	6.840×10^{-9}	3.602×10^{-9}
Residence	1.130	WNW	3.035×10^{-6}	5.922×10^{-7}	3.499×10^{-8}	1.376×10^{-8}
Residence	1.720	NW	1.512×10^{-6}	3.205×10^{-7}	1.492×10^{-8}	6.363×10^{-9}
Residence	1.690	NNW	1.737×10^{-6}	3.298×10^{-7}	1.468×10^{-8}	5.150×10^{-9}
Garden	1.800	N	1.566×10^{-6}	3.209×10^{-7}	1.405×10^{-8}	5.790×10^{-9}
Garden	1.740	NNE	2.316×10^{-6}	5.418×10^{-7}	2.228×10^{-8}	8.508×10^{-9}
Garden	1.770	NE	2.248×10^{-6}	4.536×10^{-7}	1.927×10^{-8}	7.207×10^{-9}
Garden	1.530	S	2.209×10^{-6}	2.745×10^{-7}	1.392×10^{-8}	4.014×10^{-9}
Garden	1.840	SSW	1.046×10^{-6}	1.645×10^{-7}	6.797×10^{-9}	2.422×10^{-9}
Garden	2.150	SW	6.257×10^{-7}	1.518×10^{-7}	5.703×10^{-9}	2.858×10^{-9}
Garden	2.300	WSW	5.904×10^{-7}	1.702×10^{-7}	5.894×10^{-9}	3.261×10^{-9}
Garden	1.950	W	6.725×10^{-7}	1.744×10^{-7}	6.840×10^{-9}	3.602×10^{-9}
Garden	1.130	WNW	3.035×10^{-6}	5.922×10^{-7}	3.499×10^{-8}	1.376×10^{-8}
Garden	1.720	NW	1.512×10^{-6}	3.205×10^{-7}	1.492×10^{-8}	6.363×10^{-9}
Garden	1.690	NNW	1.737×10^{-6}	3.298×10^{-7}	1.468×10^{-8}	5.150×10^{-9}
Milk Goat	7.820	WNW	6.333×10^{-8}	2.315×10^{-8}	3.271×10^{-10}	1.861×10^{-10}
Milk Goat	3.180	NW	3.996×10^{-7}	1.138×10^{-7}	3.098×10^{-9}	1.534×10^{-9}
Meat Animal-Pig	2.600	N	6.997×10^{-7}	1.701×10^{-7}	5.393×10^{-9}	2.383×10^{-9}
Meat Animal-Beef	4.440	NNE	3.456×10^{-7}	1.138×10^{-7}	2.201×10^{-9}	9.521×10^{-10}

TABLE 3.3 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND CONTAINMENT BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Ground Source	Mixed Mode Source
Meat Animal-Beef	3.490	WSW	2.514×10^{-7}	8.675×10^{-8}	2.134×10^{-9}	1.266×10^{-9}
Meat Animal-Pig	4.100	WNW	2.064×10^{-7}	6.392×10^{-8}	1.418×10^{-9}	7.512×10^{-10}
Meat Animal-Beef	4.750	NW	1.868×10^{-7}	6.165×10^{-8}	1.223×10^{-9}	6.532×10^{-10}
Meat Animal-Beef	4.700	NNW	2.179×10^{-7}	6.248×10^{-8}	1.173×10^{-9}	4.941×10^{-10}
Milk Cow	6.440	W	6.332×10^{-8}	2.450×10^{-8}	3.958×10^{-10}	2.485×10^{-10}
Milk Cow	4.750	NW	1.868×10^{-7}	6.165×10^{-8}	1.223×10^{-9}	6.532×10^{-10}

TABLE 3.4 GRAZING PERIOD: APRIL 15 TO OCTOBER 15;* AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND CONTAINMENT BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Boundary (Under H_2O)	1.249	N	2.125×10^{-6}	4.102×10^{-7}	2.566×10^{-8}	1.061×10^{-8}
Site Boundary Swan Creek	1.646	NNE	1.436×10^{-6}	3.321×10^{-7}	1.462×10^{-8}	5.761×10^{-9}
Site Boundary (Lake Shore)	0.579	NE	8.530×10^{-6}	1.057×10^{-6}	8.990×10^{-8}	2.370×10^{-8}
Site Boundary (Marsh)	1.417	S	1.765×10^{-6}	1.902×10^{-7}	9.751×10^{-9}	2.381×10^{-9}
Site Bndry-Pnt Aux Peaux	1.542	SSW	1.087×10^{-6}	1.574×10^{-7}	7.351×10^{-9}	2.196×10^{-9}
Site Bndry-Pnt Aux Peaux	1.920	SW	3.763×10^{-7}	9.339×10^{-8}	4.226×10^{-9}	1.973×10^{-9}

TABLE 3.4 GRAZING PERIOD: APRIL 15 TO OCTOBER 15;* AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND CONTAINMENT BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Bndry (Meadow)	1.793	WSW	4.763×10^{-7}	9.490×10^{-8}	4.749×10^{-9}	2.150×10^{-9}
Site Bndry-Toll Rd.-Entrc	1.390	W	8.010×10^{-7}	1.821×10^{-7}	9.070×10^{-9}	3.793×10^{-9}
Site Bndry-Toll Rd.-Marsh	1.082	WNW	1.936×10^{-6}	3.587×10^{-7}	2.375×10^{-8}	9.480×10^{-9}
Site Bndry-Toll Rd.-Meadow	0.915	NW	2.990×10^{-6}	4.476×10^{-7}	3.965×10^{-8}	1.435×10^{-8}
Site Bndry-Toll Rd.-Meadow	0.990	NNW	2.814×10^{-6}	4.472×10^{-7}	3.271×10^{-8}	1.034×10^{-8}
Residence	1.720	N	1.002×10^{-6}	2.217×10^{-7}	1.078×10^{-8}	4.846×10^{-9}
Residence	1.740	NNE	1.252×10^{-6}	2.957×10^{-7}	1.248×10^{-8}	4.991×10^{-9}
Residence	1.770	NE	1.117×10^{-6}	2.049×10^{-7}	8.831×10^{-9}	3.093×10^{-9}
Residence	1.530	S	1.441×10^{-6}	1.591×10^{-7}	7.730×10^{-9}	1.934×10^{-9}
Residence	1.840	SSW	7.041×10^{-7}	1.095×10^{-7}	4.439×10^{-9}	1.419×10^{-9}
Residence	2.150	SW	2.912×10^{-7}	7.639×10^{-8}	3.133×10^{-9}	1.504×10^{-9}
Residence	2.300	WSW	2.728×10^{-7}	6.230×10^{-8}	2.474×10^{-9}	1.208×10^{-9}
Residence	1.950	W	3.391×10^{-7}	8.861×10^{-8}	3.423×10^{-9}	1.635×10^{-9}
Residence	1.130	WNW	1.824×10^{-6}	3.428×10^{-7}	2.202×10^{-8}	8.891×10^{-9}
Residence	1.720	NW	8.300×10^{-7}	1.867×10^{-7}	9.640×10^{-9}	4.493×10^{-9}
Residence	1.690	NNW	9.461×10^{-7}	2.087×10^{-7}	9.640×10^{-9}	3.612×10^{-9}
Garden	1.800	N	8.971×10^{-7}	2.026×10^{-7}	9.501×10^{-9}	4.328×10^{-9}
Garden	1.740	NNE	1.252×10^{-6}	2.956×10^{-7}	1.248×10^{-8}	4.991×10^{-9}
Garden	1.770	NE	1.117×10^{-6}	2.049×10^{-7}	8.831×10^{-9}	3.093×10^{-9}
Garden	1.530	S	1.441×10^{-6}	1.591×10^{-7}	7.730×10^{-9}	1.934×10^{-9}

TABLE 3.4 GRAZING PERIOD: APRIL 15 TO OCTOBER 15;* AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND CONTAINMENT BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Garden	1.840	SSW	7.041×10^{-7}	1.095×10^{-7}	4.439×10^{-9}	1.419×10^{-9}
Garden	2.150	SW	2.912×10^{-7}	7.639×10^{-8}	3.133×10^{-9}	1.504×10^{-9}
Garden	2.300	WSW	2.728×10^{-7}	6.230×10^{-8}	2.474×10^{-9}	1.208×10^{-9}
Garden	1.950	W	3.391×10^{-7}	8.861×10^{-8}	3.423×10^{-9}	1.635×10^{-9}
Garden	1.130	WNW	1.824×10^{-6}	3.428×10^{-7}	2.202×10^{-8}	8.891×10^{-9}
Garden	1.720	NW	8.300×10^{-7}	1.867×10^{-7}	9.640×10^{-9}	4.493×10^{-9}
Garden	1.690	NNW	9.461×10^{-7}	2.087×10^{-7}	9.640×10^{-9}	3.612×10^{-9}
Milk Goat	7.820	WNW	3.746×10^{-8}	1.392×10^{-8}	2.059×10^{-10}	1.192×10^{-10}
Milk Goat	3.180	NW	2.174×10^{-7}	6.581×10^{-8}	2.003×10^{-9}	1.075×10^{-9}
Meat Animal-Pig	2.600	N	3.980×10^{-7}	$1.061 \times 10_{-7}$	3.647×10^{-9}	$1.7\ 7 \times 10^{-9}$
Meat Animal-Beef	4.440	NNE	1.867×10^{-7}	6.111×10^{-8}	1.233×10^{-9}	5.580×10^{-10}
Meat Animal-Beef	3.490	WSW	1.171×10^{-7}	3.288×10^{-8}	8.960×10^{-10}	4.705×10^{-10}
Meat Animal-Pig	4.100	WNW	1.231×10^{-7}	3.779×10^{-8}	8.931×10^{-10}	4.778×10^{-10}
Meat Animal-Beef	4.750	NW	1.008×10^{-7}	3.543×10^{-8}	7.911×10^{-10}	4.565×10^{-10}
Meat Animal-Beef	4.700	NNW	1.161×10^{-7}	3.895×10^{-8}	7.711×10^{-10}	3.528×10^{-10}
Milk Cow	6.440	W	3.245×10^{-8}	1.264×10^{-8}	1.971×10^{-10}	1.134×10^{-10}
Milk Cow	4.750	NW	1.008×10^{-7}	3.543×10^{-8}	7.911×10^{-10}	4.565×10^{-10}

* see section 2 of text

TABLE 3.5 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND TURBINE BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode S	Downwind Distance (km)	Radial
Site Boundary (Under H_2O)	1.249	N	3.891×10^{-6}	2.625×10^{-6}	3.794×10^{-8}	3.348×10^{-8}
Site Boundary-Swan Creek	1.646	NNE	2.795×10^{-6}	2.164×10^{-6}	2.610×10^{-8}	2.422×10^{-8}
Site Boundary (Lake Shore)	0.579	NE	1.829×10^{-5}	1.196×10^{-5}	1.962×10^{-7}	1.702×10^{-7}
Site Boundary (Marsh)	1.417	S	2.839×10^{-6}	1.678×10^{-6}	1.758×10^{-8}	1.410×10^{-8}
Site Bndry-Pnt Aux Peaux	1.542	SSW	1.698×10^{-6}	9.864×10^{-7}	1.126×10^{-8}	9.312×10^{-9}
Site Bndry-Pnt Aux Peaux	1.920	SW	8.426×10^{-7}	5.591×10^{-7}	7.696×10^{-9}	6.920×10^{-9}
Site Bndry (Meadow)	1.798	WSW	1.077×10^{-6}	7.966×10^{-7}	1.131×10^{-8}	1.023×10^{-8}
Site Bndry-Toll Rd.-Entrc	1.390	W	1.666×10^{-6}	1.196×10^{-6}	1.814×10^{-8}	1.615×10^{-8}
Site Bndry-Toll Rd.-Marsh	1.082	WNW	3.398×10^{-6}	2.540×10^{-6}	3.773×10^{-8}	3.464×10^{-8}
Site Bndry-Toll Rd.-Meadow	0.915	NW	5.745×10^{-6}	4.186×10^{-6}	6.133×10^{-8}	5.395×10^{-8}
Site Bndry-Toll Rd.-Meadow	0.990	NNW	5.462×10^{-6}	3.950×10^{-6}	4.979×10^{-8}	4.403×10^{-8}
Residence	1.720	N	1.835×10^{-6}	1.254×10^{-6}	1.594×10^{-8}	1.418×10^{-8}
Residence	1.740	NNE	2.439×10^{-6}	1.890×10^{-6}	2.228×10^{-8}	2.069×10^{-8}
Residence	1.770	NE	2.362×10^{-6}	1.591×10^{-6}	1.927×10^{-8}	1.689×10^{-8}
Residence	1.530	S	2.313×10^{-6}	1.371×10^{-6}	1.392×10^{-8}	1.119×10^{-8}

TABLE 3.5 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND TURBINE BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode S	Downwind Distance (km)	Radial
Residence	1.840	SSW	1.100×10^{-6}	6.432×10^{-7}	6.797×10^{-9}	5.652×10^{-9}
Residence	2.150	SW	6.518×10^{-7}	4.337×10^{-7}	5.703×10^{-9}	5.140×10^{-9}
Residence	2.300	WSW	6.121×10^{-7}	4.582×10^{-7}	5.894×10^{-9}	5.355×10^{-9}
Residence	1.950	W	7.037×10^{-7}	5.128×10^{-7}	6.840×10^{-9}	6.167×10^{-9}
Residence	1.130	WNW	3.199×10^{-6}	2.394×10^{-6}	3.499×10^{-8}	3.215×10^{-8}
Residence	1.720	NW	1.575×10^{-6}	1.189×10^{-6}	1.492×10^{-8}	1.340×10^{-8}
Residence	1.690	NNW	1.824×10^{-6}	1.338×10^{-6}	1.468×10^{-8}	1.309×10^{-8}
Garden	1.800	N	1.645×10^{-6}	1.125×10^{-6}	1.405×10^{-8}	1.251×10^{-8}
Garden	1.740	NNE	2.439×10^{-6}	1.890×10^{-6}	2.228×10^{-8}	2.069×10^{-8}
Garden	1.770	NE	2.362×10^{-6}	1.591×10^{-6}	1.927×10^{-8}	1.689×10^{-8}
Garden	1.530	S	2.313×10^{-6}	1.371×10^{-6}	1.392×10^{-8}	1.119×10^{-8}
Garden	1.840	SSW	1.100×10^{-6}	6.432×10^{-7}	6.797×10^{-9}	5.652×10^{-9}
Garden	2.150	SW	6.518×10^{-7}	4.337×10^{-7}	5.703×10^{-9}	5.140×10^{-9}
Garden	2.300	WSW	6.121×10^{-7}	4.582×10^{-7}	5.894×10^{-9}	5.355×10^{-9}
Garden	1.950	W	7.037×10^{-7}	5.128×10^{-7}	6.840×10^{-9}	6.167×10^{-9}
Garden	1.130	WNW	3.199×10^{-6}	2.394×10^{-6}	3.499×10^{-8}	3.215×10^{-8}
Garden	1.720	NW	1.575×10^{-6}	1.189×10^{-6}	1.492×10^{-8}	1.340×10^{-8}
Garden	1.690	NNW	1.824×10^{-6}	1.338×10^{-6}	1.468×10^{-8}	1.309×10^{-8}
Milk Goat	7.820	WNW	6.547×10^{-8}	5.203×10^{-8}	3.271×10^{-10}	3.099×10^{-10}
Milk Goat	3.180	NW	4.180×10^{-7}	3.257×10^{-7}	3.098×10^{-9}	2.829×10^{-9}
Meat Animal-Pig	2.600	N	7.362×10^{-7}	5.108×10^{-7}	5.393×10^{-9}	4.834×10^{-9}
Meat Animal-Beef	4.440	NNE	3.596×10^{-7}	2.851×10^{-7}	2.201×10^{-9}	2.058×10^{-9}
Meat Animal-Beef	3.490	WSW	2.587×10^{-7}	1.984×10^{-7}	2.134×10^{-9}	1.948×10^{-9}

TABLE 3.5 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND TURBINE BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode S	Downwind Distance (km)	Radial
Meat Animal-Pig	4.100	WNW	2.161×10^{-7}	1.683×10^{-7}	1.418×10^{-9}	1.334×10^{-9}
Meat Animal-Beef	4.750	NW	1.939×10^{-7}	1.541×10^{-7}	1.223×10^{-9}	1.128×10^{-9}
Meat Animal-Beef	4.700	NNW	2.277×10^{-7}	1.729×10^{-7}	1.173×10^{-9}	1.060×10^{-9}
Milk Cow	6.440	W	6.514×10^{-8}	5.073×10^{-8}	3.958×10^{-10}	3.653×10^{-10}
Milk Cow	4.750	NW	1.939×10^{-7}	1.541×10^{-7}	1.223×10^{-9}	1.128×10^{-9}

TABLE 3.6 GRAZING PERIOD: APRIL 15 TO OCTOBER 15*; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND TURBINE BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Boundary (Under H_2O)	1.249	N	2.238×10^{-6}	1.578×10^{-6}	2.566×10^{-8}	2.297×10^{-8}
Site Boundary-Swan Creek	1.646	NNE	1.511×10^{-6}	1.157×10^{-6}	1.462×10^{-8}	1.355×10^{-8}
Site Boundary (Lake Shore)	0.579	NE	9.150×10^{-5}	5.696×10^{-6}	8.980×10^{-8}	7.602×10^{-8}
Site Boundary (Marsh)	1.417	S	1.849×10^{-6}	1.095×10^{-6}	9.751×10^{-9}	7.636×10^{-9}
Site Bndry-Pnt Aux Peaux	1.542	SSW	1.145×10^{-6}	7.093×10^{-7}	7.351×10^{-9}	6.160×10^{-9}
Site Bndry-Pnt Aux Peaux	1.920	SW	3.926×10^{-7}	3.079×10^{-7}	4.226×10^{-9}	3.940×10^{-9}
Site Bndry (Meadow)	1.798	WSW	4.986×10^{-7}	3.463×10^{-7}	4.749×10^{-9}	4.157×10^{-9}
Site Bndry-Toll Rd.-Entrc	1.390	W	8.383×10^{-7}	6.569×10^{-7}	9.070×10^{-9}	8.041×10^{-9}

TABLE 3.6 GRAZING PERIOD: APRIL 15 TO OCTOBER 15*; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND TURBINE BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Bndry-Toll Rd.-Marsh	1.082	WNW	2.049 x 10^{-6}	1.498 x 10^{-6}	2.375 x 10^{-8}	2.186 x 10^{-8}
Site Bndry-Toll Rd.-Meadow	0.915	NW	3.202 x 10^{-6}	2.381 x 10^{-6}	3.965 x 10^{-8}	3.544 x 10^{-8}
Site Bndry-Toll Rd.-Meadow	0.990	NNW	3.025 x 10^{-6}	2.472 x 10^{-6}	3.271 x 10^{-8}	3.002 x 10^{-8}
Residence	1.720	N	1.048 x 10^{-6}	7.481 x 10^{-7}	1.078 x 10^{-8}	9.729 x 10^{-9}
Residence	1.740	NNE	1.319 x 10^{-6}	1.010 x 10^{-6}	1.248 x 10^{-8}	1.157 x 10^{-8}
Residence	1.770	NE	1.173 x 10^{-6}	7.536 x 10^{-7}	8.831 x 10^{-9}	7.557 x 10^{-9}
Residence	1.530	S	1.507 x 10^{-6}	8.948 x 10^{-7}	7.730 x 10^{-9}	6.054 x 10^{-9}
Residence	1.840	SSW	7.446 x 10^{-7}	4.623 x 10^{-7}	4.439 x 10^{-9}	3.734 x 10^{-9}
Residence	2.150	SW	3.036 x 10^{-7}	2.383 x 10^{-7}	3.133 x 10^{-9}	2.924 x 10^{-9}
Residence	2.300	WSW	2.845 x 10^{-7}	2.000 x 10^{-7}	2.474 x 10^{-9}	2.179 x 10^{-9}
Residence	1.950	W	3.549 x 10^{-7}	2.828 x 10^{-7}	3.423 x 10^{-9}	3.608 x 10^{-9}
Residence	1.130	WNW	1.929 x 10^{-6}	1.412 x 10^{-6}	2.202 x 10^{-8}	2.029 x 10^{-8}
Residence	1.720	NW	8.645 x 10^{-7}	6.589 x 10^{-7}	9.640 x 10^{-9}	8.792 x 10^{-9}
Residence	1.690	NNW	9.921 x 10^{-7}	8.202 x 10_{-7}	9.640 x 10^{-9}	8.938 x 10^{-9}
Garden	1.800	N	9.387 x 10^{-7}	6.710 x 10^{-7}	9.501 x 10^{-9}	8.585 x 10^{-9}
Garden	1.740	NNE	1.319 x 10^{-6}	1.010 x 10^{-6}	1.248 x 10^{-8}	1.157 x 10^{-8}
Garden	1.770	NE	1.173 x 10^{-6}	7.536 x 10^{-7}	8.831 x 10^{-9}	7.557 x 10^{-9}
Garden	1.530	S	1.507 x 10^{-6}	8.948 x 10^{-7}	7.730 x 10^{-9}	6.054 x 10^{-9}
Garden	1.840	SSW	7.446 x 10^{-7}	4.623 x 10^{-7}	4.439 x 10^{-9}	3.734 x 10^{-9}
Garden	2.150	SW	3.036 x 10^{-7}	2.383 x 10^{-7}	3.133 x 10^{-9}	2.924 x 10^{-9}
Garden	2.300	WSW	2.845 x 10^{-7}	2.000 x 10^{-7}	2.474 x 10^{-9}	2.179 x 10^{-9}
Garden	1.950	W	3.549 x 10^{-7}	2.828 x 10^{-7}	3.423 x 10^{-9}	3.608 x 10^{-9}
Garden	1.130	WNW	1.929 x 10^{-6}	1.412 x 10^{-6}	2.202 x 10^{-8}	2.029 x 10^{-8}

TABLE 3.6 GRAZING PERIOD: APRIL 15 TO OCTOBER 15*; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND TURBINE BUILDING SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Garden	1.720	NW	8.645×10^{-7}	6.589×10^{-7}	9.640×10^{-9}	8.792×10^{-9}
Garden	1.690	NNW	9.921×10^{-7}	8.202×10^{-7}	9.640×10^{-9}	8.938×10^{-9}
Milk Goat	7.820	WNW	3.858×10^{-8}	3.056×10^{-8}	2.059×10^{-10}	1.959×10^{-10}
Milk Goat	3.180	NW	2.260×10^{-7}	1.759×10^{-7}	2.003×10^{-9}	1.853×10^{-9}
Meat Animal-Pig	2.600	N	4.177×10^{-7}	3.020×10^{-7}	3.647×10^{-9}	3.320×10^{-9}
Meat Animal-Beef	4.440	NNE	1.945×10^{-7}	1.514×10^{-7}	1.233×10^{-9}	1.152×10^{-9}
Meat Animal-Beef	3.490	WSW	1.211×10^{-7}	8.726×10^{-8}	8.960×10^{-10}	7.945×10^{-10}
Meat Animal-Pig	4.100	WNW	1.283×10^{-7}	9.891×10^{-8}	8.931×10^{-10}	8.424×10^{-10}
Meat Animal-Beef	4.750	NW	1.040×10^{-7}	8.207×10^{-8}	7.911×10^{-10}	7.385×10^{-10}
Meat Animal-Beef	4.700	NNW	1.204×10^{-7}	1.020×10^{-7}	7.711×10^{-10}	7.244×10^{-10}
Milk Cow	6.440	W	3.354×10^{-8}	2.822×10^{-8}	1.971×10^{-10}	1.818×10^{-10}
Milk Cow	4.750	NW	1.040×10^{-7}	8.207×10^{-8}	7.911×10^{-10}	7.385×10^{-10}

* see section 2 of text

TABLE 3.7 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Boundary (Under H_2O)	1.249	N	3.891×10^{-6}	1.370×10^{-6}	3.794×10^{-8}	2.139×10^{-8}
Site Boundary-Swan Creek	1.646	NNE	2.795×10^{-6}	1.311×10^{-6}	2.610×10^{-8}	1.656×10^{-8}

TABLE 3.7 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Boundary (Lake Shore)	0.579	NE	1.829×10^{-5}	5.611×10^{-6}	1.962×10^{-7}	1.042×10^{-7}
Site Boundary (Marsh)	1.417	S	2.839×10^{-6}	7.195×10^{-7}	1.758×10^{-8}	7.970×10^{-9}
Site Boundary - Pnt Aux Peaux	1.542	SSW	1.698×10^{-6}	4.919×10^{-7}	1.126×10^{-8}	5.936×10^{-9}
Site Boundary - Pnt Aux Peaux	1.920	SW	8.426×10^{-7}	3.419×10^{-7}	7.696×10^{-9}	5.150×10^{-9}
Site Boundary (Meadow)	1.798	WSW	1.077×10^{-6}	4.714×10^{-7}	1.131×10^{-8}	7.611×10^{-9}
Site Boundary - Toll Rd.-Entrc	1.390	W	1.666×10^{-6}	7.213×10^{-7}	1.814×10^{-8}	1.210×10^{-8}
Site Boundary - Toll Rd.-Marsh	1.082	WNW	3.398×10^{-6}	1.440×10^{-6}	3.773×10^{-8}	2.383×10^{-8}
Site Boundary - Toll Rd.- Meadow	0.915	NW	5.745×10^{-6}	1.772×10^{-6}	6.133×10^{-8}	3.238×10^{-8}
Site Boundary - Toll Rd.- Meadow	0.990	NNW	5.462×10^{-6}	1.742×10^{-6}	4.979×10^{-8}	2.579×10^{-8}
Residence	1.720	N	1.835×10^{-6}	7.029×10^{-7}	1.594×10^{-8}	9.399×10^{-9}
Residence	1.740	NNE	2.439×10^{-6}	1.155×10^{-6}	2.228×10^{-8}	1.421×10^{-8}
Residence	1.770	NE	2.362×10^{-6}	9.557×10^{-7}	1.927×10^{-8}	1.148×10^{-8}
Residence	1.530	S	2.313×10^{-6}	5.978×10^{-7}	1.392×10^{-8}	6.397×10^{-9}
Residence	1.840	SSW	1.100×10^{-6}	3.331×10^{-7}	6.797×10^{-9}	3.696×10^{-9}
Residence	2.150	SW	6.518×10^{-7}	2.720×10^{-7}	5.703×10^{-9}	3.868×10^{-9}
Residence	2.300	WSW	6.121×10^{-7}	2.862×10^{-7}	5.894×10^{-9}	4.087×10^{-9}
Residence	1.950	W	7.037×10^{-7}	3.278×10^{-7}	6.840×10^{-9}	4.828×10^{-9}

TABLE 3.7 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Residence	1.130	WNW	3.199×10^{-6}	1.368×10^{-6}	3.499×10^{-8}	2.222×10^{-8}
Residence	1.720	NW	1.575×10^{-6}	6.478×10^{-7}	1.492×10^{-8}	9.046×10^{-9}
Residence	1.690	NNW	1.824×10^{-6}	7.069 x 10+	1.468×10^{-8}	8.188×10^{-9}
Garden	1.800	N	1.645×10^{-6}	6.371×10^{-7}	1.405×10^{-8}	8.339×10^{-9}
Garden	1.740	NNE	2.439×10^{-6}	1.155×10^{-6}	2.228×10^{-8}	1.421×10^{-8}
Garden	1.770	NE	2.362×10^{-6}	9.557×10^{-7}	1.927×10^{-8}	1.148×10^{-8}
Garden	1.530	S	2.313×10^{-6}	5.978×10^{-7}	1.392×10^{-8}	6.397×10^{-9}
Garden	1.840	SSW	1.100×10^{-6}	3.331×10^{-7}	6.797×10^{-9}	3.696×10^{-9}
Garden	2.150	SW	6.518×10^{-7}	2.720×10^{-7}	5.703×10^{-9}	3.868×10^{-9}
Garden	2.300	WSW	6.121×10^{-7}	2.862×10^{-7}	5.894×10^{-9}	4.087×10^{-9}
Garden	1.950	W	7.037×10^{-7}	3.278×10^{-7}	6.840×10^{-9}	4.828×10^{-9}
Garden	1.130	WNW	3.199×10^{-6}	1.368×10^{-6}	3.499×10^{-8}	2.222×10^{-8}
Garden	1.720	NW	1.575×10^{-6}	6.478×10^{-7}	1.492×10^{-8}	9.046×10^{-9}
Garden	1.690	NNW	1.824×10^{-6}	7.069×10^{-7}	1.468×10^{-8}	8.188×10^{-9}
Milk Goat	7.820	WNW	6.547×10^{-8}	3.783×10^{-8}	3.271×10^{-10}	2.387×10^{-10}
Milk Goat	3.180	NW	4.180×10^{-7}	1.988×10^{-7}	3.098×10^{-9}	1.985×10^{-9}
Meat Animal-Pig	2.600	N	7.362×10^{-7}	3.108×10^{-7}	5.393×10^{-9}	3.281×10^{-9}
Meat Animal-Beef	4.440	NNE	3.596×10^{-7}	1.976×10^{-7}	2.201×10^{-9}	1.445×10^{-9}
Meat Animal-Beef	3.490	WSW	2.587×10^{-7}	1.332×10^{-7}	2.134×10^{-9}	1.506×10^{-9}
Meat Animal-Pig	4.100	WNW	2.161×10^{-7}	1.161×10^{-7}	1.418×10^{-9}	1.004×10^{-9}
Meat Animal-Beef	4.750	NW	1.939×10^{-7}	9.904×10^{-8}	1.223×10^{-9}	7.988×10^{-10}

TABLE 3.7 ANNUAL: 6/1/74 - 5/31/75; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Meat Animal-Beef	4.700	NNW	2.277×10^{-7}	1.081×10^{-7}	1.173×10^{-9}	6.907×10^{-10}
Milk Cow	6.440	W	6.514×10^{-8}	3.691×10^{-8}	3.958×10^{-10}	2.937×10^{-10}
Milk Cow	4.750	NW	1.939×10^{-7}	9.904×10^{-8}	1.223×10^{-9}	7.988×10^{-10}

TABLE 3.8 GRAZING PERIOD: APRIL 15 TO OCTOBER 15*; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Boundary (Under H_2O)	1.249	N	2.238×10^{-6}	8.485×10^{-7}	2.566×10^{-8}	1.527×10^{-8}
Site Boundary-Swan Creek	1.646	NNE	1.511×10^{-6}	6.896×10^{-7}	1.462×10^{-8}	9.440×10^{-9}
Site Boundary (Lake Shore)	0.579	NE	9.150×10^{-6}	2.607×10^{-6}	8.989×10^{-8}	4.582×10^{-8}
Site Boundary (Marsh)	1.417	S	1.849×10^{-6}	4.166×10^{-7}	9.756×10^{-9}	3.859×10^{-9}
Site Bndry-Pnt Aux Peaux	1.542	SSW	1.145×10^{-6}	3.274×10^{-7}	7.353×10^{-9}	3.631×10^{-9}
Site Bndry-Pnt Aux Peaux	1.920	SW	3.926×10^{-7}	1.756×10^{-7}	4.227×10^{-9}	2.754×10^{-9}
Site Bndry (Meadow)	1.798	WSW	4.986×10^{-7}	1.768×10^{-7}	4.749×10^{-9}	2.746×10^{-9}
Site Bndry-Toll Rd.-Entrc	1.390	W	8.382×10^{-7}	3.815×10^{-7}	9.076×10^{-9}	5.659×10^{-9}
Site Bndry-Toll Rd.-Marsh	1.082	WNW	2.049×10^{-6}	8.548×10^{-7}	2.375×10^{-8}	1.491×10^{-8}

TABLE 3.8 GRAZING PERIOD: APRIL 15 TO OCTOBER 15*; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Site Bndry-Toll Rd.-Meadow	0.915	NW	3.202×10^{-6}	1.031×10^{-6}	3.965×10^{-8}	2.181×10^{-8}
Site Bndry-Toll Rd.-Meadow	0.990	NNW	3.025×10^{-6}	1.084×10^{-6}	3.271×10^{-8}	1.745×10^{-8}
Residence	1.720	N	1.048×10^{-6}	4.313×10^{-7}	1.078×10^{-8}	6.692×10^{-9}
Residence	1.740	NNE	1.319×10^{-6}	6.072×10^{-7}	1.248×10^{-8}	8.105×10^{-9}
Residence	1.770	NE	1.173×10^{-6}	4.347×10^{-7}	8.826×10^{-9}	5.081×10^{-9}
Residence	1.530	S	1.507×10^{-6}	3.446×10^{-7}	7.726×10^{-9}	3.089×10^{-9}
Residence	1.840	SSW	7.446×10^{-7}	2.204×10^{-7}	4.439×10^{-9}	2.248×10^{-9}
Residence	2.150	SW	3.036×10^{-7}	1.393×10^{-7}	3.132×10^{-9}	2.063×10^{-9}
Residence	2.300	WSW	2.845×10^{-7}	1.094×10^{-7}	2.474×10^{-9}	1.482×10^{-9}
Residence	1.950	W	3.549×10^{-7}	1.742×10^{-7}	3.423×10^{-9}	2.269×10^{-9}
Residence	1.130	WNW	1.929×10^{-6}	8.127×10^{-7}	2.203×10^{-8}	1.390×10^{-8}
Residence	1.720	NW	8.644×10^{-7}	3.767×10^{-7}	9.645×10^{-9}	6.118×10^{-9}
Residence	1.690	NNW	9.920×10^{-7}	4.388×10^{-7}	9.645×10^{-9}	5.613×10^{-9}
Garden	1.800	N	9.386×10^{-7}	3.905×10^{-7}	9.500×10^{-9}	5.935×10^{-9}
Garden	1.740	NNE	1.319×10^{-6}	6.072×10^{-7}	1.248×10^{-8}	8.105×10^{-9}
Garden	1.770	NE	1.173×10^{-6}	4.347×10^{-7}	8.826×10^{-9}	5.081×10^{-9}
Garden	1.530	S	1.507×10^{-6}	3.446×10^{-7}	7.726×10^{-9}	3.089×10^{-9}
Garden	1.840	SSW	7.446×10^{-7}	2.204×10^{-7}	4.439×10^{-9}	2.248×10^{-9}
Garden	2.150	SW	3.036×10^{-7}	1.393×10^{-7}	3.132×10^{-9}	2.063×10^{-9}
Garden	2.300	WSW	2.845×10^{-7}	1.094×10^{-7}	2.474×10^{-9}	1.482×10^{-9}
Garden	1.950	W	3.549×10^{-7}	1.742×10^{-7}	3.423×10^{-9}	2.269×10^{-9}
Garden	1.130	WNW	1.929×10^{-6}	8.127×10^{-7}	2.203×10^{-8}	1.390×10^{-8}

TABLE 3.8 GRAZING PERIOD: APRIL 15 TO OCTOBER 15*; AVERAGE χ/Q (sec/m^3) AND D/Q (m^{-2}) FOR VARIOUS RECEPTOR LOCATIONS AND RADWASTE BUILDING VENT SOURCE

			χ/Q		D/Q	
Receptor Label	Downwind Distance (km)	Radial	Ground Source	Mixed Mode Source	Downwind Distance (km)	Radial
Garden	1.720	NW	8.644×10^{-7}	3.767×10^{-7}	9.645×10^{-9}	6.118×10^{-9}
Garden	1.690	NNW	9.920×10^{-7}	4.388×10^{-7}	9.645×10^{-9}	5.613×10^{-9}
Milk Goat	7.820	WNW	3.858×10^{-8}	2.299×10^{-8}	2.059×10^{-10}	1.505×10^{-8}
Milk Goat	3.180	NW	2.260×10^{-7}	1.146×10^{-7}	2.003×10^{-9}	1.343×10^{-9}
Meat Animal-Pig	2.600	N	4.177×10^{-7}	1.886×10^{-7}	3.647×10^{-9}	2.331×10^{-9}
Meat Animal-Beef	4.440	NNE	1.945×10^{-7}	1.032×10^{-7}	1.233×10^{-9}	8.259×10^{-10}
Meat Animal-Beef	3.490	WSW	1.211×10^{-7}	5.260×10^{-8}	8.960×10^{-10}	5.477×10^{-10}
Meat Animal-Pig	4.100	WNW	1.283×10^{-7}	7.041×10^{-8}	8.926×10^{-10}	6.295×10^{-10}
Meat Animal-Beef	4.750	NW	1.040×10^{-7}	5.665×10^{-8}	7.908×10^{-10}	5.403×10^{-10}
Meat Animal-Beef	4.700	NNW	1.204×10^{-7}	6.515×10^{-8}	7.706×10^{-10}	4.777×10^{-10}
Milk Cow	6.440	W	3.354×10^{-8}	1.988×10^{-8}	1.981×10^{-10}	1.388×10^{-10}
Milk Cow	4.750	NW	1.040×10^{-7}	5.665×10^{-8}	7.908×10^{-10}	5.403×10^{-10}

* see section 2 of text

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APPENDIX A

Strict Ground Level Joint Frequency Distributions Between Wind Speed, Wind Direction, and Stability for Fermi 2

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

APPENDIX A

Part A-1: Joint Frequency Distribution of Annual Data Base
6/1/74 - 5/31/75

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0004	.0005	.0013	.0000	.0006	.0000	.0000	.0000	.0000	.0029	9.60
NNE	.0000	.0000	.0003	.0004	.0003	.0003	.0000	.0001	.0000	.0000	.0000	.0000	.0013	7.56
NE	.0000	.0000	.0001	.0006	.0015	.0015	.0004	.0003	.0001	.0000	.0000	.0000	.0045	9.19
ENE	.0000	.0000	.0003	.0021	.0020	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0066	7.91
E	.0000	.0001	.0013	.0009	.0008	.0006	.0006	.0000	.0001	.0000	.0000	.0000	.0044	7.14
ESE	.0000	.0001	.0006	.0005	.0016	.0029	.0011	.0000	.0000	.0000	.0000	.0000	.0069	8.79
SE	.0000	.0001	.0003	.0026	.0060	.0025	.0004	.0000	.0000	.0000	.0000	.0000	.0119	7.60
SSE	.0000	.0000	.0003	.0016	.0035	.0020	.0003	.0001	.0000	.0000	.0000	.0000	.0078	7.92
S	.0000	.0001	.0005	.0014	.0020	.0044	.0019	.0005	.0000	.0000	.0000	.0000	.0108	9.41
SSW	.0000	.0000	.0004	.0016	.0014	.0025	.0016	.0006	.0000	.0000	.0000	.0000	.0081	9.42
SW	.0000	.0000	.0001	.0004	.0015	.0014	.0021	.0011	.0000	.0000	.0000	.0000	.0066	10.86
WSW	.0000	.0000	.0003	.0008	.0008	.0014	.0021	.0008	.0000	.0000	.0000	.0000	.0060	10.75
W	.0000	.0000	.0001	.0010	.0013	.0013	.0006	.0003	.0000	.0000	.0000	.0000	.0045	8.97
WNW	.0000	.0000	.0003	.0000	.0008	.0008	.0006	.0003	.0000	.0000	.0000	.0000	.0026	9.99
NW	.0000	.0004	.0006	.0003	.0014	.0008	.0008	.0006	.0001	.0000	.0000	.0000	.0049	9.23
NNW	.0000	.0000	.0001	.0004	.0004	.0004	.0003	.0004	.0000	.0000	.0000	.0000	.0019	10.11
TOTAL	.0000	.0010	.0054	.0149	.0256	.0258	.0130	.0056	.0004	.0000	.0000	.0000	.0917	8.95

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 777

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0003	.0001	.0003	.0000	.0000	.0000	.0000	.0008	12.08
NNE	.0000	.0000	.0001	.0000	.0003	.0006	.0000	.0000	.0001	.0000	.0000	.0000	.0011	9.59
NE	.0000	.0000	.0000	.0003	.0003	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0014	9.15
ENE	.0000	.0000	.0003	.0004	.0003	.0003	.0000	.0001	.0001	.0000	.0000	.0000	.0014	8.73
E	.0000	.0000	.0001	.0000	.0005	.0010	.0003	.0005	.0000	.0000	.0000	.0000	.0024	11.33
ESE	.0000	.0000	.0000	.0001	.0008	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0015	9.38
SE	.0000	.0000	.0001	.0003	.0003	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0113	7.73
SSE	.0000	.0000	.0001	.0001	.0004	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0010	7.53
S	.0000	.0000	.0000	.0008	.0006	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0020	8.15
SSW	.0000	.0000	.0001	.0003	.0004	.0005	.0003	.0001	.0000	.0000	.0000	.0000	.0016	9.11
SW	.0000	.0000	.0001	.0000	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0006	9.26
WSW	.0000	.0000	.0000	.0001	.0001	.0005	.0003	.0004	.0000	.0000	.0000	.0000	.0014	11.71
W	.0000	.0000	.0001	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0006	11.10
WNW	.0000	.0000	.0003	.0000	.0000	.0003	.0003	.0001	.0001	.0000	.0000	.0000	.0010	10.60
NW	.0000	.0000	.0001	.0000	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0009	8.69
NNW	.0000	.0000	.0000	.0000	.0003	.0003	.0005	.0008	.0001	.0000	.0000	.0000	.0019	13.56
TOTAL	.0000	.0000	.0015	.0023	.0046	.0065	.0029	.0025	.0005	.0000	.0000	.0000	.0208	9.94

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 777

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0001	.0001	.0003	.0003	.0003	.0001	.0000	.0000	.0000	.0010	10.52
NNE	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0004	7.09
NE	.0000	.0000	.0000	.0003	.0001	.0008	.0004	.0000	.0000	.0000	.0000	.0000	.0015	9.50
ENE	.0000	.0000	.0000	.0000	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0010	9.21
E	.0000	.0000	.0003	.0001	.0008	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0016	9.01
ESE	.0000	.0000	.0001	.0003	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0014	6.75
SE	.0000	.0001	.0000	.0005	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	7.12
SSE	.0000	.0000	.0000	.0004	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0014	7.59
S	.0000	.0000	.0003	.0005	.0003	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0016	10.99
SSW	.0000	.0000	.0000	.0000	.0005	.0008	.0009	.0001	.0000	.0000	.0000	.0000	.0021	10.39
SW	.0000	.0000	.0000	.0005	.0003	.0006	.0008	.0005	.0003	.0000	.0000	.0000	.0030	11.39
WSW	.0000	.0000	.0000	.0001	.0000	.0005	.0009	.0001	.0000	.0000	.0000	.0000	.0018	11.92
W	.0000	.0000	.0003	.0001	.0005	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0015	7.54
WNW	.0000	.0000	.0000	.0001	.0004	.0009	.0003	.0005	.0003	.0000	.0000	.0000	.0019	12.70
NW	.0000	.0000	.0000	.0000	.0003	.0004	.0000	.0001	.0003	.0001	.0000	.0000	.0016	13.04
NNW	.0000	.0000	.0000	.0000	.0001	.0074	.0001	.0004	.0000	.0000	.0000	.0000	.0010	12.03
TOTAL	.0000	.0010	.0010	.0031	.0051	.0065	.0039	.0024	.0009	.0001	.0000	.0000	.0240	10.08

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 777

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0003	.0009	.0013	.0029	.0029	.0018	.0005	.0000	.0000	.0000	.0000	.0104	8.70
NNE	.0000	.0001	.0004	.0023	.0015	.0028	.0028	.0013	.0003	.0000	.0000	.0000	.0113	10.05
NE	.0000	.0003	.0006	.0026	.0055	.0063	.0025	.0011	.0001	.0000	.0000	.0000	.0190	9.17
ENE	.0000	.0001	.0006	.0025	.0074	.0076	.0034	.0040	.0009	.0001	.0000	.0000	.0267	10.41
E	.0000	.0000	.0015	.0015	.0034	.0035	.0034	.0029	.0009	.0000	.0000	.0000	.0170	10.77
ESE	.0000	.0005	.0010	.0015	.0038	.0056	.0028	.0013	.0006	.0000	.0000	.0000	.0170	9.66
SE	.0000	.0004	.0018	.0038	.0076	.0043	.0020	.0008	.0000	.0000	.0000	.0000	.0205	8.05
SSE	.0000	.0001	.0006	.0024	.0056	.0029	.0004	.0004	.0001	.0000	.0000	.0000	.0125	8.10
S	.0000	.0001	.0015	.0025	.0025	.0065	.0024	.0000	.0000	.0000	.0000	.0000	.0155	8.68
SSW	.0000	.0003	.0005	.0020	.0028	.0074	.0050	.0024	.0010	.0000	.0000	.0000	.0213	10.87
SW	.0000	.0004	.0009	.0016	.0036	.0049	.0040	.0024	.0015	.0000	.0000	.0000	.0193	10.95
WSW	.0000	.0001	.0010	.0020	.0048	.0063	.0050	.0045	.0018	.0001	.0000	.0000	.0256	11.33
W	.0000	.0001	.0009	.0028	.0065	.0069	.0040	.0033	.0006	.0003	.0000	.0000	.0253	10.32
WNW	.0000	.0006	.0013	.0026	.0031	.0063	.0055	.0028	.0009	.0001	.0000	.0000	.0232	10.65
NW	.0000	.0005	.0013	.0024	.0024	.0083	.0051	.0023	.0009	.0000	.0000	.0000	.0230	10.37
NNW	.0000	.0004	.0009	.0013	.0021	.0046	.0040	.0019	.0000	.0000	.0000	.0000	.0152	10.20
TOTAL	.0000	.0043	.0155	.0349	.0655	.0869	.0540	.0316	.0095	.0006	.0000	.0000	.3029	10.04

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 777

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0025	.0026	.0041	.0031	.0021	.0005	.0000	.0000	.0000	.0000	.0152	7.97
NNE	.0000	.0008	.0014	.0030	.0031	.0028	.0029	.0010	.0000	.0000	.0000	.0000	.0145	8.27
NE	.0000	.0003	.0020	.0021	.0034	.0041	.0029	.0009	.0006	.0001	.0000	.0000	.0164	9.32
ENE	.0000	.0008	.0020	.0039	.0036	.0029	.0014	.0015	.0008	.0000	.0000	.0000	.0168	8.62
E	.0000	.0003	.0014	.0021	.0020	.0029	.0010	.0009	.0001	.0000	.0000	.0000	.0106	8.51
ESE	.0000	.0004	.0005	.0024	.0039	.0045	.0020	.0016	.0008	.0000	.0000	.0000	.0160	9.88
SE	.0000	.0003	.0020	.0034	.0069	.0056	.0019	.0010	.0001	.0000	.0000	.0000	.0212	8.39
SSE	.0000	.0003	.0024	.0041	.0073	.0066	.0043	.0005	.0000	.0000	.0000	.0000	.0254	8.41
S	.0000	.0008	.0021	.0048	.0083	.0078	.0034	.0011	.0005	.0000	.0000	.0000	.0287	8.62
SSW	.0000	.0008	.0021	.0048	.0111	.0155	.0108	.0025	.0006	.0000	.0000	.0000	.0482	9.70
SW	.0000	.0013	.0038	.0064	.0090	.0138	.0081	.0031	.0008	.0014	.0000	.0000	.0476	9.74
WSW	.0000	.0006	.0043	.0080	.0101	.0132	.0075	.0039	.0004	.0000	.0000	.0000	.0480	9.12
W	.0000	.0011	.0033	.0069	.0064	.0101	.0021	.0004	.0003	.0000	.0000	.0000	.0306	7.79
WNW	.0000	.0013	.0043	.0050	.0045	.0064	.0024	.0026	.0008	.0000	.0000	.0000	.0272	8.57
NW	.0000	.0005	.0033	.0051	.0050	.0044	.0024	.0011	.0000	.0000	.0000	.0000	.0218	7.75
NNW	.0000	.0010	.0028	.0040	.0033	.0028	.0015	.0010	.0000	.0000	.0000	.0000	.0163	7.45
TOTAL	.0001	.0103	.0400	.0686	.0921	.1065	.0562	.0237	.0056	.0015	.0000	.0000	.4046	8.79

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 1

NUMBER OF MISSING HOURS - 777

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0004	.0019	.0038	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0069	5.00
NNE	.0000	.0004	.0013	.0016	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0039	5.07
NE	.0000	.0003	.0001	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	4.52
ENE	.0000	.0001	.0004	.0004	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015	5.59
E	.0000	.0003	.0003	.0004	.0006	.0013	.0005	.0003	.0000	.0000	.0000	.0000	.0035	9.01
ESE	.0000	.0000	.0005	.0008	.0014	.0034	.0011	.0000	.0001	.0000	.0000	.0000	.0073	9.16
SE	.0000	.0000	.0004	.0015	.0005	.0015	.0006	.0001	.0000	.0000	.0000	.0000	.0046	8.32
SSE	.0000	.0005	.0008	.0016	.0019	.0018	.0001	.0006	.0001	.0001	.0000	.0000	.0075	8.22
S	.0000	.0005	.0008	.0015	.0013	.0014	.0014	.0005	.0003	.0000	.0000	.0000	.0075	8.69
SSW	.0000	.0003	.0014	.0023	.0024	.0040	.0023	.0010	.0005	.0000	.0000	.0000	.0140	9.34
SW	.0000	.0001	.0029	.0021	.0009	.0018	.0004	.0008	.0003	.0000	.0000	.0000	.0089	7.09
WSW	.0000	.0006	.0036	.0028	.0003	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0078	4.83
W	.0000	.0003	.0034	.0028	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0071	4.85
WNW	.0000	.0003	.0046	.0021	.0003	.0001	.0001	.0000	.0003	.0000	.0000	.0000	.0075	4.45
NW	.0000	.0009	.0026	.0030	.0008	.0004	.0001	.0000	.0003	.0000	.0000	.0000	.0078	4.98
NNW	.0000	.0005	.0029	.0011	.0008	.0003	.0005	.0001	.0000	.0000	.0000	.0000	.0061	5.32
TOTAL	.0001	.0053	.0277	.0282	.0133	.0167	.0073	.0035	.0010	.0001	.0000	.0000	.1031	6.82

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 1

NUMBER OF MISSING HOURS - 777

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0031	.0015	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0053	4.54
NNE	.0000	.0003	.0009	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	4.90
NE	.0000	.0003	.0003	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	3.47
ENE	.0000	.0000	.0000	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006	7.11
E	.0000	.0000	.0001	.0004	.0005	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0014	7.80
ESE	.0000	.0003	.0003	.0003	.0009	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0028	7.47
SE	.0000	.0001	.0006	.0009	.0010	.0005	.0000	.0000	.0001	.0000	.0000	.0000	.0033	6.88
SSE	.0000	.0001	.0008	.0010	.0009	.0011	.0004	.0000	.0000	.0000	.0000	.0000	.0043	7.22
S	.0000	.0003	.0006	.0003	.0003	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0018	6.04
SSW	.0000	.0004	.0003	.0004	.0004	.0010	.0006	.0001	.0000	.0000	.0000	.0000	.0031	8.67
SW	.0000	.0000	.0018	.0004	.0003	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0031	6.19
WSW	.0000	.0001	.0019	.0011	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0038	5.06
W	.0000	.0000	.0025	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0039	4.14
WNW	.0000	.0011	.0035	.0013	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0063	3.87
NW	.0000	.0005	.0029	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0051	4.01
NNW	.0000	.0005	.0034	.0013	.0001	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0054	4.21
TOTAL	.0000	.0040	.0228	.0130	.0056	.0051	.0020	.0003	.0001	.0000	.0000	.0000	.0530	5.41

PERIOD OF RECORD: 6/1/74 – 5/31/75

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 777

APPENDIX A

Part A-2: Joint Frequency Distribution of Grazing Period Data Base

6/1/74 - 10/15/74

sequenced on to

4/15/74 - 5/31/75

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0005	.0008	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0025	8.17
NNE	.0000	.0000	.0003	.0008	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0018	6.75
NE	.0000	.0000	.0000	.0008	.0028	.0031	.0008	.0003	.0003	.0000	.0000	.0000	.0079	9.39
ENE	.0000	.0000	.0003	.0031	.0036	.0036	.0005	.0000	.0000	.0000	.0000	.0000	.0109	8.14
E	.0000	.0003	.0020	.0010	.0013	.0013	.0003	.0000	.0000	.0000	.0000	.0000	.0061	6.29
ESE	.0000	.0000	.0010	.0008	.0033	.0053	.0020	.0000	.0000	.0000	.0000	.0000	.0125	8.99
SE	.0000	.0003	.0003	.0046	.0114	.0048	.0005	.0000	.0000	.0000	.0000	.0000	.0219	7.64
SSE	.0000	.0000	.0003	.0023	.0066	.0031	.0003	.0000	.0000	.0000	.0000	.0000	.0125	7.78
S	.0000	.0003	.0010	.0028	.0033	.0086	.0036	.0010	.0000	.0000	.0000	.0000	.0206	9.43
SSW	.0000	.0000	.0008	.0033	.0025	.0036	.0015	.0013	.0000	.0000	.0000	.0000	.0130	9.04
SW	.0000	.0000	.0003	.0005	.0013	.0015	.0025	.0013	.0000	.0000	.0000	.0000	.0074	10.99
WSW	.0000	.0000	.0005	.0003	.0013	.0020	.0041	.0010	.0000	.0000	.0000	.0000	.0092	11.33
W	.0000	.0000	.0003	.0008	.0018	.0015	.0008	.0000	.0000	.0000	.0000	.0000	.0051	8.72
WNW	.0000	.0000	.0005	.0000	.0010	.0015	.0010	.0000	.0000	.0000	.0000	.0000	.0041	9.42
NW	.0000	.0005	.0008	.0005	.0025	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0056	7.28
NNW	.0000	.0000	.0000	.0003	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0010	8.50
TOTAL	.0000	.0013	.0081	.0221	.0445	.0422	.0186	.0048	.0003	.0000	.0000	.0000	.1419	8.73

PERIOD OF RECORD: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0008	13.12
NNE	.0000	.0000	.0003	.0000	.0005	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0013	7.66
NE	.0000	.0000	.0000	.0005	.0000	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0020	9.74
ENE	.0000	.0000	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	4.99
E	.0000	.0000	.0003	.0000	.0005	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0025	9.26
ESE	.0000	.0000	.0000	.0003	.0010	.0008	.0003	.0003	.0000	.0000	.0000	.0000	.0025	9.62
SE	.0000	.0000	.0000	.0000	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0010	8.67
SSE	.0000	.0000	.0003	.0000	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0010	6.67
S	.0000	.0000	.0000	.0013	.0010	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0033	8.26
SSW	.0000	.0000	.0000	.0005	.0003	.0008	.0005	.0003	.0000	.0000	.0000	.0000	.0023	10.07
SW	.0000	.0000	.0003	.0000	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0008	7.33
WSW	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0003	10.00
W	.0000	.0000	.0003	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	6.07
WNW	.0000	.0000	.0003	.0000	.0000	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0010	8.76
NW	.0000	.0000	.0003	.0000	.0005	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0018	8.69
NNW	.0000	.0000	.0000	.0000	.0005	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0010	9.61
TOTAL	.0000	.0000	.0023	.0033	.0058	.0084	.0025	.0010	.0000	.0000	.0000	.0000	.0234	8.77

PERIOD OF RECORD: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0003	.0003	.0000	.0000	.0005	.0000	.0003	.0000	.0000	.0000	.0013	13.89
NNE	.0000	.0000	.0000	.0003	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0008	7.09
NE	.0000	.0000	.0000	.0000	.0003	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0018	9.97
ENE	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0003	10.60
E	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.10
ESE	.0000	.0000	.0003	.0003	.0000	.0010	.0003	.0003	.0000	.0000	.0000	.0000	.0020	9.48
SE	.0000	.0000	.0000	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	6.73
SSE	.0000	.0000	.0000	.0005	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	6.98
S	.0000	.0000	.0005	.0010	.0005	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0031	7.03
SSW	.0000	.0000	.0000	.0000	.0008	.0008	.0013	.0000	.0000	.0000	.0000	.0000	.0028	10.57
SW	.0000	.0000	.0000	.0008	.0000	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0025	9.39
WSW	.0000	.0000	.0000	.0000	.0000	.0008	.0003	.0000	.0000	.0000	.0000	.0000	.0010	11.30
W	.0000	.0000	.0003	.0003	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0023	7.50
WNW	.0000	.0000	.0000	.0000	.0005	.0003	.0003	.0005	.0000	.0000	.0000	.0000	.0015	11.72
NW	.0000	.0000	.0000	.0000	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0013	9.53
NNW	.0000	.0000	.0000	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0005	9.54
TOTAL	.0000	.0000	.0015	.0043	.0058	.0084	.0038	.0008	.0003	.0000	.0000	.0000	.0249	8.94

PERIOD OF RECORD0: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0008	.0008	.0013	.0038	.0010	.0003	.0000	.0000	.0000	.0000	.0079	8.98
NNE	.0000	.0000	.0005	.0020	.0020	.0025	.0018	.0015	.0000	.0000	.0000	.0000	.0104	9.60
NE	.0000	.0000	.0003	.0028	.0041	.0066	.0013	.0005	.0000	.0000	.0000	.0000	.0155	8.93
ENE	.0000	.0003	.0005	.0025	.0064	.0051	.0008	.0000	.0000	.0000	.0000	.0000	.0155	7.98
E	.0000	.0000	.0010	.0018	.0033	.0043	.0018	.0008	.0000	.0000	.0000	.0000	.0130	8.90
ESE	.0000	.0010	.0008	.0020	.0043	.0076	.0023	.0008	.0000	.0000	.0000	.0000	.0188	8.71
SE	.0000	.0008	.0013	.0051	.0122	.0051	.0013	.0005	.0000	.0000	.0000	.0000	.0262	7.71
SSE	.0000	.0000	.0013	.0031	.0099	.0043	.0000	.0000	.0003	.0000	.0000	.0000	.0188	7.80
S	.0000	.0000	.0025	.0028	.0033	.0084	.0020	.0000	.0000	.0000	.0000	.0000	.0191	8.33
SSW	.0000	.0005	.0005	.0025	.0036	.0086	.0051	.0008	.0000	.0000	.0000	.0000	.0216	9.54
SW	.0000	.0000	.0008	.0015	.0041	.0041	.0013	.0013	.0010	.0000	.0000	.0000	.0140	10.06
WSW	.0000	.0000	.0008	.0015	.0020	.0015	.0018	.0028	.0000	.0000	.0000	.0000	.0104	10.56
W	.0000	.0000	.0013	.0008	.0015	.0018	.0013	.0005	.0000	.0000	.0000	.0000	.0071	8.49
WNW	.0000	.0000	.0008	.0020	.0025	.0031	.0036	.0005	.0000	.0000	.0000	.0000	.0125	9.37
NW	.0000	.0000	.0005	.0013	.0018	.0041	.0038	.0000	.0000	.0000	.0000	.0000	.0114	9.67
NNW	.0000	.0003	.0005	.0015	.0018	.0043	.0015	.0003	.0000	.0000	.0000	.0000	.0102	8.81
TOTAL	.0000	.0028	.0140	.0341	.0641	.0753	.0305	.0104	.0013	.0000	.0000	.0000	.2325	8.84

PERIOD OF RECORD: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0023	.0020	.0038	.0031	.0018	.0003	.0000	.0000	.0000	.0000	.0132	7.97
NNE	.0000	.0003	.0015	.0038	.0046	.0051	.0031	.0018	.0000	.0000	.0000	.0000	.0201	8.88
NE	.0000	.0000	.0010	.0028	.0053	.0058	.0038	.0003	.0000	.0000	.0000	.0000	.0191	8.91
ENE	.0000	.0003	.0020	.0041	.0043	.0036	.0000	.0000	.0000	.0000	.0000	.0000	.0142	6.87
E	.0000	.0000	.0018	.0028	.0028	.0025	.0013	.0005	.0003	.0000	.0000	.0000	.0120	8.18
ESE	.0000	.0008	.0005	.0023	.0056	.0064	.0010	.0010	.0000	.0000	.0000	.0000	.0175	8.50
SE	.0000	.0000	.0020	.0031	.0092	.0074	.0015	.0005	.0000	.0000	.0000	.0000	.0237	8.20
SSE	.0000	.0000	.0015	.0046	.0112	.0099	.0053	.0005	.0000	.0000	.0000	.0000	.0331	8.76
S	.0000	.0005	.0023	.0053	.0125	.0086	.0048	.0018	.0008	.0000	.0000	.0000	.0366	8.87
SSW	.0000	.0003	.0020	.0053	.0104	.0163	.0140	.0031	.0005	.0000	.0000	.0000	.0519	10.03
SW	.0000	.0008	.0041	.0061	.0079	.0099	.0092	.0046	.0005	.0003	.0000	.0000	.0432	9.59
WSW	.0000	.0005	.0038	.0056	.0084	.0114	.0043	.0018	.0000	.0000	.0000	.0000	.0359	8.57
W	.0000	.0008	.0036	.0051	.0061	.0084	.0020	.0008	.0003	.0000	.0000	.0000	.0270	7.93
WNW	.0000	.0000	.0028	.0043	.0043	.0031	.0015	.0003	.0000	.0000	.0000	.0000	.0163	7.34
NW	.0000	.0003	.0023	.0053	.0033	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0130	6.39
NNW	.0000	.0010	.0025	.0043	.0043	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0137	5.99
TOTAL	.0000	.0053	.0361	.0669	.1040	.1040	.0544	.0170	.0023	.0003	.0000	.0000	.3904	8.58

PERIOD OF RECORD: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0005	.0028	.0061	.0013	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0112	5.12
NNE	.0000	.0008	.0023	.0028	.0008	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0069	4.98
NE	.0000	.0003	.0003	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	4.84
ENE	.0000	.0003	.0008	.0005	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.40
E	.0000	.0000	.0003	.0005	.0005	.0020	.0008	.0005	.0000	.0000	.0000	.0000	.0046	10.25
ESE	.0000	.0000	.0003	.0010	.0013	.0058	.0020	.0000	.0000	.0000	.0000	.0000	.0104	9.55
SE	.0000	.0000	.0003	.0010	.0008	.0025	.0010	.0000	.0000	.0000	.0000	.0000	.0056	9.06
SSE	.0000	.0003	.0008	.0013	.0025	.0023	.0003	.0000	.0000	.0000	.0000	.0000	.0074	7.47
S	.0000	.0003	.0010	.0010	.0013	.0010	.0013	.0010	.0000	.0000	.0000	.0000	.0069	9.08
SSW	.0000	.0005	.0020	.0025	.0028	.0020	.0020	.0020	.0005	.0000	.0000	.0000	.0145	9.30
SW	.0000	.0003	.0028	.0025	.0013	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0076	5.36
WSW	.0000	.0010	.0043	.0031	.0005	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0097	4.82
W	.0000	.0003	.0036	.0038	.0005	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0086	5.06
WNW	.0000	.0005	.0048	.0031	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0086	4.27
NW	.0000	.0018	.0031	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0071	3.88
NNW	.0000	.0008	.0031	.0020	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0069	4.42
TOTAL	.0000	.0074	.0323	.0338	.0163	.0181	.0079	.0036	.0005	.0000	.0000	.0000	.1198	6.57

PERIOD OF RECORD: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0056	.0031	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0094	4.61
NNE	.0000	.0003	.0013	.0018	.0003	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0038	5.11
NE	.0000	.0000	.0005	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	4.39
ENE	.0000	.0000	.0000	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	7.28
E	.0000	.0000	.0003	.0003	.0010	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0023	8.41
ESE	.0000	.0003	.0003	.0003	.0003	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0020	7.39
SE	.0000	.0000	.0003	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0018	5.20
SSE	.0000	.0000	.0005	.0005	.0008	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0033	7.73
S	.0000	.0003	.0010	.0000	.0003	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0023	6.66
SSW	.0000	.0005	.0003	.0008	.0003	.0008	.0008	.0003	.0000	.0000	.0000	.0000	.0036	8.17
SW	.0000	.0000	.0033	.0003	.0005	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0053	6.22
WSW	.0000	.0003	.0020	.0018	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0053	5.43
W	.0000	.0000	.0033	.0023	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0056	4.29
WNW	.0000	.0008	.0048	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0069	3.62
NW	.0000	.0008	.0043	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0076	3.95
NNW	.0000	.0000	.0048	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0066	4.13
TOTAL	.0000	.0031	.0336	.0168	.0051	.0051	.0033	.0003	.0000	.0000	.0000	.0000	.0671	5.24

PERIOD OF RECORD: 4/15/74 – 10/15/74

NUMBER OF CALM HOURS - 0

NUMBER OF MISSING HOURS - 485

APPENDIX B

Mixed Mode Joint Frequency Distribution Between Wind Speed, Wind Direction, and Stability for the Fermi 2 Containment Building Source.

APPENDIX B

Part B-1: Analysis for Ground Level Portion of Mixed Mode Source

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Containment building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0001	.0000	.0000	.0000	.0000	.0004	11.66
NNE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	10.07
NE	.0000	.0000	.0000	.0000	.0002	.0002	.0001	.0001	.0001	.0000	.0000	.0000	.0006	11.58
ENE	.0000	.0000	.0000	.0001	.0002	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0006	9.01
E	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0001	.0000	.0000	.0000	.0004	12.09
ESE	.0000	.0000	.0000	.0000	.0002	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0008	10.17
SE	.0000	.0000	.0000	.0001	.0006	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0011	8.56
SSE	.0000	.0000	.0000	.0000	.0004	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0008	8.98
S	.0000	.0000	.0000	.0000	.0002	.0007	.0004	.0001	.0000	.0000	.0000	.0000	.0014	10.77
SSW	.0000	.0000	.0000	.0000	.0001	.0004	.0003	.0001	.0000	.0000	.0000	.0000	.0010	11.16
SW	.0000	.0000	.0000	.0000	.0002	.0002	.0004	.0002	.0000	.0000	.0000	.0000	.0010	12.25
WSW	.0000	.0000	.0000	.0000	.0001	.0002	.0004	.0002	.0000	.0000	.0000	.0000	.0009	12.23
W	.0000	.0000	.0000	.0000	.0001	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0005	10.53
WNW	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0004	11.44
NW	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0006	12.68
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0003	12.21
TOTAL	.0000	.0000	.0000	.0004	.0026	.0039	.0024	.0012	.0002	.0000	.0000	.0000	.0108	10.82

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0002	13.32
NNE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0001	.0000	.0000	.0000	.0002	13.86
NE	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0002	10.14
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0002	14.44
E	.0000	.0000	.0000	.0000	.0001	.0002	.0001	.0002	.0000	.0000	.0000	.0000	.0004	12.54
ESE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	10.14
SE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.99
SSE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	9.36
S	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0002	9.57
SSW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0002	10.95
SW	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0001	11.71
WSW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0003	13.47
W	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	13.10
WNW	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0002	15.84
NW	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	9.26
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0003	.0001	.0000	.0000	.0000	.0005	15.39
TOTAL	.0000	.0000	.0000	.0001	.0006	.0011	.0006	.0008	.0003	.0000	.0000	.0000	.0035	12.57

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0002	15.04
NNE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	8.49
NE	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0002	10.63
ENE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.48
E	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0003	13.19
ESE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	11.10
SE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.46
SSE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.23
S	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.19
SSW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0004	11.66
SW	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0002	.0002	.0000	.0000	.0000	.0007	15.41
WSW	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0003	12.33
W	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.36
WNW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0002	.0000	.0000	.0000	.0006	16.55
NW	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0002	.0001	.0000	.0000	.0006	18.15
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0002	13.92
TOTAL	.0000	.0000	.0000	.0001	.0006	.0012	.0008	.0008	.0008	.0001	.0000	.0000	.0044	13.60

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0001	.0004	.0005	.0004	.0002	.0000	.0000	.0000	.0000	.0015	10.88
NNE	.0000	.0000	.0000	.0001	.0002	.0005	.0006	.0006	.0003	.0000	.0000	.0000	.0022	13.38
NE	.0000	.0000	.0000	.0001	.0007	.0011	.0005	.0005	.0001	.0000	.0000	.0000	.0030	11.14
ENE	.0000	.0000	.0000	.0001	.0009	.0013	.0007	.0018	.0008	.0001	.0000	.0000	.0057	13.77
E	.0000	.0000	.0000	.0001	.0004	.0006	.0007	.0013	.0008	.0000	.0000	.0000	.0039	14.56
ESE	.0000	.0000	.0000	.0001	.0004	.0009	.0006	.0006	.0005	.0000	.0000	.0000	.0032	13.13
SE	.0000	.0000	.0000	.0002	.0009	.0007	.0004	.0004	.0000	.0000	.0000	.0000	.0026	10.09
SSE	.0000	.0000	.0000	.0001	.0007	.0005	.0001	.0002	.0001	.0000	.0000	.0000	.0017	10.05
S	.0000	.0000	.0000	.0001	.0003	.0011	.0005	.0000	.0000	.0000	.0000	.0000	.0020	10.00
SSW	.0000	.0000	.0000	.0001	.0003	.0012	.0010	.0011	.0009	.0000	.0000	.0000	.0047	13.99
SW	.0000	.0000	.0000	.0001	.0004	.0008	.0008	.0011	.0014	.0000	.0000	.0000	.0046	14.99
WSW	.0000	.0000	.0000	.0001	.0006	.0011	.0010	.0020	.0016	.0001	.0000	.0000	.0065	15.21
W	.0000	.0000	.0000	.0002	.0008	.0012	.0008	.0015	.0005	.0003	.0000	.0000	.0052	13.91
WNW	.0000	.0000	.0000	.0001	.0004	.0011	.0011	.0013	.0008	.0001	.0000	.0000	.0049	14.24
NW	.0000	.0000	.0000	.0001	.0003	.0014	.0010	.0010	.0008	.0000	.0000	.0000	.0047	13.72
NNW	.0000	.0000	.0000	.0001	.0003	.0008	.0008	.0009	.0000	.0000	.0000	.0000	.0027	12.56
TOTAL	.0000	.0000	.0000	.0020	.0080	.0145	.0107	.0144	.0087	.0006	.0000	.0000	.0590	13.44

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0002	.0006	.0006	.0004	.0003	.0000	.0000	.0000	.0000	.0021	10.51
NNE	.0000	.0000	.0000	.0002	.0004	.0005	.0005	.0007	.0000	.0000	.0000	.0000	.0024	11.57
NE	.0000	.0000	.0000	.0002	.0005	.0007	.0006	.0006	.0006	.0001	.0000	.0000	.0033	13.65
ENE	.0000	.0000	.0000	.0003	.0005	.0005	.0003	.0010	.0008	.0000	.0000	.0000	.0035	13.91
E	.0000	.0000	.0000	.0002	.0003	.0005	.0002	.0006	.0001	.0000	.0000	.0000	.0019	12.21
ESE	.0000	.0000	.0000	.0002	.0005	.0008	.0004	.0011	.0008	.0000	.0000	.0000	.0039	13.84
SE	.0000	.0000	.0000	.0003	.0010	.0010	.0004	.0007	.0001	.0000	.0000	.0000	.0034	10.87
SSE	.0000	.0000	.0000	.0003	.0010	.0012	.0009	.0003	.0000	.0000	.0000	.0000	.0038	10.21
S	.0000	.0000	.0000	.0004	.0012	.0014	.0007	.0007	.00005	.0000	.0000	.0000	.0049	11.57
SSW	.0000	.0000	.0000	.0004	.0016	.0028	.0022	.0017	.0006	.0000	.0000	.0000	.0093	12.00
SW	.0000	.0000	.0000	.0005	.0013	.0025	.0017	.0021	.0008	.0014	.0000	.0000	.0103	14.45
WSW	.0000	.0000	.0000	.0007	.0014	.0024	.0016	.0026	.0004	.0000	.0000	.0000	.0091	12.17
W	.0000	.0000	.0000	.0006	.0009	.0018	.0004	.0003	.0003	.0000	.0000	.0000	.0043	10.36
WNW	.0000	.0000	.0000	.0004	.0006	.0012	.0005	.0018	.0008	.0000	.0000	.0000	.0053	13.47
NW	.0000	.0000	.0000	.0004	.0007	.0008	.0005	.0007	.0000	.0000	.0000	.0000	.0032	10.54
NNW	.0000	.0000	.0000	.0003	.0005	.0005	.0003	.0007	.0000	.0000	.0000	.0000	.0023	11.17
TOTAL	.0000	.0000	.0000	.0057	.0130	.0192	.0117	.0160	.0058	.0015	.0000	.0000	.0729	12.33

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0005	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0007	6.04
NNE	.0000	.0000	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	6.06
NE	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	5.85
ENE	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.62
E	.0000	.0000	.0000	.0001	.0001	.0003	.0003	.0003	.0000	.0000	.0000	.0000	.0011	12.26
ESE	.0000	.0000	.0000	.0001	.0002	.0007	.0007	.0000	.0001	.0000	.0000	.0000	.0019	11.12
SE	.0000	.0000	.0000	.0002	.0001	.0003	.0004	.0001	.0000	.0000	.0000	.0000	.0011	10.62
SSE	.0000	.0000	.0000	.0002	.0003	.0004	.0001	.0006	.0001	.0001	.0000	.0000	.0018	12.81
S	.0000	.0000	.0000	.0002	.0002	.0003	.0009	.0005	.0003	.0000	.0000	.0000	.0024	13.17
SSW	.0000	.0000	.0000	.0003	.0004	.0008	.0015	.0010	.0005	.0000	.0000	.0000	.0046	13.05
SW	.0000	.0000	.0001	.0003	.0002	.0004	.0003	.0008	.0000	.0000	.0000	.0000	.0019	12.01
WSW	.0000	.0000	.0001	.0004	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0007	7.92
W	.0000	.0000	.0001	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006	5.94
WNW	.0000	.0000	.0001	.0003	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0005	6.31
NW	.0000	.0000	.0001	.0004	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0007	6.84
NNW	.0000	.0000	.0001	.0001	.0001	.0001	.0003	.0001	.0000	.0000	.0000	.0000	.0008	10.16
TOTAL	.0000	.0000	.0008	.0036	.0023	.0035	.0047	.0035	.0010	.0001	.0000	.0000	.0194	11.16

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.37
NNE	.0000	.0000	.0000	.0001	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0003	7.48
NE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	5.97
ENE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.26
E	.0000	.0000	.0000	.0001	.0001	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0004	10.42
ESE	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0004	8.52
SE	.0000	.0000	.0000	.0001	.0002	.0001	.0000	.0000	.0001	.0000	.0000	.0000	.0005	9.96
SSE	.0000	.0000	.0000	.0001	.0002	.0002	.0003	.0000	.0000	.0000	.0000	.0000	.0008	9.61
S	.0000	.0000	.0000	.0000	.0001	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0003	10.54
SSW	.0000	.0000	.0000	.0001	.0001	.0002	.0004	.0001	.0000	.0000	.0000	.0000	.0009	11.66
SW	.0000	.0000	.0001	.0001	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0005	10.10
WSW	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.47
W	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.84
WNW	.0000	.0000	.0001	.0002	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.65
NW	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.88
NNW	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0004	7.64
TOTAL	.0000	.0000	.0008	.0018	.0010	.0011	.0015	.0002	.0001	.0000	.0000	.0000	.0065	8.59

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

APPENDIX B

Part B-2: Analysis for Elevated Portion of Mixed Mode Source

a) Wind speed at 51.2 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Containment building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0000	.0004	.0004	.0011	.0000	.0005	.0000	.0000	.0000	.0025	12.27
NNE	.0000	.0000	.0003	.0000	.0004	.0003	.0003	.0000	.0001	.0000	.0000	.0000	.0013	8.83
NE	.0000	.0000	.0001	.0000	.0006	.0013	.0013	.0003	.0002	.0000	.0000	.0000	.0039	11.36
ENE	.0000	.0000	.0003	.0000	.0020	.0018	.0017	.0002	.0000	.0000	.0000	.0000	.0061	9.51
E	.0000	.0001	.0013	.0000	.0009	.0007	.0005	.0005	.0000	.0000	.0000	.0000	.0040	8.44
ESE	.0000	.0001	.0006	.0000	.0005	.0014	.0025	.0009	.0000	.0000	.0000	.0000	.0060	10.94
SE	.0000	.0001	.0003	.0000	.0025	.0054	.0021	.0003	.0000	.0000	.0000	.0000	.0108	9.47
SSE	.0000	.0000	.0003	.0000	.0016	.0031	.0017	.0002	.0001	.0000	.0000	.0000	.0070	9.80
S	.0000	.0001	.0005	.0000	.0014	.0018	.0037	.0015	.0004	.0000	.0000	.0000	.0094	11.59
SSW	.0000	.0000	.0004	.0000	.0016	.0013	.0021	.0013	.0005	.0000	.0000	.0000	.0071	11.57
SW	.0000	.0000	.0001	.0000	.0004	.0013	.0012	.0017	.0009	.0000	.0000	.0000	.0056	13.72
WSW	.0000	.0000	.0003	.0000	.0008	.0007	.0012	.0017	.0006	.0000	.0000	.0000	.0053	13.06
W	.0000	.0000	.0001	.0000	.0010	.0012	.0011	.0005	.0002	.0000	.0000	.0000	.0041	11.06
WNW	.0000	.0000	.0003	.0000	.0000	.0007	.0007	.0005	.0002	.0000	.0000	.0000	.0024	12.21
NW	.0000	.0004	.0006	.0000	.0003	.0013	.0007	.0007	.0005	.0000	.0000	.0000	.0044	10.75
NNW	.0000	.0000	.0001	.0000	.0004	.0004	.0003	.0002	.0003	.0000	.0000	.0000	.0017	12.22
TOTAL	.0000	.0009	.0056	.0000	.0146	.0232	.0222	.0107	.0045	.0001	.0000	.0000	.0817	10.97

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0001	.0003	.0001	.0002	.0000	.0000	.0000	.0006	16.16
NNE	.0000	.0000	.0000	.0001	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0009	11.66
NE	.0000	.0000	.0000	.0000	.0003	.0003	.0005	.0002	.0000	.0000	.0000	.0000	.0013	12.07
ENE	.0000	.0000	.0000	.0003	.0004	.0003	.0003	.0000	.0001	.0000	.0000	.0000	.0013	9.49
E	.0000	.0000	.0000	.0001	.0000	.0004	.0008	.0002	.0003	.0000	.0000	.0000	.0020	14.10
ESE	.0000	.0000	.0000	.0000	.0001	.0007	.0003	.0001	.0001	.0000	.0000	.0000	.0013	11.75
SE	.0000	.0000	.0000	.0001	.0003	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0012	10.33
SSE	.0000	.0000	.0000	.0001	.0001	.0004	.0003	.0001	.0000	.0000	.0000	.0000	.0009	10.73
S	.0000	.0000	.0000	.0000	.0008	.0005	.0003	.0003	.0000	.0000	.0000	.0000	.0019	10.62
SSW	.0000	.0000	.0000	.0001	.0003	.0004	.0004	.0002	.0001	.0000	.0000	.0000	.0015	11.82
SW	.0000	.0000	.0000	.0001	.0000	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0005	12.96
WSW	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0002	.0003	.0000	.0000	.0000	.0011	15.49
W	.0000	.0000	.0000	.0001	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0004	12.70
WNW	.0000	.0000	.0000	.0003	.0000	.0000	.0003	.0002	.0001	.0000	.0000	.0000	.0009	12.44
NW	.0000	.0000	.0000	.0001	.0000	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0008	11.10
NNW	.0000	.0000	.0000	.0000	.0000	.0003	.0003	.0004	.0005	.0000	.0000	.0000	.0015	17.14
TOTAL	.0000	.0000	.0000	.0014	.0023	.0043	.0056	.0025	.0017	.0001	.0000	.0000	.0179	12.50

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0001	.0001	.0001	.0003	.0002	.0000	.0000	.0000	.0000	.0008	12.68
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0003	10.06
NE	.0000	.0000	.0000	.0000	.0003	.0001	.0007	.0003	.0000	.0000	.0000	.0000	.0014	12.76
ENE	.0000	.0000	.0000	.0000	.0000	.0003	.0007	.0000	.0000	.0000	.0000	.0000	.0009	12.34
E	.0000	.0000	.0000	.0003	.0001	.0007	.0000	.0000	.0003	.0000	.0000	.0000	.0014	11.47
ESE	.0000	.0000	.0000	.0001	.0003	.0000	.0007	.0001	.0001	.0000	.0000	.0000	.0012	11.90
SE	.0000	.0001	.0000	.0000	.0005	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0011	8.35
SSE	.0000	.0000	.0000	.0000	.0004	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0013	9.16
S	.0000	.0000	.0000	.0003	.0005	.0003	.0004	.0001	.0000	.0000	.0000	.0000	.0015	9.40
SSW	.0000	.0000	.0000	.0000	.0000	.0004	.0005	.0007	.0001	.0000	.0000	.0000	.0017	14.44
SW	.0000	.0000	.0000	.0000	.0005	.0003	.0007	.0006	.0003	.0001	.0000	.0000	.0025	14.33
WSW	.0000	.0000	.0000	.0000	.0001	.0000	.0005	.0007	.0001	.0000	.0000	.0000	.0014	15.37
W	.0000	.0000	.0000	.0003	.0001	.0004	.0004	.0001	.0000	.0000	.0000	.0000	.0013	10.07
WNW	.0000	.0000	.0000	.0000	.0001	.0004	.0003	.0002	.0003	.0001	.0000	.0000	.0014	15.36
NW	.0000	.0000	.0000	.0000	.0000	.0003	.0008	.0000	.0001	.0001	.0000	.0000	.0011	13.75
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0003	.0001	.0003	.0000	.0000	.0000	.0008	16.32
TOTAL	.0000	.0001	.0000	.0011	.0030	.0047	.0064	.0032	.0015	.0002	.0000	.0000	.0202	12.55

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0003	.0000	.0009	.0012	.0025	.0024	.0014	.0003	.0000	.0000	.0000	.0091	11.88
NNE	.0000	.0001	.0000	.0004	.0022	.0013	.0027	.0022	.0007	.0000	.0000	.0000	.0093	13.34
NE	.0000	.0003	.0000	.0006	.0025	.0048	.0052	.0020	.0006	.0000	.0000	.0000	.0160	12.36
ENE	.0000	.0001	.0000	.0006	.0024	.0065	.0063	.0027	.0022	.0001	.0000	.0000	.0209	13.51
E	.0000	.0000	.0000	.0015	.0014	.0030	.0029	.0027	.0016	.0001	.0000	.0000	.0132	13.62
ESE	.0000	.0005	.0000	.0010	.0014	.0033	.0047	.0022	.0007	.0001	.0000	.0000	.0139	12.71
SE	.0000	.0004	.0000	.0018	.0036	.0067	.0036	.0016	.0004	.0000	.0000	.0000	.0181	10.94
SSE	.0000	.0001	.0000	.0006	.0023	.0049	.0024	.0003	.0002	.0000	.0000	.0000	.0108	10.86
S	.0000	.0001	.0000	.0015	.0024	.0022	.0054	.0019	.0000	.0000	.0000	.0000	.0135	11.89
SSW	.0000	.0003	.0000	.0005	.0019	.0025	.0062	.0040	.0013	.0001	.0000	.0000	.0167	14.17
SW	.0000	.0004	.0000	.0009	.0015	.0032	.0041	.0032	.0013	.0001	.0000	.0000	.0147	13.66
WSW	.0000	.0001	.0000	.0010	.0019	.0042	.0052	.0040	.0025	.0002	.0000	.0000	.0191	14.32
W	.0000	.0001	.0000	.0009	.0026	.0057	.0057	.0032	.0018	.0001	.0000	.0000	.0202	13.31
WNW	.0000	.0006	.0000	.0013	.0025	.0027	.0052	.0044	.0015	.0001	.0000	.0000	.0183	13.51
NW	.0000	.0005	.0000	.0013	.0023	.0021	.0069	.0041	.0013	.0001	.0000	.0000	.0185	13.55
NNW	.0000	.0004	.0000	.0009	.0012	.0018	.0038	.0032	.0010	.0000	.0000	.0000	.0125	13.73
TOTAL	.0000	.0043	.0000	.0157	.0331	.0575	.0726	.0434	.0175	.0009	.0000	.0000	.2449	13.05

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0025	.0000	.0024	.0035	.0025	.0017	.0002	.0000	.0000	.0129	11.98
NNE	.0000	.0008	.0000	.0014	.0000	.0028	.0027	.0023	.0020	.0003	.0000	.0000	.0122	12.26
NE	.0000	.0003	.0000	.0020	.0000	.0019	.0029	.0034	.0023	.0003	.0000	.0000	.0131	12.99
ENE	.0000	.0008	.0000	.0020	.0000	.0036	.0031	.0024	.0011	.0005	.0000	.0000	.0134	11.38
E	.0000	.0003	.0000	.0014	.0000	.0019	.0017	.0024	.0008	.0003	.0000	.0000	.0088	12.09
ESE	.0000	.0004	.0000	.0005	.0000	.0022	.0034	.0037	.0016	.0005	.0000	.0000	.0122	13.56
SE	.0000	.0003	.0000	.0020	.0000	.0031	.0059	.0046	.0015	.0003	.0000	.0000	.0178	12.38
SSE	.0000	.0003	.0000	.0024	.0000	.0038	.0063	.0054	.0034	.0002	.0000	.0000	.0217	12.86
S	.0000	.0008	.0000	.0021	.0000	.0044	.0071	.0064	.0027	.0004	.0000	.0000	.0239	12.58
SSW	.0000	.0008	.0000	.0021	.0000	.0044	.0095	.0127	.0086	.0008	.0000	.0000	.0389	14.38
SW	.0000	.0013	.0000	.0038	.0000	.0059	.0077	.0113	.0064	.0010	.0000	.0000	.0374	13.38
WSW	.0000	.0006	.0000	.0043	.0000	.0073	.0087	.0108	.0059	.0013	.0000	.0000	.0389	13.23
W	.0000	.0011	.0000	.0033	.0000	.0063	.0055	.0083	.0017	.0001	.0000	.0000	.0263	11.70
WNW	.0000	.0013	.0000	.0043	.0000	.0046	.0039	.0052	.0019	.0008	.0000	.0000	.0220	11.57
NW	.0000	.0005	.0000	.0033	.0000	.0047	.0043	.0036	.0019	.0004	.0000	.0000	.0186	11.55
NNW	.0000	.0010	.0000	.0028	.0000	.0037	.0028	.0023	.0012	.0003	.0000	.0000	.0141	10.75
TOTAL	.0000	.0107	.0000	.0402	.0000	.0629	.0790	.0873	.0446	.0076	.0000	.0000	.3323	12.65

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0004	.0000	.0018	.0033	.0000	.0005	.0002	.0000	.0000	.0000	.0063	9.51
NNE	.0000	.0000	.0004	.0000	.0013	.0014	.0000	.0004	.0001	.0000	.0000	.0000	.0036	9.19
NE	.0000	.0000	.0003	.0000	.0001	.0004	.0000	.0001	.0000	.0000	.0000	.0000	.0009	8.18
ENE	.0000	.0000	.0001	.0000	.0004	.0003	.0000	.0005	.0000	.0000	.0000	.0000	.0013	10.54
E	.0000	.0000	.0003	.0000	.0003	.0003	.0000	.0005	.0010	.0002	.0000	.0000	.0026	14.66
ESE	.0000	.0000	.0000	.0000	.0005	.0007	.0000	.0012	.0027	.0004	.0000	.0000	.0054	16.75
SE	.0000	.0000	.0000	.0000	.0004	.0013	.0000	.0004	.0012	.0002	.0000	.0000	.0035	14.73
SSE	.0000	.0000	.0005	.0000	.0008	.0014	.0000	.0016	.0014	.0000	.0000	.0000	.0057	12.98
S	.0000	.0000	.0005	.0000	.0008	.0013	.0000	.0011	.0011	.0005	.0000	.0000	.0053	13.54
SSW	.0000	.0000	.0003	.0000	.0014	.0020	.0000	.0020	.0032	.0008	.0000	.0000	.0096	14.98
SW	.0000	.0000	.0001	.0000	.0028	.0018	.0000	.0007	.0014	.0001	.0000	.0000	.0071	11.63
WSW	.0000	.0000	.0006	.0000	.0035	.0024	.0000	.0002	.0002	.0000	.0000	.0000	.0071	8.71
W	.0000	.0000	.0003	.0000	.0033	.0024	.0000	.0004	.0002	.0000	.0000	.0000	.0067	9.08
WNW	.0000	.0000	.0003	.0000	.0045	.0018	.0000	.0002	.0001	.0000	.0000	.0000	.0070	8.27
NW	.0000	.0000	.0009	.0000	.0025	.0026	.0000	.0007	.0003	.0000	.0000	.0000	.0071	9.24
NNW	.0000	.0000	.0005	.0000	.0028	.0010	.0000	.0007	.0002	.0002	.0000	.0000	.0054	9.37
TOTAL	.0000	.0000	.0055	.0000	.0271	.0247	.0000	.0112	.0135	.0025	.0000	.0000	.0846	11.42

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0000	.0030	.0013	.0000	.0004	.0000	.0000	.0000	.0000	.0048	8.84
NNE	.0000	.0000	.0003	.0000	.0009	.0009	.0000	.0001	.0000	.0000	.0000	.0000	.0021	8.77
NE	.0000	.0000	.0003	.0000	.0003	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0007	6.30
ENE	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0002	.0001	.0000	.0000	.0000	.0006	14.14
E	.0000	.0000	.0000	.0000	.0001	.0003	.0000	.0004	.0001	.0001	.0000	.0000	.0010	14.45
ESE	.0000	.0000	.0003	.0000	.0003	.0003	.0000	.0007	.0009	.0000	.0000	.0000	.0025	14.19
SE	.0000	.0000	.0001	.0000	.0006	.0008	.0000	.0008	.0004	.0000	.0000	.0000	.0027	12.61
SSE	.0000	.0000	.0001	.0000	.0008	.0009	.0000	.0007	.0009	.0001	.0000	.0000	.0035	13.73
S	.0000	.0000	.0003	.0000	.0006	.0003	.0000	.0002	.0001	.0001	.0000	.0000	.0016	10.06
SSW	.0000	.0000	.0004	.0000	.0003	.0003	.0000	.0003	.0008	.0002	.0000	.0000	.0023	14.10
SW	.0000	.0000	.0000	.0000	.0017	.0003	.0000	.0002	.0003	.0001	.0000	.0000	.0028	10.68
WSW	.0000	.0000	.0001	.0000	.0018	.0010	.0000	.0002	.0003	.0000	.0000	.0000	.0034	9.93
W	.0000	.0000	.0000	.0000	.0024	.0012	.0000	.0000	.0000	.0000	.0000	.0000	.0036	8.49
WNW	.0000	.0000	.0011	.0000	.0034	.0011	.0000	.0001	.0002	.0000	.0000	.0000	.0059	7.79
NW	.0000	.0000	.0005	.0000	.0028	.0016	.0000	.0000	.0000	.0000	.0000	.0000	.0049	8.01
NNW	.0000	.0000	.0005	.0000	.0033	.0011	.0000	.0001	.0000	.0000	.0000	.0000	.0050	7.77
TOTAL	.0000	.0000	.0041	.0000	.0222	.0116	.0000	.0048	.0040	.0006	.0000	.0000	.0473	9.97

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

APPENDIX B

Part 2: Mixed Mode Joint Frequency Distribution of Grazing Period Data Base for the Containment Building Source

6/01/74 - 10/15/74

and

4/15/75 - 05/31/75

APPENDIX B

Part B-3: Analysis for Ground Level portion of Mixed Mode Source

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Containment building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0003	9.08
NNE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.06
NE	.0000	.0000	.0000	.0000	.0003	.0005	.0001	.0001	.0002	.0000	.0000	.0000	.0012	11.99
ENE	.0000	.0000	.0000	.0001	.0004	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0011	9.05
E	.0000	.0000	.0000	.0000	.0001	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0004	9.29
ESE	.0000	.0000	.0000	.0000	.0003	.0008	.0004	.0000	.0000	.0000	.0000	.0000	.0015	10.11
SE	.0000	.0000	.0000	.0001	.0012	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0021	8.47
SSE	.0000	.0000	.0000	.0001	.0007	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0013	8.56
S	.0000	.0000	.0000	.0001	.0003	.0013	.0007	.0002	.0000	.0000	.0000	.0000	.0026	10.83
SSW	.0000	.0000	.0000	.0001	.0003	.0005	.0003	.0003	.0000	.0000	.0000	.0000	.0014	11.07
SW	.0000	.0000	.0000	.0000	.0001	.0002	.0005	.0003	.0000	.0000	.0000	.0000	.0011	12.50
WSW	.0000	.0000	.0000	.0000	.0001	.0003	.0008	.0002	.0000	.0000	.0000	.0000	.0014	12.32
W	.0000	.0000	.0000	.0000	.0002	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0006	9.80
WNW	.0000	.0000	.0000	.0000	.0001	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0005	10.59
NW	.0000	.0000	.0000	.0000	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0005	9.48
NNW	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.41
TOTAL	.0000	.0000	.0000	.0007	.0045	.0064	.0035	.0010	.0002	.0000	.0000	.0000	.0163	10.32

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0002	14.99
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.97
NE	.0000	.0000	.0000	.0000	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0003	10.68
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	5.50
E	.0000	.0000	.0000	.0000	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0003	9.59
ESE	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0004	11.18
SE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.48
SSE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.65
S	.0000	.0000	.0000	.0001	.0001	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0004	9.79
SSW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0004	11.99
SW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.97
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	10.00
W	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	7.50
WNW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0001	11.26
NW	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.35
NNW	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0002	10.20
TOTAL	.0000	.0000	.0000	.0002	.0007	.0014	.0005	.0004	.0000	.0000	.0000	.0000	.0031	10.51

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0002	.0000	.0000	.0000	.0004	18.25
NNE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.49
NE	.0000	.0000	.0000	.0000	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0003	10.71
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	10.00
E	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
ESE	.0000	.0000	.0000	.0000	.0000	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0003	12.30
SE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	6.85
SSE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.24
S	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0003	8.70
SSW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0005	11.12
SW	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0003	10.87
WSW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0002	10.93
W	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0003	8.66
WNW	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0003	13.38
NW	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.24
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	10.00
TOTAL	.0000	.0000	.0000	.0002	.0007	.0014	.0008	.0003	.0002	.0000	.0000	.0000	.0035	11.18

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0002	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0012	10.74
NNE	.0000	.0000	.0000	.0001	.0002	.0004	.0004	.0007	.0000	.0000	.0000	.0000	.0018	12.40
NE	.0000	.0000	.0000	.0002	.0005	.0011	.0003	.0002	.0000	.0000	.0000	.0000	.0022	10.12
ENE	.0000	.0000	.0000	.0001	.0008	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0019	8.90
E	.0000	.0000	.0000	.0001	.0004	.0007	.0004	.0004	.0000	.0000	.0000	.0000	.0019	11.00
ESE	.0000	.0000	.0000	.0001	.0005	.0013	.0005	.0004	.0000	.0000	.0000	.0000	.0027	10.69
SE	.0000	.0000	.0000	.0003	.0015	.0009	.0003	.0002	.0000	.0000	.0000	.0000	.0031	9.10
SSE	.0000	.0000	.0000	.0002	.0012	.0007	.0000	.0000	.0003	.0000	.0000	.0000	.0024	9.65
S	.0000	.0000	.0000	.0002	.0004	.0014	.0004	.0000	.0000	.0000	.0000	.0000	.0024	9.77
SSW	.0000	.0000	.0000	.0001	.0004	.0014	.0010	.0004	.0000	.0000	.0000	.0000	.0034	11.07
SW	.0000	.0000	.0000	.0001	.0005	.0007	.0003	.0006	.0009	.0000	.0000	.0000	.0030	14.28
WSW	.0000	.0000	.0000	.0001	.0002	.0003	.0004	.0013	.0000	.0000	.0000	.0000	.0022	13.77
W	.0000	.0000	.0000	.0000	.0002	.0003	.0003	.0002	.0000	.0000	.0000	.0000	.0010	11.56
WNW	.0000	.0000	.0000	.0001	.0003	.0005	.0007	.0002	.0000	.0000	.0000	.0000	.0019	11.24
NW	.0000	.0000	.0000	.0001	.0002	.0007	.0008	.0000	.0000	.0000	.0000	.0000	.0017	10.79
NNW	.0000	.0000	.0000	.0001	.0002	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0015	10.57
TOTAL	.0000	.0000	.0000	.0020	.0078	.0125	.0061	.0048	.0012	.0000	.0000	.0000	.0344	10.99

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0002	.0005	.0006	.0004	.0002	.0000	.0000	.0000	.0000	.0015	10.19
NNE	.0000	.0000	.0000	.0003	.0006	.0009	.0006	.0012	.0000	.0000	.0000	.0000	.0037	11.82
NE	.0000	.0000	.0000	.0002	.0007	.0010	.0005	.0002	.0000	.0000	.0000	.0000	.0030	10.26
ENE	.0000	.0000	.0000	.0003	.0006	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0016	8.09
E	.0000	.0000	.0000	.0002	.0004	.0005	.0003	.0003	.0003	.0000	.0000	.0000	.0020	12.15
ESE	.0000	.0000	.0000	.0002	.0008	.0012	.0002	.0007	.0000	.0000	.0000	.0000	.0030	10.72
SE	.0000	.0000	.0000	.0003	.0013	.0013	.0003	.0003	.0000	.0000	.0000	.0000	.0035	9.64
SSE	.0000	.0000	.0000	.0004	.0016	.0018	.0011	.0003	.0000	.0000	.0000	.0000	.0052	9.97
S	.0000	.0000	.0000	.0004	.0018	.0016	.0010	.0012	.0008	.0000	.0000	.0000	.0068	11.97
SSW	.0000	.0000	.0000	.0004	.0015	.0029	.0029	.0021	.0005	.0000	.0000	.0000	.0104	12.14
SW	.0000	.0000	.0000	.0005	.0011	.0018	.0019	.0031	.0005	.0003	.0000	.0000	.0092	13.41
WSW	.0000	.0000	.0000	.0005	.0012	.0021	.0009	.0012	.0000	.0000	.0000	.0000	.0058	10.95
W	.0000	.0000	.0000	.0004	.0009	.0015	.0004	.0005	.0003	.0000	.0000	.0000	.0041	10.99
WNW	.0000	.0000	.0000	.0004	.0006	.0006	.0003	.0002	.0000	.0000	.0000	.0000	.0020	9.57
NW	.0000	.0000	.0000	.0004	.0005	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0013	7.89
NNW	.0000	.0000	.0000	.0004	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0012	7.47
TOTAL	.0000	.0000	.0000	.0056	.0147	.0188	.0113	.0117	.0024	.0003	.0000	.0000	.0647	11.23

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0008	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0012	6.14
NNE	.0000	.0000	.0001	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006	6.19
NE	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	6.21
ENE	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	6.67
E	.0000	.0000	.0000	.0001	.0001	.0004	.0005	.0005	.0000	.0000	.0000	.0000	.0016	12.68
ESE	.0000	.0000	.0000	.0001	.0002	.0012	.0013	.0000	.0000	.0000	.0000	.0000	.0028	10.95
SE	.0000	.0000	.0000	.0001	.0001	.0005	.0006	.0000	.0000	.0000	.0000	.0000	.0014	10.68
SSE	.0000	.0000	.0000	.0002	.0004	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0013	8.92
S	.0000	.0000	.0000	.0001	.0002	.0002	.0008	.0010	.0000	.0000	.0000	.0000	.0024	13.18
SSW	.0000	.0000	.0000	.0003	.0005	.0004	.0013	.0020	.0005	.0000	.0000	.0000	.0051	13.83
SW	.0000	.0000	.0001	.0003	.0002	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0009	7.92
WSW	.0000	.0000	.0001	.0004	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0009	7.57
W	.0000	.0000	.0001	.0005	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0008	6.07
WNW	.0000	.0000	.0001	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	5.22
NW	.0000	.0000	.0001	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.33
NNW	.0000	.0000	.0001	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	5.84
TOTAL	.0000	.0000	.0009	.0043	.0029	.0037	.0052	.0035	.0005	.0000	.0000	.0000	.0209	10.56

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0002	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	5.33
NNE	.0000	.0000	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	8.42
NE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	6.47
ENE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	6.64
E	.0000	.0000	.0000	.0000	.0002	.0001	.0004	.0000	.0000	.0000	.0000	.0000	.0006	10.58
ESE	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0003	8.77
SE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.95
SSE	.0000	.0000	.0000	.0001	.0001	.0002	.0004	.0000	.0000	.0000	.0000	.0000	.0008	10.38
S	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0000	.0000	.0000	.0000	.0000	.0005	11.37
SSW	.0000	.0000	.0000	.0001	.0001	.0002	.0006	.0003	.0000	.0000	.0000	.0000	.0012	12.47
SW	.0000	.0000	.0001	.0000	.0001	.0001	.0006	.0000	.0000	.0000	.0000	.0000	.0003	10.57
WSW	.0000	.0000	.0001	.0002	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0006	6.87
W	.0000	.0000	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	4.93
WNW	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.49
NW	.0000	.0000	.0002	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.85
NNW	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	4.65
TOTAL	.0000	.0000	.0012	.0023	.0010	.0011	.0024	.0003	.0000	.0000	.0000	.0000	.0083	8.62

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

APPENDIX B

Part B-4: Analysis for Elevated Portion of Mixed Mode Source

a) Wind speed at 51.2 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Containment building source

Note: In the tables of computer printout, the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0005	.0007	.0011	.0000	.0000	.0000	.0000	.0000	.0023	10.42
NNE	.0000	.0000	.0003	.0000	.0008	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0018	7.95
NE	.0000	.0000	.0000	.0000	.0008	.0025	.0026	.0007	.0002	.0001	.0000	.0000	.0069	11.62
ENE	.0000	.0000	.0003	.0000	.0030	.0032	.0031	.0004	.0000	.0000	.0000	.0000	.0100	9.78
E	.0000	.0003	.0020	.0000	.0010	.0012	.0011	.0002	.0000	.0000	.0000	.0000	.0058	7.78
ESE	.0000	.0000	.0010	.0000	.0008	.0030	.0045	.0016	.0000	.0000	.0000	.0000	.0109	11.14
SE	.0000	.0003	.0003	.0000	.0045	.0102	.0041	.0004	.0000	.0000	.0000	.0000	.0198	9.47
SSE	.0000	.0000	.0003	.0000	.0022	.0059	.0026	.0002	.0000	.0000	.0000	.0000	.0113	9.69
S	.0000	.0003	.0010	.0000	.0027	.0030	.0073	.0029	.0008	.0000	.0000	.0000	.0180	11.56
SSW	.0000	.0000	.0008	.0000	.00032	.0022	.0031	.0012	.0010	.0000	.0000	.0000	.0116	10.97
SW	.0000	.0000	.0003	.0000	.0005	.0012	.0013	.0020	.0010	.0000	.0000	.0000	.0063	13.74
WSW	.0000	.0000	.0005	.0000	.0003	.0012	.0017	.0033	.0008	.0000	.0000	.0000	.0078	13.83
W	.0000	.0000	.0003	.0000	.0008	.0016	.0013	.0007	.0000	.0000	.0000	.0000	.0046	10.54
WNW	.0000	.0000	.0005	.0000	.0000	.0009	.0013	.0008	.0000	.0000	.0000	.0000	.0035	11.49
NW	.0000	.0005	.0008	.0000	.0005	.0022	.0004	.0007	.0000	.0000	.0000	.0000	.0051	8.82
NNW	.0000	.0000	.0000	.0000	.0003	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0010	9.51
TOTAL	.0000	.0014	.0084	.0000	.0217	.0400	.0359	.0152	.0039	.0001	.0000	.0000	.1266	10.68

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0003	.0000	.0000	.0000	.0006	16.66
NNE	.0000	.0000	.0000	.0003	.0000	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0012	9.83
NE	.0000	.0000	.0000	.0000	.0005	.0000	.0008	.0004	.0000	.0000	.0000	.0000	.0017	12.60
ENE	.0000	.0000	.0000	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.28
E	.0000	.0000	.0000	.0003	.0000	.0004	.0015	.0000	.0000	.0000	.0000	.0000	.0023	11.52
ESE	.0000	.0000	.0000	.0000	.0003	.0009	.0007	.0002	.0002	.0000	.0000	.0000	.0023	12.47
SE	.0000	.0000	.0000	.0000	.0000	.0003	.0007	.0000	.0000	.0000	.0000	.0000	.0009	12.38
SSE	.0000	.0000	.0000	.0003	.0000	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0010	9.24
S	.0000	.0000	.0000	.0000	.0012	.0009	.0003	.0006	.0000	.0000	.0000	.0000	.0030	10.75
SSW	.0000	.0000	.0000	.0000	.0005	.0003	.0007	.0004	.0002	.0000	.0000	.0000	.0020	13.13
SW	.0000	.0000	.0000	.0003	.0000	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0008	9.07
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0003	13.33
W	.0000	.0000	.0000	.0003	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0006	7.17
WNW	.0000	.0000	.0000	.0003	.0000	.0000	.0004	.0002	.0000	.0000	.0000	.0000	.0010	11.64
NW	.0000	.0000	.0000	.0003	.0000	.0004	.0008	.0000	.0000	.0000	.0000	.0000	.0016	10.76
NNW	.0000	.0000	.0000	.0000	.0000	.0004	.0003	.0002	.0000	.0000	.0000	.0000	.0009	12.79
TOTAL	.0000	.0000	.0000	.0026	.0032	.0053	.0073	.0022	.0007	.0000	.0000	.0000	.0214	11.24

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

		WIND SPEED CLASS (MPH)												
	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0003	.0003	.0000	.0000	.0004	.0000	.0001	.0000	.0000	.0010	11.51
NNE	.0000	.0000	.0000	.0000	.0003	.0003	.0007	.0000	.0000	.0000	.0000	.0000	.0008	10.06
NE	.0000	.0000	.0000	.0000	.0000	.0003	.0008	.0004	.0000	.0000	.0000	.0000	.0015	13.77
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0003	13.29
E	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.65
ESE	.0000	.0000	.0000	.0003	.0003	.0000	.0008	.0002	.0002	.0000	.0000	.0000	.0019	12.43
SE	.0000	.0000	.0000	.0000	.0010	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0017	8.44
SSE	.0000	.0000	.0000	.0000	.0005	.0012	.0000	.0000	.0000	.0000	.0000	.0000	.0016	9.19
S	.0000	.0000	.0000	.0005	.0010	.0004	.0008	.0000	.0000	.0000	.0000	.0000	.0027	9.09
SSW	.0000	.0000	.0000	.0000	.0000	.0007	.0007	.0011	.0000	.0000	.0000	.0000	.0024	14.04
SW	.0000	.0000	.0000	.0000	.0008	.0000	.0008	.0006	.0000	.0000	.0000	.0000	.0023	12.40
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0007	.0002	.0000	.0000	.0000	.0000	.0009	14.34
W	.0000	.0000	.0000	.0003	.0003	.0009	.0007	.0000	.0000	.0000	.0000	.0000	.0021	9.91
WNW	.0000	.0000	.0000	.0000	.0000	.0004	.0003	.0002	.0003	.0000	.0000	.0000	.0013	15.16
NW	.0000	.0000	.0000	.0000	.0000	.0004	.0007	.0000	.0000	.0000	.0000	.0000	.0011	11.97
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0004	13.29
TOTAL	.0000	.0000	.0000	.0017	.0043	.0053	.0072	.0032	.0005	.0001	.0000	.0000	.0224	11.51

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0008	.0008	.0011	.0032	.0008	.0002	.0000	.0000	.0000	.0068	12.43
NNE	.0000	.0000	.0000	.0005	.0019	.0018	.0021	.0014	.0008	.0000	.0000	.0000	.0085	13.00
NE	.0000	.0000	.0000	.0003	.0026	.0036	.0055	.0010	.0003	.0000	.0000	.0000	.0134	12.18
ENE	.0000	.0003	.0000	.0005	.0024	.0056	.0042	.0006	.0000	.0000	.0000	.0000	.0137	11.13
E	.0000	.0000	.0000	.0010	.0017	.0029	.0036	.0014	.0004	.0000	.0000	.0000	.0111	12.26
ESE	.0000	.0010	.0000	.0008	.0019	.0038	.0063	.0018	.0004	.0000	.0000	.0000	.0161	12.03
SE	.0000	.0008	.0000	.0013	.0048	.0107	.0042	.0010	.0003	.0000	.0000	.0000	.0232	10.50
SSE	.0000	.0000	.0000	.0013	.0029	.0087	.0036	.0000	.0000	.0000	.0000	.0000	.0165	10.41
S	.0000	.0000	.0000	.0025	.0026	.0029	.0070	.0016	.0000	.0000	.0000	.0000	.0166	11.49
SSW	.0000	.0005	.0000	.0005	.0024	.0032	.0072	.0041	.0004	.0000	.0000	.0000	.0182	13.23
SW	.0000	.0000	.0000	.0008	.0014	.0036	.0034	.0010	.0007	.0001	.0000	.0000	.0111	12.57
WSW	.0000	.0000	.0000	.0008	.0014	.0018	.0012	.0014	.0015	.0000	.0000	.0000	.0082	13.78
W	.0000	.0000	.0000	.0013	.0008	.0013	.0015	.0010	.0003	.0000	.0000	.0000	.0062	11.74
WNW	.0000	.0000	.0000	.0008	.0019	.0022	.0026	.0029	.0003	.0000	.0000	.0000	.0106	12.91
NW	.0000	.0000	.0000	.0005	.0012	.0016	.0034	.0030	.0000	.0000	.0000	.0000	.0098	13.56
NNW	.0000	.0003	.0000	.0005	.0014	.0016	.0036	.0012	.0002	.0000	.0000	.0000	.0087	12.23
TOTAL	.0000	.0029	.0000	.0142	.0320	.0563	.0627	.0246	.0058	.0001	.0000	.0000	.1986	12.02

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0023	.0000	.0018	.0033	.0025	.0014	.0001	.0000	.0000	.0115	12.09
NNE	.0000	.0003	.0000	.0015	.0000	.0035	.0040	.0042	.0025	.0006	.0000	.0000	.0165	13.17
NE	.0000	.0000	.0000	.0010	.0000	.0026	.0046	.0048	.0030	.0001	.0000	.0000	.0160	13.77
ENE	.0000	.0003	.0000	.0020	.0000	.0038	.0037	.0029	.0000	.0000	.0000	.0000	.0127	10.56
E	.0000	.0000	.0000	.0018	.0000	.0026	.0024	.0020	.0010	.0002	.0000	.0000	.0100	11.78
ESE	.0000	.0008	.0000	.0005	.0000	.0021	.0048	.0052	.0008	.0003	.0000	.0000	.0146	12.80
SE	.0000	.0000	.0000	.0020	.0000	.0028	.0079	.0061	.0012	.0002	.0000	.0000	.0202	12.53
SSE	.0000	.0000	.0000	.0015	.0000	.0042	.0096	.0081	.0042	.0002	.0000	.0000	.0278	13.51
S	.0000	.0005	.0000	.0023	.0000	.0049	.0107	.0070	.0038	.0006	.0000	.0000	.0298	12.94
SSW	.0000	.0003	.0000	.0020	.0000	.0049	.0089	.0134	.0111	.0010	.0000	.0000	.0415	14.96
SW	.0000	.0008	.0000	.0041	.0000	.0056	.0068	.0081	.0073	.0015	.0000	.0000	.0342	13.69
WSW	.0000	.0005	.0000	.0038	.0000	.0051	.0072	.0093	.0034	.0006	.0000	.0000	.0300	12.78
W	.0000	.0008	.0000	.0036	.0000	.0047	.0052	.0069	.0016	.0003	.0000	.0000	.0230	11.77
WNW	.0000	.0000	.0000	.0028	.0000	.0039	.0037	.0025	.0012	.0001	.0000	.0000	.0143	11.20
NW	.0000	.0003	.0000	.0023	.0000	.0049	.0028	.0008	.0006	.0000	.0000	.0000	.0117	9.76
NNW	.0000	.0010	.0000	.0025	.0000	.0039	.0037	.0012	.0000	.0000	.0000	.0000	.0124	9.14
TOTAL	.0000	.0056	.0000	.0360	.0000	.0612	.0893	.0852	.0431	.0056	.0000	.0000	.3261	12.76

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0005	.0000	.0027	.0053	.0000	.0011	.0004	.0000	.0000	.0000	.0100	10.13
NNE	.0000	.0000	.0008	.0000	.0022	.0024	.0000	.0007	.0002	.0000	.0000	.0000	.0064	9.19
NE	.0000	.0000	.0003	.0000	.0003	.0004	.0000	.0002	.0000	.0000	.0000	.0000	.0013	8.83
ENE	.0000	.0000	.0003	.0000	.0008	.0004	.0000	.0008	.0000	.0000	.0000	.0000	.0023	9.89
E	.0000	.0000	.0000	.0000	.0003	.0004	.0000	.0004	.0016	.0003	.0000	.0000	.0030	17.02
ESE	.0000	.0000	.0000	.0000	.0003	.0009	.0000	.0011	.0046	.0007	.0000	.0000	.0076	18.00
SE	.0000	.0000	.0000	.0000	.0003	.0009	.0000	.0007	.0020	.0004	.0000	.0000	.0042	16.63
SSE	.0000	.0000	.0003	.0000	.0008	.0011	.0000	.0021	.0018	.0001	.0000	.0000	.0062	14.10
S	.0000	.0000	.0003	.0000	.0010	.0009	.0000	.0011	.0008	.0005	.0000	.0000	.0045	13.46
SSW	.0000	.0000	.0005	.0000	.0019	.0022	.0000	.0023	.0016	.0007	.0000	.0000	.0092	13.19
SW	.0000	.0000	.0003	.0000	.0027	.0022	.0000	.0011	.0004	.0001	.0000	.0000	.0068	10.26
WSW	.0000	.0000	.0010	.0000	.0042	.0027	.0000	.0004	.0004	.0001	.0000	.0000	.0088	8.81
W	.0000	.0000	.0003	.0000	.0035	.0033	.0000	.0004	.0004	.0000	.0000	.0000	.0079	9.43
WNW	.0000	.0000	.0005	.0000	.0047	.0027	.0000	.0002	.0000	.0000	.0000	.0000	.0081	8.19
NW	.0000	.0000	.0018	.0000	.0030	.0017	.0000	.0002	.0000	.0000	.0000	.0000	.0068	7.14
NNW	.0000	.0000	.0008	.0000	.0030	.0017	.0000	.0008	.0000	.0000	.0000	.0000	.0064	8.48
TOTAL	.0000	.0000	.0077	.0000	.0317	.0294	.0000	.0136	.0142	.0028	.0000	.0000	.0995	11.17

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0054	.0027	.0000	.0007	.0000	.0000	.0000	.0000	.0087	8.99
NNE	.0000	.0000	.0003	.0000	.0013	.0016	.0000	.0002	.0000	.0001	.0000	.0000	.0034	9.68
NE	.0000	.0000	.0000	.0000	.0005	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0007	19.88
ENE	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0002	.0000	.0000	.0000	.0000	.0005	13.17
E	.0000	.0000	.0000	.0000	.0003	.0003	.0000	.0008	.0002	.0001	.0000	.0000	.0018	14.92
ESE	.0000	.0000	.0003	.0000	.0003	.0003	.0000	.0002	.0008	.0000	.0000	.0000	.0019	13.65
SE	.0000	.0000	.0000	.0000	.0013	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0016	10.30
SSE	.0000	.0000	.0000	.0000	.0005	.0004	.0000	.0007	.0008	.0001	.0000	.0000	.0025	15.24
S	.0000	.0000	.0003	.0000	.0010	.0000	.0000	.0002	.0002	.0001	.0000	.0000	.0019	10.67
SSW	.0000	.0000	.0005	.0000	.0003	.0007	.0000	.0002	.0006	.0002	.0000	.0000	.0026	13.14
SW	.0000	.0000	.0000	.0000	.0032	.0003	.0000	.0004	.0004	.0002	.0000	.0000	.0045	10.27
WSW	.0000	.0000	.0003	.0000	.0019	.0016	.0000	.0004	.0006	.0000	.0000	.0000	.0048	10.61
W	.0000	.0000	.0000	.0000	.0032	.0020	.0000	.0000	.0000	.0000	.0000	.0000	.0052	8.69
WNW	.0000	.0000	.0008	.0000	.0046	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0066	7.33
NW	.0000	.0000	.0008	.0000	.0041	.0022	.0000	.0000	.0000	.0000	.0000	.0000	.0071	7.91
NNW	.0000	.0000	.0000	.0000	.0046	.0016	.0000	.0000	.0000	.0000	.0000	.0000	.0062	8.15
TOTAL	.0000	.0000	.0033	.0000	.0324	.0148	.0000	.0044	.0041	.0010	.0000	.0000	.0600	9.73

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

APPENDIX C

Mixed Mode Joint Frequency Distribution Between Wind Speed. Wind Direction, and Stability for the Fermi 2 Turbine Building Source.

APPENDIX C

Part 1: Mixed Mode Joint Frequency Distribution of Annual Data Base for the Turbine Building Source

6/1/74 - 5/31/75

APPENDIX C

Part C-1: Analysis for Ground Level Portion of Mixed Mode Source

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Turbine building source

Note: In the tables of computer printout the term,"Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0001	.0005	.0013	.0000	.0006	.0000	.0000	.0000	.0000	.0025	10.83
NNE	.0000	.0000	.0001	.0001	.0003	.0003	.0000	.0001	.0000	.0000	.0000	.0000	.0009	8.83
NE	.0000	.0000	.0000	.0002	.0014	.0015	.0004	.0003	.0001	.0000	.0000	.0000	.0039	9.91
ENE	.0000	.0000	.0001	.0007	.0019	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0050	8.50
E	.0000	.0000	.0002	.0003	.0008	.0006	.0006	.0000	.0001	.0000	.0000	.0000	.0026	9.29
ESE	.0000	.0000	.0001	.0002	.0015	.0029	.0011	.0000	.0000	.0000	.0000	.0000	.0058	9.67
SE	.0000	.0000	.0001	.0009	.0057	.0025	.0004	.0000	.0000	.0000	.0000	.0000	.0095	8.17
SSE	.0000	.0000	.0001	.0006	.0033	.0020	.0003	.0001	.0000	.0000	.0000	.0000	.0063	8.48
S	.0000	.0000	.0001	.0005	.0019	.0044	.0019	.0005	.0000	.0000	.0000	.0000	.0093	10.16
SSW	.0000	.0000	.0001	.0006	.0013	.0025	.0016	.0006	.0000	.0000	.0000	.0000	.0067	10.36
SW	.0000	.0000	.0000	.0001	.0014	.0014	.0021	.0011	.0000	.0000	.0000	.0000	.0062	11.48
WSW	.0000	.0000	.0001	.0003	.0008	.0014	.0021	.0008	.0000	.0000	.0000	.0000	.0054	11.49
W	.0000	.0000	.0000	.0004	.0012	.0013	.0006	.0003	.0000	.0000	.0000	.0000	.0038	9.73
WNW	.0000	.0000	.0001	.0000	.0008	.0008	.0006	.0003	.0000	.0000	.0000	.0000	.0025	10.61
NW	.0000	.0000	.0001	.0001	.0013	.0008	.0008	.0006	.0001	.0000	.0000	.0000	.0038	10.77
NNW	.0000	.0000	.0000	.0001	.0004	.0004	.0003	.0004	.0000	.0000	.0000	.0000	.0016	11.11
TOTAL	.0000	.0000	.0009	.0053	.0244	.0261	.0131	.0057	.0003	.0000	.0000	.0000	.0758	9.85

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0003	.0001	.0003	.0000	.0000	.0000	.0000	.0008	12.50
NNE	.0000	.0000	.0000	.0000	.0003	.0006	.0000	.0000	.0001	.0000	.0000	.0000	.0010	10.23
NE	.0000	.0000	.0000	.0001	.0003	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0013	9.65
ENE	.0000	.0000	.0001	.0002	.0003	.0003	.0000	.0001	.0001	.0000	.0000	.0000	.0010	9.84
E	.0000	.0000	.0000	.0000	.0005	.0010	.0003	.0005	.0000	.0000	.0000	.0000	.0023	11.20
ESE	.0000	.0000	.0000	.0000	.0008	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0014	9.13
SE	.0000	.0000	.0000	.0001	.0003	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0011	8.60
SSE	.0000	.0000	.0000	.0000	.0004	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0009	8.82
S	.0000	.0000	.0000	.0004	.0006	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0014	8.83
SSW	.0000	.0000	.0000	.0001	.0004	.0005	.0003	.0001	.0000	.0000	.0000	.0000	.0015	9.88
SW	.0000	.0000	.0000	.0000	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0005	11.04
WSW	.0000	.0000	.0000	.0000	.0001	.0005	.0003	.0004	.0000	.0000	.0000	.0000	.0013	12.26
W	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0004	11.41
WNW	.0000	.0000	.0001	.0000	.0000	.0003	.0003	.0001	.0001	.0000	.0000	.0000	.0008	12.71
NW	.0000	.0000	.0000	.0000	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0008	8.94
NNW	.0000	.0000	.0000	.0000	.0003	.0003	.0005	.0008	.0001	.0000	.0000	.0000	.0020	13.52
TOTAL	.0000	.0000	.0002	.0011	.0049	.0067	.0031	.0025	.0004	.0000	.0000	.0000	.0189	10.59

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0003	.0003	.0000	.0001	.0000	.0000	.0000	.0009	11.66
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	8.15
NE	.0000	.0000	.0000	.0001	.0001	.0008	.0004	.0000	.0000	.0000	.0000	.0000	.0014	10.24
ENE	.0000	.0000	.0000	.0000	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0011	9.32
E	.0000	.0000	.0001	.0000	.0008	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0014	10.51
ESE	.0000	.0000	.0000	.0001	.0000	.0008	.0001	.0001	.0000	.0000	.0000	.0000	.0012	10.20
SE	.0000	.0000	.0000	.0002	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0008	7.25
SSE	.0000	.0000	.0000	.0002	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012	7.19
S	.0000	.0000	.0001	.0002	.0003	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0012	8.47
SSW	.0000	.0000	.0000	.0000	.0005	.0006	.0009	.0001	.0000	.0000	.0000	.0000	.0021	11.00
SW	.0000	.0000	.0000	.0002	.0003	.0008	.0008	.0005	.0003	.0000	.0000	.0000	.0029	12.45
WSW	.0000	.0000	.0000	.0000	.0000	.0006	.0009	.0001	.0000	.0000	.0000	.0000	.0016	11.91
W	.0000	.0000	.0001	.0000	.0005	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0012	8.75
WNW	.0000	.0000	.0000	.0000	.0004	.0004	.0003	.0005	.0003	.0000	.0000	.0000	.0019	13.21
NW	.0000	.0000	.0000	.0000	.0003	.0009	.0000	.0001	.0003	.0001	.0000	.0000	.0017	12.88
NNW	.0000	.0000	.0000	.0000	.0001	.0004	.0001	.0004	.0000	.0000	.0000	.0000	.0010	12.65
TOTAL	.0000	.0000	.0002	.0014	.0053	.0076	.0040	.0023	.0010	.0001	.0000	.0000	.0219	10.86

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0002	.0007	.0029	.0029	.0018	.0005	.0000	.0000	.0000	.0000	.0090	9.67
NNE	.0000	.0000	.0001	.0013	.0015	.0028	.0028	.0013	.0003	.0000	.0000	.0000	.0100	11.01
NE	.0000	.0000	.0001	.0014	.0055	.0063	.0025	.0011	.0001	.0000	.0000	.0000	.0171	9.69
ENE	.0000	.0000	.0001	.0014	.0074	.0076	.0034	.0040	.0009	.0001	.0000	.0000	.0249	10.90
E	.0000	.0000	.0003	.0008	.0034	.0035	.0034	.0029	.0009	.0000	.0000	.0000	.0152	11.64
ESE	.0000	.0000	.0002	.0008	.0038	.0056	.0028	.0013	.0006	.0000	.0000	.0000	.0151	10.59
SE	.0000	.0000	.0003	.0021	.0076	.0043	.0020	.0008	.0000	.0000	.0000	.0000	.0171	8.87
SSE	.0000	.0000	.0002	.0013	.0056	.0029	.0004	.0004	.0001	.0000	.0000	.0000	.0108	8.54
S	.0000	.0000	.0003	.0014	.0025	.0065	.0024	.0000	.0000	.0000	.0000	.0000	.0131	9.46
SSW	.0000	.0000	.0001	.0011	.0028	.0074	.0050	.0024	.0010	.0000	.0000	.0000	.0198	11.46
SW	.0000	.0000	.0002	.0009	.0036	.0049	.0040	.0024	.0015	.0000	.0000	.0000	.0175	11.72
WSW	.0000	.0000	.0002	.0011	.0048	.0063	.0050	.0045	.0018	.0001	.0000	.0000	.0238	12.00
W	.0000	.0000	.0002	.0015	.0065	.0069	.0040	.0033	.0006	.0003	.0000	.0000	.0233	10.90
WNW	.0000	.0000	.0002	.0014	.0071	.0063	.0055	.0028	.0009	.0001	.0000	.0000	.0204	11.50
NW	.0000	.0000	.0002	.0013	.0024	.0083	.0051	.0023	.0009	.0000	.0000	.0000	.0206	11.29
NNW	.0000	.0000	.0002	.0007	.0021	.0046	.0040	.0019	.0000	.0000	.0000	.0000	.0135	11.09
TOTAL	.0000	.0001	.0028	.0194	.0655	.0871	.0541	.0319	.0096	.0006	.0000	.0000	.2711	10.79

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0005	.0019	.0041	.0031	.0021	.0005	.0000	.0000	.0000	.0000	.0122	8.98
NNE	.0000	.0000	.0003	.0022	.0031	.0028	.0025	.0010	.0000	.0000	.0000	.0000	.0119	9.52
NE	.0000	.0000	.0004	.0015	.0034	.0041	.0029	.0009	.0006	.0001	.0000	.0000	.0139	10.35
ENE	.0000	.0000	.0004	.0029	.0036	.0029	.0014	.0015	.0008	.0000	.0000	.0000	.0135	9.86
E	.0000	.0000	.0003	.0015	.0020	.0029	.0010	.0009	.0001	.0000	.0000	.0000	.0087	9.56
ESE	.0000	.0000	.0001	.0018	.0039	.0045	.0020	.0016	.0008	.0000	.0000	.0000	.0147	10.46
SE	.0000	.0000	.0004	.0025	.0069	.0056	.0019	.0010	.0001	.0000	.0000	.0000	.0184	9.03
SSE	.0000	.0000	.0005	.0030	.0073	.0066	.0043	.0005	.0000	.0000	.0000	.0000	.0222	9.15
S	.0000	.0000	.0004	.0035	.0083	.0078	.0034	.0011	.0005	.0000	.0000	.0000	.0251	9.33
SSW	.0000	.0000	.0004	.0035	.0111	.0155	.0108	.0025	.0006	.0000	.0000	.0000	.0445	10.20
SW	.0000	.0001	.0007	.0047	.0090	.0138	.0081	.0031	.0008	.0014	.0000	.0000	.0417	10.68
WSW	.0000	.0000	.0008	.0059	.0101	.0132	.0075	.0039	.0004	.0000	.0000	.0000	.0418	9.88
W	.0000	.0000	.0006	.0051	.0064	.0101	.0021	.0004	.0003	.0000	.0000	.0000	.0251	8.76
WNW	.0000	.0001	.0008	.0037	.0045	.0064	.0024	.0026	.0008	.0000	.0000	.0000	.0213	9.97
NW	.0000	.0000	.0006	.0038	.0050	.0044	.0024	.0011	.0000	.0000	.0000	.0000	.0173	8.88
NNW	.0000	.0000	.0005	.0029	.0033	.0028	.0015	.0010	.0000	.0000	.0000	.0000	.0121	8.82
TOTAL	.0000	.0005	.0076	.0505	.0920	.1065	.0563	.0236	.0058	.0015	.0000	.0000	.3443	9.71

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0004	.0038	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0051	5.81
NNE	.0000	.0000	.0003	.0016	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.81
NE	.0000	.0000	.0000	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	5.58
ENE	.0000	.0000	.0001	.0004	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011	6.41
E	.0000	.0000	.0001	.0004	.0006	.0013	.0005	.0003	.0000	.0000	.0000	.0000	.0032	9.85
ESE	.0000	.0000	.0001	.0008	.0014	.0034	.0011	.0000	.0001	.0000	.0000	.0000	.0069	9.51
SE	.0000	.0000	.0001	.0015	.0005	.0015	.0006	.0001	.0000	.0000	.0000	.0000	.0043	8.58
SSE	.0000	.0000	.0002	.0016	.0019	.0018	.0001	.0006	.0001	.0001	.0000	.0000	.0064	9.00
S	.0000	.0000	.0002	.0015	.0013	.0014	.0014	.0005	.0003	.0000	.0000	.0000	.0066	9.89
SSW	.0000	.0000	.0003	.0023	.0024	.0040	.0023	.0000	.0005	.0000	.0000	.0000	.0128	10.03
SW	.0000	.0000	.0006	.0021	.0009	.0018	.0004	.0008	.0000	.0000	.0000	.0000	.0066	8.59
WSW	.0000	.0001	.0008	.0028	.0003	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0044	5.97
W	.0000	.0000	.0007	.0028	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0043	5.69
WNW	.0000	.0000	.0010	.0021	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0036	5.44
NW	.0000	.0001	.0005	.0030	.0008	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0049	6.06
NNW	.0000	.0000	.0006	.0011	.0008	.0003	.0005	.0001	.0000	.0000	.0000	.0000	.0034	7.36
TOTAL	.0000	.0005	.0058	.0283	.0135	.0170	.0072	.0035	.0010	.0001	.0000	.0000	.0769	8.10

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0008	.0015	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028	5.28
NNE	.0000	.0000	.0002	.0010	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0015	5.76
NE	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	5.19
ENE	.0000	.0000	.0000	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0007	7.00
E	.0000	.0000	.0000	.0004	.0005	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0013	8.25
ESE	.0000	.0000	.0001	.0003	.0009	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0024	8.20
SE	.0000	.0000	.0002	.0009	.0010	.0005	.0000	.0000	.0001	.0000	.0000	.0000	.0027	7.55
SSE	.0000	.0000	.0002	.0010	.0009	.0011	.0004	.0000	.0000	.0000	.0000	.0000	.0036	8.08
S	.0000	.0000	.0002	.0003	.0003	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0012	7.94
SSW	.0000	.0000	.0001	.0004	.0004	.0010	.0006	.0001	.0000	.0000	.0000	.0000	.0026	9.56
SW	.0000	.0000	.0005	.0004	.0003	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0020	7.80
WSW	.0000	.0000	.0005	.0011	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0023	6.11
W	.0000	.0000	.0006	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	4.88
WNW	.0000	.0001	.0009	.0013	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0027	5.26
NW	.0000	.0000	.0007	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026	4.86
NNW	.0000	.0000	.0009	.0013	.0001	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0024	5.25
TOTAL	.0000	.0004	.0058	.0134	.0058	.0051	.0021	.0002	.0001	.0000	.0000	.0000	.0329	6.74

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

APPENDIX C

Part C-2: Analysis for Elevated Portion of Mixed Mode Source

a) Wind speed at 51.2 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Turbine building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "Mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.60
NNE	.0000	.0000	.0002	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	5.61
NE	.0000	.0000	.0001	.0000	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006	6.68
ENE	.0000	.0000	.0002	.0000	.0014	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0017	6.49
E	.0000	.0001	.0011	.0000	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	5.02
ESE	.0000	.0001	.0005	.0000	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0010	5.21
SE	.0000	.0001	.0002	.0000	.0017	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0024	6.56
SSE	.0000	.0000	.0002	.0000	.0010	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0015	6.59
S	.0000	.0001	.0004	.0000	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0015	5.88
SSW	.0000	.0000	.0003	.0000	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0014	6.25
SW	.0000	.0000	.0001	.0000	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.67
WSW	.0000	.0000	.0002	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	6.07
W	.0000	.0000	.0001	.0000	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0008	6.65
WNW	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.97
NW	.0000	.0004	.0005	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0012	4.14
NNW	.0000	.0000	.0001	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.27
TOTAL	.0000	.0009	.0047	.0000	.0097	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0167	5.95

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
NNE	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	4.47
NE	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.02
ENE	.0000	.0000	.0002	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	5.66
E	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	4.47
ESE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.02
SE	.0000	.0000	.0001	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.16
SSE	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	5.48
S	.0000	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	7.02
SSW	.0000	.0000	.0001	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.16
SW	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	4.47
WSW	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.02
W	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	4.47
WNW	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
NW	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	4.47
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
TOTAL	.0000	.0000	.0012	.0000	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.82

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	5.47
NNE	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.00
NE	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.00
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
E	.0000	.0000	.0002	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.92
ESE	.0000	.0000	.0001	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.15
SE	.0000	.0001	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.64
SSE	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.00
S	.0000	.0000	.0002	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	5.79
SSW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
SW	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.00
WSW	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.00
W	.0000	.0000	.0002	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.92
WNW	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.00
NW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
TOTAL	.0000	.0001	.0009	.0000	.0017	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0027	5.96

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0003	.0000	.0007	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016	5.15
NNE	.0000	.0001	.0000	.0003	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015	6.39
NE	.0000	.0003	.0000	.0005	.0012	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019	5.87
ENE	.0000	.0001	.0000	.0005	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0017	6.27
E	.0000	.0000	.0000	.0012	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019	5.62
ESE	.0000	.0005	.0000	.0008	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	4.92
SE	.0000	.0004	.0000	.0015	.0017	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0036	5.66
SSE	.0000	.0001	.0000	.0005	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0017	6.24
S	.0000	.0001	.0000	.0012	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	5.79
SSW	.0000	.0003	.0000	.0004	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016	5.68
SW	.0000	.0004	.0000	.0007	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	5.14
WSW	.0000	.0001	.0000	.0008	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	5.85
W	.0000	.0001	.0000	.0007	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021	6.15
WNW	.0000	.0006	.0000	.0011	.0012	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028	5.22
NW	.0000	.0005	.0000	.0011	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026	5.27
NNW	.0000	.0004	.0000	.0007	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0017	4.97
TOTAL	.0000	.0042	.0000	.0129	.0157	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0328	5.61

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0020	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028	5.76
NNE	.0000	.0008	.0000	.0011	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0027	5.17
NE	.0000	.0003	.0000	.0016	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.46
ENE	.0000	.0008	.0000	.0016	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034	5.37
E	.0000	.0003	.0000	.0011	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	5.54
ESE	.0000	.0004	.0000	.0004	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014	5.66
SE	.0000	.0003	.0000	.0016	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028	5.78
SSE	.0000	.0003	.0000	.0019	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0033	5.85
S	.0000	.0008	.0000	.0017	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0037	5.54
SSW	.0000	.0008	.0000	.0017	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0037	5.54
SW	.0000	.0012	.0000	.0031	.0017	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0060	5.36
WSW	.0000	.0006	.0000	.0035	.0021	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0062	5.87
W	.0000	.0011	.0000	.0027	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0055	5.55
WNW	.0000	.0012	.0000	.0035	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0060	5.18
NW	.0000	.0005	.0000	.0027	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0045	5.71
NNW	.0000	.0010	.0000	.0023	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0043	5.21
TOTAL	.0000	.0102	.0000	.0326	.0181	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0609	5.52

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0004	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019	5.52
NNE	.0000	.0000	.0004	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014	5.29
NE	.0000	.0000	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	3.46
ENE	.0000	.0000	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.42
E	.0000	.0000	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.32
ESE	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.22
SE	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	6.22
SSE	.0000	.0000	.0005	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011	4.73
S	.0000	.0000	.0005	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011	4.73
SSW	.0000	.0000	.0003	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014	5.51
SW	.0000	.0000	.0001	.0023	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	6.08
WSW	.0000	.0000	.0005	.0028	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034	5.65
W	.0000	.0000	.0003	.0027	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0030	5.89
WNW	.0000	.0000	.0003	.0036	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0039	5.97
NW	.0000	.0000	.0008	.0021	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0029	5.20
NNW	.0000	.0000	.0005	.0023	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028	5.63
TOTAL	.0000	.0000	.0050	.0221	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0271	5.56

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0023	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	6.26
NNE	.0000	.0000	.0003	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009	5.35
NE	.0000	.0000	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.40
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
E	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	6.40
ESE	.0000	.0000	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.40
SE	.0000	.0000	.0001	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	5.79
SSE	.0000	.0000	.0001	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007	5.92
S	.0000	.0000	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007	5.02
SSW	.0000	.0000	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	4.14
SW	.0000	.0000	.0000	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.40
WSW	.0000	.0000	.0001	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015	6.18
W	.0000	.0000	.0000	.0019	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019	6.40
WNW	.0000	.0000	.0010	.0026	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0036	5.39
NW	.0000	.0000	.0005	.0022	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026	5.77
NNW	.0000	.0000	.0005	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0030	5.85
TOTAL	.0000	.0000	.0037	.0172	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0209	5.75

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

APPENDIX C

Part 2: Mixed Mode Joint Frequency Distribution of Grazing Period Data Base for the Turbine Building Source

6/01/74 - 10/15/74

sequenced on to

4/15/75 - 05/31/75

APPENDIX C

Part C-3: Analysis for Ground Level Portion of Mixed Mode Source

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Turbine building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0002	.0008	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0022	8.80
NNE	.0000	.0000	.0001	.0003	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0011	7.49
NE	.0000	.0000	.0000	.0003	.0027	.0031	.0008	.0003	.0003	.0000	.0000	.0000	.0074	9.97
ENE	.0000	.0000	.0001	.0011	.0034	.0036	.0005	.0000	.0000	.0000	.0000	.0000	.0087	8.58
E	.0000	.0000	.0003	.0004	.0012	.0013	.0003	.0000	.0000	.0000	.0000	.0000	.0035	8.31
ESE	.0000	.0000	.0002	.0003	.0031	.0053	.0020	.0000	.0000	.0000	.0000	.0000	.0109	9.62
SE	.0000	.0000	.0001	.0016	.0108	.0048	.0005	.0000	.0000	.0000	.0000	.0000	.0178	8.14
SSE	.0000	.0000	.0001	.0008	.0062	.0031	.0003	.0000	.0000	.0000	.0000	.0000	.0105	8.22
S	.0000	.0000	.0002	.0010	.0031	.0036	.0036	.0010	.0000	.0000	.0000	.0000	.0175	10.23
SSW	.0000	.0000	.0001	.0012	.0024	.0036	.0015	.0013	.0000	.0000	.0000	.0000	.0101	10.09
SW	.0000	.0000	.0001	.0002	.0012	.0015	.0025	.0013	.0000	.0000	.0000	.0000	.0068	11.74
WSW	.0000	.0000	.0001	.0001	.0012	.0020	.0041	.0010	.0000	.0000	.0000	.0000	.0085	11.73
W	.0000	.0000	.0001	.0003	.0017	.0015	.0008	.0000	.0000	.0000	.0000	.0000	.0043	9.20
WNW	.0000	.0000	.0001	.0000	.0009	.0015	.0010	.0000	.0000	.0000	.0000	.0000	.0035	10.03
NW	.0000	.0000	.0001	.0002	.0024	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0040	8.70
NNW	.0000	.0000	.0000	.0001	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0009	8.11
TOTAL	.0000	.0000	.0014	.0079	.0421	.0423	.0187	.0049	.0003	.0000	.0000	.0000	.1176	9.50

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0008	13.13
NNE	.0000	.0000	.0001	.0000	.0005	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0011	8.49
NE	.0000	.0000	.0000	.0002	.0000	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0017	10.27
ENE	.0000	.0000	.0001	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	5.12
E	.0000	.0000	.0001	.0000	.0005	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0024	9.32
ESE	.0000	.0000	.0000	.0001	.0010	.0008	.0003	.0003	.0000	.0000	.0000	.0000	.0025	9.89
SE	.0000	.0000	.0000	.0000	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0011	9.32
SSE	.0000	.0000	.0001	.0000	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0009	8.14
S	.0000	.0000	.0000	.0006	.0010	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0027	8.97
SSW	.0000	.0000	.0000	.0002	.0003	.0008	.0005	.0003	.0000	.0000	.0000	.0000	.0021	10.78
SW	.0000	.0000	.0001	.0000	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0007	8.33
WSW	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0003	10.00
W	.0000	.0000	.0001	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.91
WNW	.0000	.0000	.0001	.0000	.0000	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0009	10.66
NW	.0000	.0000	.0001	.0000	.0005	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0016	8.98
NNW	.0000	.0000	.0000	.0000	.0005	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0011	9.68
TOTAL	.0000	.0000	.0005	.0016	.0060	.0087	.0027	.0011	.0000	.0000	.0000	.0000	.0205	9.53

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0001	.0000	.0000	.0005	.0000	.0003	.0000	.0000	.0000	.0010	13.90
NNE	.0000	.0000	.0000	.0001	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0007	8.15
NE	.0000	.0000	.0000	.0000	.0003	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0018	10.42
ENE	.0000	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0003	10.00
E	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	3.50
ESE	.0000	.0000	.0001	.0001	.0000	.0010	.0003	.0003	.0000	.0000	.0000	.0000	.0018	11.06
SE	.0000	.0000	.0000	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.78
SSE	.0000	.0000	.0000	.0002	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015	7.20
S	.0000	.0000	.0001	.0005	.0005	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0020	8.11
SSW	.0000	.0000	.0000	.0000	.0008	.0008	.0013	.0000	.0000	.0000	.0000	.0000	.0029	10.66
SW	.0000	.0000	.0000	.0004	.0000	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0022	10.36
WSW	.0000	.0000	.0000	.0000	.0000	.0008	.0003	.0000	.0000	.0000	.0000	.0000	.0011	10.82
W	.0000	.0000	.0001	.0001	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0020	8.27
WNW	.0000	.0000	.0000	.0000	.0005	.0003	.0003	.0005	.0000	.0000	.0000	.0000	.0016	11.81
NW	.0000	.0000	.0000	.0000	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0013	9.04
NNW	.0000	.0000	.0000	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0005	10.00
TOTAL	.0000	.0000	.0003	.0020	.0060	.0086	.0040	.0008	.0003	.0000	.0000	.0000	.0220	9.75

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0004	.0013	.0038	.0010	.0003	.0000	.0000	.0000	.0000	.0070	9.82
NNE	.0000	.0000	.0001	.0011	.0020	.0025	.0018	.0015	.0000	.0000	.0000	.0000	.0090	10.51
NE	.0000	.0000	.0001	.0015	.0041	.0066	.0013	.0005	.0000	.0000	.0000	.0000	.0141	9.26
ENE	.0000	.0000	.0001	.0014	.0064	.0051	.0008	.0000	.0000	.0000	.0000	.0000	.0138	8.52
E	.0000	.0000	.0002	.0010	.0033	.0043	.0018	.0008	.0000	.0000	.0000	.0000	.0114	9.71
ESE	.0000	.0000	.0001	.0011	.0043	.0076	.0023	.0008	.0000	.0000	.0000	.0000	.0163	9.71
SE	.0000	.0000	.0002	.0028	.0122	.0051	.0013	.0005	.0000	.0000	.0000	.0000	.0222	8.30
SSE	.0000	.0000	.0002	.0017	.0099	.0043	.0000	.0000	.0003	.0000	.0000	.0000	.0164	8.13
S	.0000	.0000	.0004	.0015	.0033	.0084	.0020	.0000	.0000	.0000	.0000	.0000	.0157	9.23
SSW	.0000	.0000	.0001	.0014	.0036	.0086	.0051	.0008	.0000	.0000	.0000	.0000	.0196	10.24
SW	.0000	.0000	.0001	.0008	.0041	.0041	.0013	.0013	.0010	.0000	.0000	.0000	.0128	10.66
WSW	.0000	.0000	.0001	.0008	.0020	.0015	.0018	.0028	.0000	.0000	.0000	.0000	.0091	11.54
W	.0000	.0000	.0002	.0004	.0015	.0018	.0013	.0005	.0000	.0000	.0000	.0000	.0058	9.98
WNW	.0000	.0000	.0001	.0011	.0025	.0031	.0036	.0005	.0000	.0000	.0000	.0000	.0109	10.17
NW	.0000	.0000	.0001	.0007	.0018	.0041	.0038	.0000	.0000	.0000	.0000	.0000	.0105	10.29
NNW	.0000	.0000	.0001	.0008	.0018	.0043	.0015	.0003	.0000	.0000	.0000	.0000	.0088	9.73
TOTAL	.0000	.0001	.0025	.0188	.0641	.0752	.0307	.0106	.0013	.0000	.0000	.0000	.2033	9.57

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0004	.0015	.0038	.0031	.0018	.0003	.0000	.0000	.0000	.0000	.0109	8.94
NNE	.0000	.0000	.0003	.0028	.0046	.0051	.0031	.0018	.0000	.0000	.0000	.0000	.0177	9.71
NE	.0000	.0000	.0002	.0021	.0053	.0058	.0038	.0003	.0000	.0000	.0000	.0000	.0175	9.40
ENE	.0000	.0000	.0004	.0030	.0043	.0036	.0000	.0000	.0000	.0000	.0000	.0000	.0113	7.62
E	.0000	.0000	.0003	.0021	.0028	.0025	.0013	.0005	.0003	.0000	.0000	.0000	.0098	9.18
ESE	.0000	.0000	.0001	.0017	.0056	.0064	.0010	.0010	.0000	.0000	.0000	.0000	.0158	9.18
SE	.0000	.0000	.0004	.0023	.0092	.0074	.0015	.0005	.0000	.0000	.0000	.0000	.0213	8.68
SSE	.0000	.0000	.0003	.0034	.0112	.0099	.0053	.0005	.0000	.0000	.0000	.0000	.0306	9.15
S	.0000	.0000	.0004	.0039	.0125	.0086	.0048	.0018	.0008	.0000	.0000	.0000	.0329	9.48
SSW	.0000	.0000	.0004	.0039	.0104	.0163	.0140	.0031	.0005	.0000	.0000	.0000	.0486	10.44
SW	.0000	.0000	.0008	.0045	.0079	.0099	.0092	.0046	.0005	.0003	.0000	.0000	.0377	10.60
WSW	.0000	.0000	.0007	.0041	.0084	.0114	.0043	.0018	.0000	.0000	.0000	.0000	.0308	9.36
W	.0000	.0000	.0007	.0038	.0061	.0084	.0020	.0008	.0003	.0000	.0000	.0000	.0221	8.99
WNW	.0000	.0000	.0005	.0032	.0043	.0031	.0015	.0003	.0000	.0000	.0000	.0000	.0129	8.29
NW	.0000	.0000	.0004	.0039	.0033	.0010	.0008	.0000	.0000	.0000	.0000	.0000	.0094	7.21
NNW	.0000	.0000	.0005	.0032	.0043	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0095	7.00
TOTAL	.0000	.0002	.0068	.0492	.1040	.1040	.0544	.0173	.0024	.0003	.0000	.0000	.3386	9.35

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0006	.0061	.0013	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0085	5.91
NNE	.0000	.0001	.0005	.0028	.0008	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0045	5.88
NE	.0000	.0000	.0001	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009	5.92
ENE	.0000	.0000	.0002	.0005	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0017	6.42
E	.0000	.0000	.0001	.0005	.0005	.0020	.0008	.0005	.0000	.0000	.0000	.0000	.0044	10.40
ESE	.0000	.0000	.0001	.0010	.0013	.0058	.0020	.0000	.0000	.0000	.0000	.0000	.0102	9.79
SE	.0000	.0000	.0001	.0010	.0008	.0025	.0010	.0000	.0000	.0000	.0000	.0000	.0054	9.27
SSE	.0000	.0000	.0002	.0013	.0025	.0023	.0003	.0000	.0000	.0000	.0000	.0000	.0066	8.10
S	.0000	.0000	.0002	.0010	.0013	.0010	.0013	.0010	.0000	.0000	.0000	.0000	.0058	10.18
SSW	.0000	.0000	.0004	.0025	.0028	.0020	.0020	.0020	.0005	.0000	.0000	.0000	.0123	10.26
SW	.0000	.0000	.0006	.0025	.0013	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0052	6.62
WSW	.0000	.0001	.0009	.0031	.0005	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0054	6.12
W	.0000	.0000	.0008	.0038	.0005	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0056	5.79
WNW	.0000	.0000	.0010	.0031	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0044	5.14
NW	.0000	.0002	.0006	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0031	5.07
NNW	.0000	.0001	.0006	.0020	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0037	5.61
TOTAL	.0000	.0007	.0068	.0337	.0165	.0179	.0080	.0035	.0005	.0000	.0000	.0000	.0876	7.82

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0014	.0031	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0053	5.27
NNE	.0000	.0000	.0003	.0018	.0003	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0028	6.25
NE	.0000	.0000	.0001	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.31
ENE	.0000	.0000	.0000	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	6.50
E	.0000	.0000	.0001	.0003	.0010	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0022	8.69
ESE	.0000	.0000	.0001	.0003	.0003	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0017	8.34
SE	.0000	.0000	.0003	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0008	7.42
SSE	.0000	.0000	.0001	.0005	.0008	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0029	8.78
S	.0000	.0000	.0003	.0000	.0003	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0014	9.18
SSW	.0000	.0000	.0001	.0008	.0003	.0008	.0008	.0003	.0000	.0000	.0000	.0000	.0031	9.71
SW	.0000	.0000	.0008	.0003	.0005	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0029	8.08
WSW	.0000	.0000	.0005	.0018	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0036	6.46
W	.0000	.0000	.0008	.0023	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0031	4.97
WNW	.0000	.0001	.0012	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026	4.45
NW	.0000	.0001	.0011	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0037	4.82
NNW	.0000	.0000	.0012	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0030	4.69
TOTAL	.0000	.0003	.0085	.0171	.0054	.0052	.0034	.0003	.0000	.0000	.0000	.0000	.0402	6.61

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

APPENDIX C

Part C-4: Analysis for Elevated Portion of Mixed Mode Source

a) Wind speed at 51.2 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Turbine building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.97
NNE	.0000	.0000	.0002	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	6.01
NE	.0000	.0000	.0000	.0000	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0007	7.23
ENE	.0000	.0000	.0002	.0000	.0020	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0024	6.63
E	.0000	.0003	.0017	.0000	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0027	4.70
ESE	.0000	.0000	.0008	.0000	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0015	5.64
SE	.0000	.0003	.0002	.0000	.0030	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0041	6.55
SSE	.0000	.0000	.0002	.0000	.0015	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0021	6.81
S	.0000	.0003	.0008	.0000	.0018	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0031	5.71
SSW	.0000	.0000	.0007	.0000	.0021	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0029	6.25
SW	.0000	.0000	.0002	.0000	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006	6.01
WSW	.0000	.0000	.0004	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0007	5.45
W	.0000	.0000	.0002	.0000	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0009	6.26
WNW	.0000	.0000	.0004	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.81
NW	.0000	.0005	.0007	.0000	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0016	4.39
NNW	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.98
TOTAL	.0000	.0014	.0070	.0000	.0145	.0024	.0000	.0000	.0000	.0000	.0000	.0000	.0253	5.98

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
NNE	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
NE	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.02
ENE	.0000	.0000	.0004	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	5.78
E	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
ESE	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.02
SE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
SSE	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
S	.0000	.0000	.0000	.0000	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007	7.02
SSW	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.02
SW	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
W	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
WNW	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
NW	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.47
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
TOTAL	.0000	.0000	.0021	.0000	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0040	5.65

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0002	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.47
NNE	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.00
NE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
E	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	4.46
ESE	.0000	.0000	.0002	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.47
SE	.0000	.0000	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	7.00
SSE	.0000	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.00
S	.0000	.0000	.0004	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	5.91
SSW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
SW	.0000	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	7.00
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
W	.0000	.0000	.0002	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	5.47
WNW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
NW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
TOTAL	.0000	.0000	.0014	.0000	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0039	6.08

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0007	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	5.62
NNE	.0000	.0000	.0000	.0004	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.51
NE	.0000	.0000	.0000	.0002	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015	6.91
ENE	.0000	.0003	.0000	.0004	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	5.88
E	.0000	.0000	.0000	.0008	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016	6.00
ESE	.0000	.0010	.0000	.0007	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	4.58
SE	.0000	.0008	.0000	.0011	.0023	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0041	5.64
SSE	.0000	.0000	.0000	.0011	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	6.19
S	.0000	.0000	.0000	.0021	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0033	5.69
SSW	.0000	.0005	.0000	.0004	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	5.51
SW	.0000	.0000	.0000	.0007	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.03
WSW	.0000	.0000	.0000	.0007	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.03
W	.0000	.0000	.0000	.0011	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014	5.35
WNW	.0000	.0000	.0000	.0007	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016	6.22
NW	.0000	.0000	.0000	.0004	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	6.24
NNW	.0000	.0003	.0000	.0004	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014	5.41
TOTAL	.0000	.0028	.0000	.0117	.0152	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0297	5.79

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0019	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	5.79
NNE	.0000	.0003	.0000	.0012	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.98
NE	.0000	.0000	.0000	.0008	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015	6.54
ENE	.0000	.0003	.0000	.0016	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0030	5.92
E	.0000	.0000	.0000	.0015	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0022	6.13
ESE	.0000	.0008	.0000	.0004	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	4.88
SE	.0000	.0000	.0000	.0016	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	6.13
SSE	.0000	.0000	.0000	.0012	.0012	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0024	6.61
S	.0000	.0005	.0000	.0019	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0037	5.87
SSW	.0000	.0003	.0000	.0016	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0033	6.13
SW	.0000	.0008	.0000	.0033	.0016	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0057	5.68
WSW	.0000	.0005	.0000	.0031	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0050	5.73
W	.0000	.0008	.0000	.0029	.0013	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0050	5.48
WNW	.0000	.0000	.0000	.0023	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034	6.12
NW	.0000	.0003	.0000	.0019	.0014	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0036	6.06
NNW	.0000	.0010	.0000	.0020	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0041	5.27
TOTAL	.0000	.0054	.0000	.0292	.0176	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0522	5.83

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0005	.0022	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0027	5.61
NNE	.0000	.0000	.0007	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.20
NE	.0000	.0000	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.32
ENE	.0000	.0000	.0003	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009	5.15
E	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.22
ESE	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.22
SE	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.22
SSE	.0000	.0000	.0003	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009	5.15
S	.0000	.0000	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011	6.30
SSW	.0000	.0000	.0005	.0016	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	5.42
SW	.0000	.0000	.0003	.0022	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	5.83
WSW	.0000	.0000	.0009	.0034	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0043	5.47
W	.0000	.0000	.0003	.0028	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0031	5.91
WNW	.0000	.0000	.0005	.0038	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0043	5.84
NW	.0000	.0000	.0016	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0041	4.79
NNW	.0000	.0000	.0007	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0032	5.40
TOTAL	.0000	.0000	.0070	.0258	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0328	5.46

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0042	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0042	6.40
NNE	.0000	.0000	.0003	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012	5.60
NE	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.40
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	0.00
E	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.40
ESE	.0000	.0000	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	4.40
SE	.0000	.0000	.0000	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	6.40
SSE	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	6.40
S	.0000	.0000	.0003	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	5.43
SSW	.0000	.0000	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007	3.95
SW	.0000	.0000	.0000	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	6.40
WSW	.0000	.0000	.0003	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018	5.84
W	.0000	.0000	.0000	.0025	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0025	6.40
WNW	.0000	.0000	.0007	.0036	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0043	5.79
NW	.0000	.0000	.0007	.0032	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0039	5.73
NNW	.0000	.0000	.0000	.0036	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0036	6.40
TOTAL	.0000	.0000	.0030	.0251	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0281	6.01

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

APPENDIX D

Mixed Mode Joint Frequency Distribution Between Wind Speed, Wind Direction and Stability for the Fermi 2 Radwaste Building Source

APPENDIX D

Part 1: Mixed Mode Joint Frequency Distribution of Annual Data Base for the Radwaste Building Source.

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APPENDIX D

Part D-1: Analysis for Ground Level Portion of Mixed Mode Source

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Radwaste building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0003	.0000	.0006	.0000	.0000	.0000	.0000	.0010	13.47
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0003	10.95
NE	.0000	.0000	.0000	.0001	.0003	.0003	.0002	.0003	.0001	.0000	.0000	.0000	.0013	12.18
ENE	.0000	.0000	.0000	.0003	.0003	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0012	8.74
E	.0000	.0000	.0000	.0001	.0001	.0001	.0004	.0000	.0001	.0000	.0000	.0000	.0009	11.35
ESE	.0000	.0000	.0000	.0001	.0003	.0006	.0007	.0000	.0000	.0000	.0000	.0000	.0018	10.61
SE	.0000	.0000	.0000	.0003	.0010	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0021	8.43
SSE	.0000	.0000	.0000	.0002	.0006	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0015	9.18
S	.0000	.0000	.0000	.0002	.0003	.0009	.0012	.0005	.0000	.0000	.0000	.0000	.0031	11.64
SSW	.0000	.0000	.0000	.0002	.0002	.0005	.0010	.0006	.0000	.0000	.0000	.0000	.0025	12.09
SW	.0000	.0000	.0000	.0000	.0003	.0003	.0013	.0011	.0000	.0000	.0000	.0000	.0030	13.40
WSW	.0000	.0000	.0000	.0001	.0001	.0003	.0013	.0008	.0000	.0000	.0000	.0000	.0026	13.15
W	.0000	.0000	.0000	.0001	.0002	.0003	.0004	.0003	.0000	.0000	.0000	.0000	.0013	11.51
WNW	.0000	.0000	.0000	.0000	.0001	.0002	.0004	.0003	.0000	.0000	.0000	.0000	.0010	12.74
NW	.0000	.0000	.0000	.0000	.0002	.0002	.0005	.0006	.0001	.0000	.0000	.0000	.0016	13.42
NNW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0004	.0000	.0000	.0000	.0000	.0008	13.49
TOTAL	.0000	.0000	.0001	.0019	.0044	.0053	.0081	.0057	.0003	.0000	.0000	.0000	.0258	11.72

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0005	14.69
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0001	.0000	.0000	.0000	.0003	13.35
NE	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0004	10.77
ENE	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0001	.0001	.0000	.0000	.0000	.0004	13.44
E	.0000	.0000	.0000	.0000	.0001	.0002	.0002	.0005	.0000	.0000	.0000	.0000	.0010	13.59
ESE	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0004	11.10
SE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	8.48
SSE	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0002	9.79
S	.0000	.0000	.0000	.0001	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0006	10.21
SSW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0001	.0000	.0000	.0000	.0000	.0005	11.71
SW	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0003	12.24
WSW	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0004	.0000	.0000	.0000	.0000	.0007	14.19
W	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0002	13.72
WNW	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0001	.0001	.0000	.0000	.0000	.0005	14.75
NW	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.02
NNW	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0008	.0001	.0000	.0000	.0000	.0014	15.27
TOTAL	.0000	.0000	.0001	.0003	.0009	.0014	.0022	.0025	.0004	.0000	.0000	.0000	.0078	13.01

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0001	.0000	.0000	.0000	.0004	13.93
NNE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	7.99
NE	.0000	.0000	.0000	.0000	.0000	.0002	.0003	.0000	.0000	.0000	.0000	.0000	.0005	11.24
ENE	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.39
E	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0007	14.15
ESE	.0000	.0000	.0000	.0000	.0000	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0004	11.74
SE	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.04
SSE	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.04
S	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0003	9.06
SSW	.0000	.0000	.0000	.0000	.0001	.0001	.0006	.0001	.0000	.0000	.0000	.0000	.0010	12.46
SW	.0000	.0000	.0000	.0001	.0001	.0002	.0006	.0005	.0003	.0000	.0000	.0000	.0017	14.73
WSW	.0000	.0000	.0000	.0000	.0000	.0001	.0006	.0001	.0000	.0000	.0000	.0000	.0009	12.86
W	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0003	9.52
WNW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0005	.0003	.0000	.0000	.0000	.0012	15.89
NW	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0001	.0003	.0001	.0000	.0000	.0007	17.46
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0000	.0000	.0000	.0000	.0006	14.84
TOTAL	.0000	.0000	.0000	.0004	.0009	.0016	.0028	.0023	.0010	.0001	.0000	.0000	.0092	13.45

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0002	.0005	.0008	.0015	.0005	.0000	.0000	.0000	.0000	.0035	11.47
NNE	.0000	.0000	.0000	.0003	.0003	.0008	.0023	.0013	.0003	.0000	.0000	.0000	.0052	13.10
NE	.0000	.0000	.0000	.0004	.0010	.0017	.0020	.0011	.0001	.0000	.0000	.0000	.0063	11.57
ENE	.0000	.0000	.0000	.0004	.0014	.0021	.0027	.0040	.0009	.0001	.0000	.0000	.0116	13.52
E	.0000	.0000	.0001	.0002	.0006	.0010	.0027	.0029	.0009	.0000	.0000	.0000	.0084	14.04
ESE	.0000	.0000	.0000	.0002	.0007	.0015	.0023	.0013	.0006	.0000	.0000	.0000	.0066	12.83
SE	.0000	.0000	.0001	.0005	.0014	.0012	.0016	.0006	.0000	.0000	.0000	.0000	.0056	10.64
SSE	.0000	.0000	.0000	.0003	.0010	.0008	.0003	.0004	.0001	.0000	.0000	.0000	.0030	10.13
S	.0000	.0000	.0001	.0004	.0005	.0016	.0019	.0000	.0000	.0000	.0000	.0000	.0046	10.56
SSW	.0000	.0000	.0000	.0003	.0005	.0020	.0040	.0024	.0010	.0000	.0000	.0000	.0103	13.50
SW	.0000	.0000	.0000	.0002	.0007	.0013	.0032	.0024	.0015	.0000	.0000	.0000	.0094	14.13
WSW	.0000	.0000	.0000	.0003	.0009	.0017	.0040	.0045	.0018	.0001	.0000	.0000	.0134	14.42
W	.0000	.0000	.0000	.0004	.0012	.0019	.0032	.0033	.0006	.0003	.0000	.0000	.0109	13.45
WNW	.0000	.0000	.0001	.0004	.0006	.0017	.0044	.0028	.0009	.0001	.0000	.0000	.0110	13.61
NW	.0000	.0000	.0001	.0003	.0004	.0023	.0041	.0023	.0009	.0000	.0000	.0000	.0104	13.27
NNW	.0000	.0000	.0000	.0002	.0004	.0013	.0032	.0019	.0000	.0000	.0000	.0000	.0070	12.85
TOTAL	.0000	.0000	.0008	.0049	.0120	.0239	.0436	.0319	.0096	.0006	.0000	.0000	.1273	13.12

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0002	.0004	.0008	.0015	.0021	.0005	.0000	.0000	.0000	.0000	.0055	10.80
NNE	.0000	.0000	.0001	.0005	.0006	.0014	.0024	.0010	.0000	.0000	.0000	.0000	.0000	11.59
NE	.0000	.0000	.0001	.0003	.0007	.0020	.0028	.0009	.0006	.0001	.0000	.0000	.0070	12.44
ENE	.0000	.0000	.0001	.0006	.0007	.0014	.0014	.0015	.0008	.0000	.0000	.0000	.0066	12.62
E	.0000	.0000	.0001	.0003	.0004	.0014	.0010	.0009	.0001	.0000	.0000	.0000	.0042	11.60
ESE	.0000	.0000	.0000	.0004	.0008	.0022	.0020	.0016	.0008	.0000	.0000	.0000	.0078	12.74
SE	.0000	.0000	.0001	.0005	.0013	.0028	.0019	.0010	.0001	.0000	.0000	.0000	.0078	10.83
SSE	.0000	.0000	.0002	.0006	.0014	.0033	.0042	.0005	.0000	.0000	.0000	.0000	.0102	10.81
S	.0000	.0000	.0002	.0007	.0016	.0039	.0033	.0011	.0005	.0000	.0000	.0000	.0113	11.26
SSW	.0000	.0000	.0002	.0007	.0022	.0077	.0106	.0025	.0006	.0000	.0000	.0000	.0244	11.83
SW	.0000	.0000	.0003	.0010	.0018	.0069	.0079	.0031	.0008	.0014	.0000	.0000	.0231	12.85
WSW	.0000	.0000	.0003	.0012	.0020	.0066	.0073	.0039	.0004	.0000	.0000	.0000	.0217	11.80
W	.0000	.0000	.0002	.0011	.0012	.0050	.0021	.0004	.0003	.0000	.0000	.0000	.0103	10.24
WNW	.0000	.0000	.0003	.0008	.0009	.0032	.0023	.0026	.0008	.0000	.0000	.0000	.0109	12.29
NW	.0000	.0000	.0002	.0008	.0010	.0022	.0023	.0011	.0000	.0000	.0000	.0000	.0076	10.86
NNW	.0000	.0000	.0002	.0006	.0006	.0014	.0015	.0010	.0000	.0000	.0000	.0000	.0053	10.90
TOTAL	.0000	.0000	.0030	.0107	.0179	.0529	.0550	.0236	.0058	.0015	.0000	.0000	.1704	11.73

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0002	.0007	.0002	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0014	6.33
NNE	.0000	.0000	.0002	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0007	6.10
NE	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	5.80
ENE	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	6.43
E	.0000	.0000	.0000	.0001	.0002	.0011	.0005	.0003	.0000	.0000	.0000	.0000	.0022	11.08
ESE	.0000	.0000	.0001	.0001	.0004	.0030	.0011	.0000	.0001	.0000	.0000	.0000	.0048	10.47
SE	.0000	.0000	.0000	.0003	.0002	.0013	.0006	.0001	.0000	.0000	.0000	.0000	.0025	10.21
SSE	.0000	.0000	.0001	.0003	.0006	.0016	.0001	.0006	.0001	.0001	.0000	.0000	.0035	11.03
S	.0000	.0000	.0001	.0003	.0004	.0012	.0014	.0005	.0003	.0000	.0000	.0000	.0042	11.87
SSW	.0000	.0000	.0002	.0004	.0008	.0035	.0023	.0010	.0005	.0000	.0000	.0000	.0007	11.62
SW	.0000	.0000	.0003	.0004	.0003	.0016	.0004	.0008	.0000	.0000	.0000	.0000	.0038	10.47
WSW	.0000	.0000	.0004	.0005	.0001	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0015	7.11
W	.0000	.0000	.0004	.0005	.0002	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.04
WNW	.0000	.0000	.0005	.0004	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0012	5.73
NW	.0000	.0000	.0003	.0005	.0003	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0016	6.94
NNW	.0000	.0000	.0003	.0002	.0003	.0003	.0005	.0001	.0000	.0000	.0000	.0000	.0017	9.05
TOTAL	.0000	.0000	.0032	.0052	.0043	.0150	.0072	.0035	.0010	.0001	.0000	.0000	.0395	10.05

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0004	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	5.07
NNE	.0000	.0000	.0001	.0002	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0004	6.90
NE	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	5.56
ENE	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.96
E	.0000	.0000	.0000	.0001	.0002	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0007	10.01
ESE	.0000	.0000	.0000	.0001	.0003	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0015	9.08
SE	.0000	.0000	.0001	.0002	.0004	.0005	.0000	.0000	.0001	.0000	.0000	.0000	.0012	9.08
SSE	.0000	.0000	.0001	.0002	.0003	.0010	.0004	.0000	.0000	.0000	.0000	.0000	.0021	9.45
S	.0000	.0000	.0001	.0001	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0006	9.62
SSW	.0000	.0000	.0000	.0001	.0002	.0009	.0006	.0001	.0000	.0000	.0000	.0000	.0019	10.79
SW	.0000	.0000	.0002	.0001	.0001	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0012	9.28
WSW	.0000	.0000	.0002	.0002	.0001	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0009	7.07
W	.0000	.0000	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006	4.42
WNW	.0000	.0000	.0004	.0002	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0010	6.00
NW	.0000	.0000	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007	4.48
NNW	.0000	.0000	.0004	.0002	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0008	5.94
TOTAL	.0000	.0000	.0028	.0025	.0022	.0048	.0021	.0002	.0001	.0000	.0000	.0000	.0147	8.21

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSES FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

APPENDIX D

Part D-2: Analysis for Elevated Portion of Mixed Mode Source

a) Wind speed at 44.50 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Radwaste building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0000	.0004	.0004	.0010	.0000	.0000	.0000	.0000	.0000	.0019	10.09
NNE	.0000	.0000	.0003	.0000	.0004	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0011	7.87
NE	.0000	.0000	.0001	.0000	.0005	.0012	.0012	.0002	.0000	.0000	.0000	.0000	.0032	10.17
ENE	.0000	.0000	.0003	.0000	.0018	.0017	.0016	.0001	.0000	.0000	.0000	.0000	.0055	9.20
E	.0000	.0001	.0013	.0000	.0008	.0007	.0005	.0002	.0000	.0000	.0000	.0000	.0035	7.58
ESE	.0000	.0001	.0006	.0000	.0004	.0013	.0023	.0004	.0000	.0000	.0000	.0000	.0052	10.28
SE	.0000	.0001	.0003	.0000	.0023	.0050	.0020	.0002	.0000	.0000	.0000	.0000	.0098	9.19
SSE	.0000	.0000	.0003	.0000	.0014	.0029	.0016	.0001	.0000	.0000	.0000	.0000	.0003	9.36
S	.0000	.0001	.0005	.0000	.0012	.0017	.0035	.0007	.0000	.0000	.0000	.0000	.0077	10.50
SSW	.0000	.0000	.0004	.0000	.0014	.0012	.0020	.0006	.0000	.0000	.0000	.0000	.0056	10.14
SW	.0000	.0000	.0001	.0000	.0004	.0012	.0011	.0008	.0000	.0000	.0000	.0000	.0036	11.35
WSW	.0000	.0000	.0003	.0000	.0007	.0007	.0011	.0008	.0000	.0000	.0000	.0000	.0036	10.86
W	.0000	.0000	.0001	.0000	.0009	.0011	.0010	.0002	.0000	.0000	.0000	.0000	.0033	9.89
WNW	.0000	.0000	.0003	.0000	.0000	.0007	.0006	.0002	.0000	.0000	.0000	.0000	.0018	10.40
NW	.0000	.0004	.0006	.0000	.0003	.0012	.0006	.0003	.0000	.0000	.0000	.0000	.0034	8.53
NNW	.0000	.0000	.0001	.0000	.0004	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0012	9.60
TOTAL	.0000	.0009	.0055	.0000	.0131	.0214	.0206	.0050	.0000	.0000	.0000	.0000	.0667	9.74

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0003	12.55
NNE	.0000	.0000	.0000	.0001	.0000	.0002	.0005	.0000	.0000	.0000	.0000	.0000	.0008	11.03
NE	.0000	.0000	.0000	.0000	.0003	.0002	.0005	.0001	.0000	.0000	.0000	.0000	.0011	11.14
ENE	.0000	.0000	.0000	.0003	.0003	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0011	8.30
E	.0000	.0000	.0000	.0001	.0000	.0004	.0008	.0001	.0000	.0000	.0000	.0000	.0014	11.69
ESE	.0000	.0000	.0000	.0000	.0001	.0007	.0003	.0000	.0000	.0000	.0000	.0000	.0011	10.68
SE	.0000	.0000	.0000	.0001	.0003	.0002	.0005	.0000	.0000	.0000	.0000	.0000	.0011	10.09
SSE	.0000	.0000	.0000	.0001	.0001	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0008	10.07
S	.0000	.0000	.0000	.0000	.0007	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0015	9.61
SSW	.0000	.0000	.0000	.0001	.0003	.0003	.0004	.0001	.0000	.0000	.0000	.0000	.0012	10.37
SW	.0000	.0000	.0000	.0001	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0003	10.82
WSW	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0001	.0000	.0000	.0000	.0000	.0007	12.32
W	.0000	.0000	.0000	.0001	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0003	9.61
WNW	.0000	.0000	.0000	.0003	.0000	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0006	9.55
NW	.0000	.0000	.0000	.0001	.0000	.0002	.0004	.0000	.0000	.0000	.0000	.0000	.0007	10.82
NNW	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0001	.0000	.0000	.0000	.0000	.0006	12.61
TOTAL	.0000	.0000	.0000	.0013	.0021	.0040	.0053	.0009	.0000	.0000	.0000	.0000	.0136	10.57

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0001	.0001	.0001	.0002	.0001	.0000	.0000	.0000	.0000	.0006	10.85
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0002	9.85
NE	.0000	.0000	.0000	.0000	.0003	.0001	.0006	.0001	.0000	.0000	.0000	.0000	.0011	11.74
ENE	.0000	.0000	.0000	.0000	.0000	.0002	.0006	.0000	.0000	.0000	.0000	.0000	.0009	12.06
E	.0000	.0000	.0000	.0003	.0001	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0010	8.06
ESE	.0000	.0000	.0000	.0001	.0003	.0000	.0006	.0000	.0000	.0000	.0000	.0000	.0010	10.79
SE	.0000	.0001	.0000	.0000	.0004	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0010	8.12
SSE	.0000	.0000	.0000	.0000	.0003	.0008	.0000	.0000	.0000	.0000	.0000	.0000	.0012	8.90
S	.0000	.0000	.0000	.0003	.0004	.0002	.0004	.0000	.0000	.0000	.0000	.0000	.0014	8.91
SSW	.0000	.0000	.0000	.0000	.0000	.0004	.0005	.0003	.0000	.0000	.0000	.0000	.0011	12.69
SW	.0000	.0000	.0000	.0000	.0004	.0002	.0006	.0002	.0000	.0000	.0000	.0000	.0015	11.39
WSW	.0000	.0000	.0000	.0000	.0001	.0000	.0005	.0003	.0000	.0000	.0000	.0000	.0008	13.58
W	.0000	.0000	.0000	.0003	.0001	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0012	9.53
WNW	.0000	.0000	.0000	.0000	.0001	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0008	11.48
NW	.0000	.0000	.0000	.0000	.0000	.0002	.0007	.0000	.0000	.0000	.0000	.0000	.0010	12.13
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0004	12.61
TOTAL	.0000	.0001	.0000	.0011	.0027	.0044	.0060	.0012	.0000	.0000	.0000	.0000	.0154	10.67

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0003	.0000	.0009	.0011	.0024	.0021	.0003	.0000	.0000	.0000	.0000	.0071	10.19
NNE	.0000	.0001	.0000	.0004	.0020	.0012	.0020	.0005	.0000	.0000	.0000	.0000	.0063	10.68
NE	.0000	.0003	.0000	.0006	.0022	.0045	.0046	.0005	.0000	.0000	.0000	.0000	.0127	10.85
ENE	.0000	.0001	.0000	.0006	.0021	.0060	.0055	.0007	.0000	.0000	.0000	.0000	.0150	11.18
E	.0000	.0000	.0000	.0014	.0013	.0028	.0025	.0007	.0000	.0000	.0000	.0000	.0087	10.51
ESE	.0000	.0005	.0000	.0010	.0013	.0031	.0041	.0005	.0000	.0000	.0000	.0000	.0105	10.74
SE	.0000	.0004	.0000	.0017	.0033	.0062	.0031	.0004	.0000	.0000	.0000	.0000	.0151	9.72
SSE	.0000	.0001	.0000	.0006	.0021	.0046	.0021	.0001	.0000	.0000	.0000	.0000	.0095	10.06
S	.0000	.0001	.0000	.0014	.0021	.0020	.0047	.0005	.0000	.0000	.0000	.0000	.0109	10.72
SSW	.0000	.0003	.0000	.0005	.0017	.0023	.0054	.0010	.0000	.0000	.0000	.0000	.0111	11.67
SW	.0000	.0004	.0000	.0009	.0014	.0029	.0036	.0008	.0000	.0000	.0000	.0000	.0099	10.88
WSW	.0000	.0001	.0000	.0010	.0017	.0039	.0046	.0010	.0000	.0000	.0000	.0000	.0122	11.24
W	.0000	.0001	.0000	.0009	.0024	.0053	.0050	.0008	.0000	.0000	.0000	.0000	.0145	11.00
WNW	.0000	.0006	.0000	.0012	.0022	.0025	.0046	.0011	.0000	.0000	.0000	.0000	.0122	10.73
NW	.0000	.0005	.0000	.0012	.0021	.0020	.0060	.0010	.0000	.0000	.0000	.0000	.0128	11.15
NNW	.0000	.0004	.0000	.0009	.0011	.0017	.0033	.0008	.0000	.0000	.0000	.0000	.0082	11.01
TOTAL	.0000	.0043	.0000	.0149	.0302	.0535	.0632	.0105	.0000	.0000	.0000	.0000	.1766	10.79

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0001	.0000	.0023	.0022	.0033	.0000	.0016	.0000	.0000	.0000	.0000	.0095	9.74
NNE	.0000	.0008	.0000	.0013	.0025	.0025	.0000	.0014	.0001	.0000	.0000	.0000	.0086	9.37
NE	.0000	.0003	.0000	.0019	.0018	.0027	.0000	.0021	.0001	.0000	.0000	.0000	.0088	10.10
ENE	.0000	.0008	.0000	.0019	.0033	.0029	.0000	.0015	.0000	.0000	.0000	.0000	.0103	9.15
E	.0000	.0003	.0000	.0013	.0018	.0016	.0000	.0015	.0000	.0000	.0000	.0000	.0065	9.76
ESE	.0000	.0004	.0000	.0005	.0020	.0031	.0000	.0023	.0000	.0000	.0000	.0000	.0063	10.91
SE	.0000	.0003	.0000	.0019	.0029	.0056	.0000	.0028	.0000	.0000	.0000	.0000	.0134	10.46
SSE	.0000	.0003	.0000	.0022	.0035	.0059	.0000	.0033	.0001	.0000	.0000	.0000	.0153	10.47
S	.0000	.0008	.0000	.0019	.0041	.0067	.0000	.0039	.0001	.0000	.0000	.0000	.0175	10.44
SSW	.0000	.0008	.0000	.0019	.0041	.0089	.0000	.0078	.0002	.0000	.0000	.0000	.0238	11.35
SW	.0000	.0013	.0000	.0035	.0054	.0072	.0000	.0069	.0002	.0000	.0000	.0000	.0246	10.46
WSW	.0000	.0006	.0000	.0040	.0068	.0081	.0000	.0066	.0002	.0000	.0000	.0000	.0263	10.45
W	.0000	.0011	.0000	.0031	.0058	.0052	.0000	.0051	.0000	.0000	.0000	.0000	.0203	10.04
WNW	.0000	.0013	.0000	.0040	.0042	.0036	.0000	.0032	.0001	.0000	.0000	.0000	.0164	9.15
NW	.0000	.0005	.0000	.0031	.0043	.0040	.0000	.0022	.0001	.0000	.0000	.0000	.0142	9.42
NNW	.0000	.0010	.0000	.0026	.0034	.0027	.0000	.0014	.0000	.0000	.0000	.0000	.0111	8.69
TOTAL	.0000	.0107	.0000	.0372	.0579	.0741	.0000	.0536	.0013	.0000	.0000	.0000	.2348	10.13

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0004	.0017	.0000	.0031	.0004	.0000	.0000	.0000	.0000	.0000	.0056	8.89
NNE	.0000	.0000	.0004	.0011	.0000	.0013	.0003	.0000	.0000	.0000	.0000	.0000	.0032	8.38
NE	.0000	.0000	.0003	.0001	.0000	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0009	7.55
ENE	.0000	.0000	.0001	.0004	.0000	.0003	.0004	.0000	.0000	.0000	.0000	.0000	.0012	9.76
E	.0000	.0000	.0003	.0003	.0000	.0003	.0004	.0000	.0002	.0000	.0000	.0000	.0015	9.93
ESE	.0000	.0000	.0000	.0004	.0000	.0007	.0010	.0000	.0004	.0000	.0000	.0000	.0025	12.35
SE	.0000	.0000	.0000	.0004	.0000	.0012	.0003	.0000	.0002	.0000	.0000	.0000	.0021	10.89
SSE	.0000	.0000	.0005	.0007	.0000	.0013	.0013	.0000	.0002	.0000	.0000	.0000	.0040	10.27
S	.0000	.0000	.0005	.0007	.0000	.0012	.0009	.0000	.0002	.0000	.0000	.0000	.0035	9.73
SSW	.0000	.0000	.0003	.0012	.0000	.0019	.0016	.0000	.0005	.0000	.0000	.0000	.0055	10.79
SW	.0000	.0000	.0001	.0026	.0000	.0017	.0006	.0000	.0002	.0000	.0000	.0000	.0052	9.01
WSW	.0000	.0000	.0006	.0032	.0000	.0023	.0002	.0000	.0000	.0000	.0000	.0000	.0063	7.80
W	.0000	.0000	.0003	.0030	.0000	.0023	.0003	.0000	.0000	.0000	.0000	.0000	.0060	8.23
WNW	.0000	.0000	.0003	.0041	.0000	.0017	.0002	.0000	.0000	.0000	.0000	.0000	.0063	7.59
NW	.0000	.0000	.0009	.0023	.0000	.0025	.0005	.0000	.0000	.0000	.0000	.0000	.0062	8.16
NNW	.0000	.0000	.0005	.0026	.0000	.0009	.0005	.0000	.0000	.0000	.0000	.0000	.0045	7.81
TOTAL	.0000	.0000	.0055	.0247	.0000	.0231	.0092	.0000	.0020	.0000	.0000	.0000	.0645	8.94

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0001	.0000	.0027	.0012	.0003	.0000	.0000	.0000	.0000	.0000	.0044	8.23
NNE	.0000	.0000	.0003	.0000	.0008	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0020	7.94
NE	.0000	.0000	.0003	.0000	.0003	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0006	5.62
ENE	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0004	12.28
E	.0000	.0000	.0000	.0000	.0001	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0007	11.76
ESE	.0000	.0000	.0003	.0000	.0003	.0002	.0006	.0000	.0001	.0000	.0000	.0000	.0014	10.13
SE	.0000	.0000	.0001	.0000	.0005	.0007	.0006	.0000	.0000	.0000	.0000	.0000	.0020	10.45
SSE	.0000	.0000	.0001	.0000	.0007	.0008	.0006	.0000	.0001	.0000	.0000	.0000	.0022	10.21
S	.0000	.0000	.0003	.0000	.0005	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0013	7.71
SSW	.0000	.0000	.0004	.0000	.0003	.0003	.0002	.0000	.0001	.0000	.0000	.0000	.0013	8.56
SW	.0000	.0000	.0000	.0000	.0016	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0021	8.11
WSW	.0000	.0000	.0001	.0000	.0017	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0029	8.36
W	.0000	.0000	.0000	.0000	.0022	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0033	8.01
WNW	.0000	.0000	.0011	.0000	.0031	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0053	6.80
NW	.0000	.0000	.0005	.0000	.0025	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0045	7.52
NNW	.0000	.0000	.0005	.0000	.0030	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0046	7.27
TOTAL	.0000	.0000	.0041	.0000	.0202	.0109	.0036	.0000	.0003	.0000	.0000	.0000	.0391	8.17

PERIOD OF RECORD: 6/1/74 – 5/31/75

ANALYSIS FOR ELEVATED PORTION OF SPLIT-H SOURCE

APPENDIX D

Part 2: Mixed Mode Joint Frequency Distribution of Grazing Period Data Base for the Radwaste Building Source

6/01/74 - 10/15/74

and

4/15/75 - 05/31/75

APPENDIX D

Part D-3: Analysis for Ground Level Portion of Mixed Mode Source

a) Wind speed at 10 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Radwaste building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode".

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0005	8.66
NNE	.0000	.0000	.0000	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.21
NE	.0000	.0000	.0000	.0001	.0005	.0006	.0005	.0003	.0003	.0000	.0000	.0000	.0023	12.21
ENE	.0000	.0000	.0000	.0004	.0006	.0007	.0003	.0000	.0000	.0000	.0000	.0000	.0020	8.83
E	.0000	.0000	.0000	.0001	.0002	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0008	8.98
ESE	.0000	.0000	.0000	.0001	.0006	.0011	.0012	.0000	.0000	.0000	.0000	.0000	.0030	10.57
SE	.0000	.0000	.0000	.0006	.0019	.0010	.0003	.0000	.0000	.0000	.0000	.0000	.0038	8.28
SSE	.0000	.0000	.0000	.0003	.0011	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0022	8.39
S	.0000	.0000	.0000	.0003	.0006	.0017	.0022	.0010	.0000	.0000	.0000	.0000	.0059	11.70
SSW	.0000	.0000	.0000	.0004	.0004	.0007	.0009	.0013	.0000	.0000	.0000	.0000	.0038	12.15
SW	.0000	.0000	.0000	.0001	.0002	.0003	.0015	.0013	.0000	.0000	.0000	.0000	.0034	13.55
WSW	.0000	.0000	.0000	.0000	.0002	.0004	.0025	.0010	.0000	.0000	.0000	.0000	.0042	13.16
W	.0000	.0000	.0000	.0001	.0003	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0012	10.18
WNW	.0000	.0000	.0000	.0000	.0002	.0003	.0006	.0000	.0000	.0000	.0000	.0000	.0011	11.22
NW	.0000	.0000	.0000	.0001	.0004	.0001	.0005	.0000	.0000	.0000	.0000	.0000	.0011	10.01
NNW	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.93
TOTAL	.0000	.0000	.0002	.0028	.0076	.0086	.0115	.0049	.0003	.0000	.0000	.0000	.0359	11.03

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0006	15.63
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	8.56
NE	.0000	.0000	.0000	.0001	.0000	.0002	.0004	.0000	.0000	.0000	.0000	.0000	.0006	11.23
ENE	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	5.20
E	.0000	.0000	.0000	.0000	.0001	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0005	9.38
ESE	.0000	.0000	.0000	.0000	.0002	.0002	.0002	.0003	.0000	.0000	.0000	.0000	.0009	12.20
SE	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.39
SSE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	8.19
S	.0000	.0000	.0000	.0002	.0002	.0001	.0006	.0000	.0000	.0000	.0000	.0000	.0010	10.51
SSW	.0000	.0000	.0000	.0001	.0001	.0002	.0004	.0003	.0000	.0000	.0000	.0000	.0009	12.75
SW	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	8.38
WSW	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	10.00
W	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	6.81
WNW	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0003	11.73
NW	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0003	9.04
NNW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0004	11.16
TOTAL	.0000	.0000	.0001	.0005	.0011	.0018	.0019	.0011	.0000	.0000	.0000	.0000	.0065	11.18

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0000	.0004	.0000	.0003	.0000	.0000	.0000	.0007	15.83
NNE	.0000	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002	7.99
NE	.0000	.0000	.0000	.0000	.0001	.0002	.0004	.0000	.0000	.0000	.0000	.0000	.0006	11.51
ENE	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	10.00
E	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	3.50
ESE	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0003	.0000	.0000	.0000	.0000	.0008	13.03
SE	.0000	.0001	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	6.53
SSE	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	7.05
S	.0000	.0000	.0000	.0001	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0004	7.91
SSW	.0000	.0000	.0000	.0000	.0001	.0002	.0009	.0000	.0000	.0000	.0000	.0000	.0012	11.96
SW	.0000	.0000	.0000	.0001	.0000	.0002	.0006	.0000	.0000	.0000	.0000	.0000	.0009	11.39
WSW	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0004	11.69
W	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0004	8.24
WNW	.0000	.0000	.0000	.0000	.0001	.0001	.0002	.0005	.0000	.0000	.0000	.0000	.0009	14.25
NW	.0000	.0000	.0000	.0000	.0001	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0003	9.13
NNW	.0000	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	10.00
TOTAL	.0000	.0000	.0001	.0006	.0011	.0018	.0028	.0008	.0003	.0000	.0000	.0000	.0074	11.52

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0001	.0002	.0010	.0008	.0003	.0000	.0000	.0000	.0000	.0025	11.18
NNE	.0000	.0000	.0000	.0003	.0004	.0007	.0015	.0015	.0000	.0000	.0000	.0000	.0043	12.73
NE	.0000	.0000	.0000	.0004	.0003	.0018	.0010	.0005	.0000	.0000	.0000	.0000	.0045	10.59
ENE	.0000	.0000	.0000	.0004	.0012	.0014	.0006	.0000	.0000	.0000	.0000	.0000	.0036	9.24
E	.0000	.0000	.0000	.0003	.0006	.0012	.0015	.0008	.0000	.0000	.0000	.0000	.0043	11.52
ESE	.0000	.0000	.0000	.0003	.0008	.0021	.0019	.0008	.0000	.0000	.0000	.0000	.0058	11.24
SE	.0000	.0000	.0001	.0007	.0022	.0014	.0010	.0005	.0000	.0000	.0000	.0000	.0060	9.52
SSE	.0000	.0000	.0001	.0004	.0018	.0012	.0000	.0000	.0003	.0000	.0000	.0000	.0038	9.05
S	.0000	.0000	.0001	.0004	.0006	.0023	.0016	.0000	.0000	.0000	.0000	.0000	.0050	10.15
SSW	.0000	.0000	.0000	.0004	.0007	.0024	.0041	.0008	.0000	.0000	.0000	.0000	.0083	11.70
SW	.0000	.0000	.0000	.0002	.0008	.0011	.0010	.0013	.0010	.0000	.0000	.0000	.0055	13.56
WSW	.0000	.0000	.0000	.0002	.0004	.0004	.0015	.0028	.0000	.0000	.0000	.0000	.0053	13.87
W	.0000	.0000	.0001	.0001	.0003	.0005	.0010	.0005	.0000	.0000	.0000	.0000	.0025	11.92
WNW	.0000	.0000	.0000	.0003	.0005	.0008	.0029	.0005	.0000	.0000	.0000	.0000	.0050	11.85
NW	.0000	.0000	.0000	.0002	.0003	.0011	.0031	.0000	.0000	.0000	.0000	.0000	.0047	11.56
NNW	.0000	.0000	.0000	.0002	.0003	.0012	.0012	.0003	.0000	.0000	.0000	.0000	.0033	11.12
TOTAL	.0000	.0000	.0007	.0048	.0117	.0206	.0247	.0106	.0013	.0000	.0000	.0000	.0745	11.37

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0002	.0003	.0007	.0015	.0018	.0003	.0000	.0000	.0000	.0000	.0048	10.60
NNE	.0000	.0000	.0001	.0006	.0009	.0025	.0030	.0018	.0000	.0000	.0000	.0000	.0090	11.69
NE	.0000	.0000	.0001	.0004	.0010	.0029	.0037	.0003	.0000	.0000	.0000	.0000	.0084	10.96
ENE	.0000	.0000	.0001	.0006	.0008	.0018	.0000	.0000	.0000	.0000	.0000	.0000	.0034	8.26
E	.0000	.0000	.0001	.0004	.0005	.0012	.0013	.0005	.0003	.0000	.0000	.0000	.0044	11.39
ESE	.0000	.0000	.0000	.0004	.0011	.0032	.0010	.0010	.0000	.0000	.0000	.0000	.0066	10.73
SE	.0000	.0000	.0001	.0005	.0018	.0037	.0015	.0005	.0000	.0000	.0000	.0000	.0081	10.00
SSE	.0000	.0000	.0001	.0007	.0022	.0049	.0052	.0005	.0000	.0000	.0000	.0000	.0136	10.69
S	.0000	.0000	.0002	.0008	.0024	.0043	.0047	.0018	.0008	.0000	.0000	.0000	.0150	11.58
SSW	.0000	.0000	.0001	.0008	.0020	.0081	.0137	.0031	.0005	.0000	.0000	.0000	.0284	12.01
SW	.0000	.0000	.0003	.0010	.0015	.0049	.0090	.0046	.0005	.0003	.0000	.0000	.0221	12.60
WSW	.0000	.0000	.0003	.0009	.0016	.0057	.0042	.0018	.0000	.0000	.0000	.0000	.0145	11.00
W	.0000	.0000	.0003	.0008	.0012	.0042	.0020	.0008	.0003	.0000	.0000	.0000	.0095	10.64
WNW	.0000	.0000	.0002	.0007	.0008	.0015	.0015	.0003	.0000	.0000	.0000	.0000	.0050	9.98
NW	.0000	.0000	.0002	.0008	.0006	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0029	8.60
NNW	.0000	.0000	.0002	.0007	.0008	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0024	7.41
TOTAL	.0000	.0000	.0027	.0104	.0202	.0516	.0532	.0173	.0024	.0003	.0000	.0000	.1581	11.19

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0003	.0011	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0023	6.44
NNE	.0000	.0000	.0003	.0005	.0003	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0013	6.40
NE	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.04
ENE	.0000	.0000	.0001	.0001	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005	6.39
E	.0000	.0000	.0000	.0001	.0002	.0018	.0008	.0005	.0000	.0000	.0000	.0000	.0033	11.38
ESE	.0000	.0000	.0000	.0002	.0004	.0051	.0020	.0000	.0000	.0000	.0000	.0000	.0077	10.51
SE	.0000	.0000	.0000	.0002	.0003	.0022	.0010	.0000	.0000	.0000	.0000	.0000	.0037	10.36
SSE	.0000	.0000	.0001	.0002	.0008	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0034	9.20
S	.0000	.0000	.0001	.0002	.0004	.0009	.0013	.0010	.0000	.0000	.0000	.0000	.0039	12.00
SSW	.0000	.0000	.0002	.0005	.0009	.0008	.0020	.0020	.0005	.0000	.0000	.0000	.0078	12.39
SW	.0000	.0000	.0003	.0005	.0004	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0019	7.78
WSW	.0000	.0000	.0005	.0006	.0002	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0020	7.31
W	.0000	.0000	.0004	.0007	.0002	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0017	6.36
WNW	.0000	.0000	.0006	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012	4.74
NW	.0000	.0000	.0004	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	4.86
NNW	.0000	.0000	.0004	.0004	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	5.42
TOTAL	.0000	.0000	.0038	.0062	.0052	.0158	.0080	.0035	.0005	.0000	.0000	.0000	.0429	9.70

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0007	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016	5.03
NNE	.0000	.0000	.0002	.0003	.0001	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0009	7.88
NE	.0000	.0000	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.12
ENE	.0000	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	6.85
E	.0000	.0000	.0000	.0001	.0004	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0013	10.04
ESE	.0000	.0000	.0000	.0001	.0001	.0009	.0000	.0000	.0000	.0000	.0000	.0000	.0011	9.32
SE	.0000	.0000	.0002	.0000	.0000	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0006	8.36
SSE	.0000	.0000	.0001	.0001	.0003	.0009	.0005	.0000	.0000	.0000	.0000	.0000	.0019	9.95
S	.0000	.0000	.0001	.0000	.0001	.0003	.0005	.0000	.0000	.0000	.0000	.0000	.0010	10.41
SSW	.0000	.0000	.0000	.0001	.0001	.0007	.0008	.0003	.0000	.0000	.0000	.0000	.0021	11.47
SW	.0000	.0000	.0004	.0001	.0002	.0005	.0008	.0000	.0000	.0000	.0000	.0000	.0019	9.51
WSW	.0000	.0000	.0002	.0003	.0002	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0015	7.65
W	.0000	.0000	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	4.53
WNW	.0000	.0000	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008	4.09
NW	.0000	.0000	.0005	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010	4.44
NNW	.0000	.0000	.0006	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009	4.23
TOTAL	.0000	.0000	.0041	.0032	.0021	.0049	.0034	.0003	.0000	.0000	.0000	.0000	.0179	8.11

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSIS FOR GROUND LEVEL PORTION OF SPLIT-H SOURCE

APPENDIX D

Part D-4: Analysis for Elevated Portion of Mixed Mode Source

a) Wind speed at 44.50 meters

b) Wind direction at 10 meters

c) Delta temperature between 10 and 60 meters

d) Radwaste building source

Note: In the tables of computer printout the term, "Split-H", should be replaced by the term, "mixed mode."

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY A

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0004	.0007	.0010	.0000	.0000	.0000	.0000	.0000	.0021	10.25
NNE	.0000	.0000	.0003	.0000	.0007	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0016	7.78
NE	.0000	.0000	.0000	.0000	.0007	.0023	.0025	.0003	.0000	.0000	.0000	.0000	.0058	10.63
ENE	.0000	.0000	.0003	.0000	.0027	.0030	.0029	.0002	.0000	.0000	.0000	.0000	.0091	9.48
E	.0000	.0003	.0020	.0000	.0009	.0011	.0010	.0001	.0000	.0000	.0000	.0000	.0054	7.38
ESE	.0000	.0000	.0010	.0000	.0007	.0027	.0042	.0008	.0000	.0000	.0000	.0000	.0094	10.50
SE	.0000	.0003	.0003	.0000	.0040	.0095	.0038	.0002	.0000	.0000	.0000	.0000	.0181	9.23
SSE	.0000	.0000	.0003	.0000	.0020	.0055	.0025	.0001	.0000	.0000	.0000	.0000	.0104	9.45
S	.0000	.0003	.0010	.0000	.0025	.0027	.0069	.0014	.0000	.0000	.0000	.0000	.0147	10.44
SSW	.0000	.0000	.0008	.0000	.0029	.0021	.0029	.0006	.0000	.0000	.0000	.0000	.0092	9.45
SW	.0000	.0000	.0003	.0000	.0004	.0011	.0012	.0010	.0000	.0000	.0000	.0000	.0040	11.19
WSW	.0000	.0000	.0005	.0000	.0003	.0011	.0016	.0016	.0000	.0000	.0000	.0000	.0050	11.77
W	.0000	.0000	.0003	.0000	.0007	.0015	.0012	.0003	.0000	.0000	.0000	.0000	.0040	9.91
WNW	.0000	.0000	.0005	.0000	.0000	.0008	.0012	.0004	.0000	.0000	.0000	.0000	.0029	10.60
NW	.0000	.0005	.0008	.0000	.0004	.0021	.0004	.0003	.0000	.0000	.0000	.0000	.0045	8.07
NNW	.0000	.0000	.0000	.0000	.0003	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0009	9.35
TOTAL	.0000	.0014	.0082	.0000	.0196	.0369	.0337	.0072	.0000	.0000	.0000	.0000	.1070	9.76

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY B

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0002	9.75
NNE	.0000	.0000	.0000	.0003	.0000	.0004	.0004	.0000	.0000	.0000	.0000	.0000	.0011	9.56
NE	.0000	.0000	.0000	.0000	.0004	.0000	.0008	.0001	.0000	.0000	.0000	.0000	.0014	11.55
ENE	.0000	.0000	.0000	.0005	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012	6.09
E	.0000	.0000	.0000	.0003	.0000	.0004	.0014	.0000	.0000	.0000	.0000	.0000	.0021	11.23
ESE	.0000	.0000	.0000	.0000	.0003	.0008	.0006	.0001	.0000	.0000	.0000	.0000	.0018	10.86
SE	.0000	.0000	.0000	.0000	.0000	.0002	.0006	.0000	.0000	.0000	.0000	.0000	.0008	12.09
SSE	.0000	.0000	.0000	.0003	.0000	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0009	8.98
S	.0000	.0000	.0000	.0000	.0011	.0008	.0002	.0002	.0000	.0000	.0000	.0000	.0024	9.53
SSW	.0000	.0000	.0000	.0000	.0004	.0002	.0006	.0001	.0000	.0000	.0000	.0000	.0015	11.09
SW	.0000	.0000	.0000	.0003	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0008	8.81
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0002	13.01
W	.0000	.0000	.0000	.0003	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0005	6.95
WNW	.0000	.0000	.0000	.0003	.0000	.0000	.0004	.0001	.0000	.0000	.0000	.0000	.0008	10.26
NW	.0000	.0000	.0000	.0003	.0000	.0004	.0008	.0000	.0000	.0000	.0000	.0000	.0015	10.47
NNW	.0000	.0000	.0000	.0000	.0000	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0007	11.64
TOTAL	.0000	.0000	.0000	.0025	.0029	.0049	.0069	.0008	.0000	.0000	.0000	.0000	.0180	10.15

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY C

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0003	.0003	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0007	8.08
NNE	.0000	.0000	.0000	.0000	.0003	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0007	9.85
NE	.0000	.0000	.0000	.0000	.0000	.0002	.0008	.0001	.0000	.0000	.0000	.0000	.0012	12.77
ENE	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0002	12.97
E	.0000	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	4.54
ESE	.0000	.0000	.0000	.0003	.0003	.0000	.0008	.0001	.0000	.0000	.0000	.0000	.0014	10.43
SE	.0000	.0001	.0000	.0000	.0009	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0015	8.25
SSE	.0000	.0000	.0000	.0000	.0004	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0015	8.98
S	.0000	.0000	.0000	.0005	.0009	.0004	.0008	.0000	.0000	.0000	.0000	.0000	.0026	8.87
SSW	.0000	.0000	.0000	.0000	.0000	.0007	.0006	.0004	.0000	.0000	.0000	.0000	.0017	12.56
SW	.0000	.0000	.0000	.0000	.0007	.0000	.0008	.0002	.0000	.0000	.0000	.0000	.0017	11.13
WSW	.0000	.0000	.0000	.0000	.0000	.0000	.0006	.0001	.0000	.0000	.0000	.0000	.0007	13.43
W	.0000	.0000	.0000	.0003	.0003	.0008	.0006	.0000	.0000	.0000	.0000	.0000	.0020	9.66
WNW	.0000	.0000	.0000	.0000	.0000	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0007	11.61
NW	.0000	.0000	.0000	.0000	.0000	.0004	.0006	.0000	.0000	.0000	.0000	.0000	.0010	11.69
NNW	.0000	.0000	.0000	.0000	.0000	.0000	.0004	.0000	.0000	.0000	.0000	.0000	.0004	12.97
TOTAL	.0000	.0000	.0000	.0016	.0039	.0049	.0068	.0012	.0000	.0000	.0000	.0000	.0185	10.36

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY D

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0008	.0007	.0011	.0028	.0002	.0000	.0000	.0000	.0000	.0055	11.13
NNE	.0000	.0000	.0000	.0005	.0017	.0016	.0018	.0003	.0000	.0000	.0000	.0000	.0060	10.50
NE	.0000	.0000	.0000	.0003	.0024	.0033	.0048	.0003	.0000	.0000	.0000	.0000	.0111	11.16
ENE	.0000	.0003	.0000	.0005	.0021	.0052	.0037	.0002	.0000	.0000	.0000	.0000	.0120	10.49
E	.0000	.0000	.0000	.0010	.0015	.0027	.0031	.0003	.0000	.0000	.0000	.0000	.0087	10.69
ESE	.0000	.0010	.0000	.0008	.0017	.0035	.0055	.0004	.0000	.0000	.0000	.0000	.0130	10.64
SE	.0000	.0008	.0000	.0012	.0044	.0100	.0037	.0003	.0000	.0000	.0000	.0000	.0203	9.72
SSE	.0000	.0000	.0000	.0012	.0027	.0081	.0031	.0000	.0000	.0000	.0000	.0000	.0151	10.02
S	.0000	.0000	.0000	.0024	.0024	.0027	.0061	.0004	.0000	.0000	.0000	.0000	.0140	10.55
SSW	.0000	.0005	.0000	.0005	.0021	.0029	.0062	.0010	.0000	.0000	.0000	.0000	.0133	11.46
SW	.0000	.0000	.0000	.0008	.0013	.0033	.0030	.0003	.0000	.0000	.0000	.0000	.0086	10.75
WSW	.0000	.0000	.0000	.0008	.0013	.0016	.0011	.0003	.0000	.0000	.0000	.0000	.0051	9.99
W	.0000	.0000	.0000	.0012	.0007	.0012	.0013	.0003	.0000	.0000	.0000	.0000	.0047	9.76
WNW	.0000	.0000	.0000	.0008	.0017	.0020	.0023	.0007	.0000	.0000	.0000	.0000	.0075	10.79
NW	.0000	.0000	.0000	.0005	.0011	.0015	.0030	.0007	.0000	.0000	.0000	.0000	.0068	11.73
NNW	.0000	.0003	.0000	.0005	.0013	.0015	.0031	.0003	.0000	.0000	.0000	.0000	.0069	10.86
TOTAL	.0000	.0029	.0000	.0135	.0292	.0524	.0546	.0060	.0000	.0000	.0000	.0000	.1585	10.59

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY E

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0021	.0017	.0031	.0000	.0016	.0000	.0000	.0000	.0000	.0085	9.96
NNE	.0000	.0003	.0000	.0014	.0032	.0037	.0000	.0026	.0001	.0000	.0000	.0000	.0112	10.40
NE	.0000	.0000	.0000	.0009	.0024	.0043	.0000	.0029	.0001	.0000	.0000	.0000	.0106	11.25
ENE	.0000	.0003	.0000	.0019	.0035	.0035	.0000	.0018	.0000	.0000	.0000	.0000	.0109	9.73
E	.0000	.0000	.0000	.0017	.0024	.0023	.0000	.0013	.0000	.0000	.0000	.0000	.0076	9.73
ESE	.0000	.0008	.0000	.0005	.0019	.0045	.0000	.0032	.0000	.0000	.0000	.0000	.0110	11.02
SE	.0000	.0000	.0000	.0019	.0026	.0074	.0000	.0037	.0000	.0000	.0000	.0000	.0156	11.04
SSE	.0000	.0000	.0000	.0014	.0039	.0090	.0000	.0050	.0001	.0000	.0000	.0000	.0194	11.33
S	.0000	.0005	.0000	.0021	.0045	.0101	.0000	.0043	.0001	.0000	.0000	.0000	.0216	10.71
SSW	.0000	.0003	.0000	.0019	.0045	.0084	.0000	.0082	.0003	.0000	.0000	.0000	.0235	11.61
SW	.0000	.0008	.0000	.0038	.0051	.0064	.0000	.0050	.0002	.0000	.0000	.0000	.0213	10.16
WSW	.0000	.0005	.0000	.0035	.0047	.0068	.0000	.0057	.0001	.0000	.0000	.0000	.0213	10.52
W	.0000	.0008	.0000	.0033	.0043	.0049	.0000	.0042	.0000	.0000	.0000	.0000	.0176	9.98
WNW	.0000	.0000	.0000	.0026	.0036	.0035	.0000	.0016	.0000	.0000	.0000	.0000	.0113	9.53
NW	.0000	.0003	.0000	.0021	.0045	.0027	.0000	.0005	.0000	.0000	.0000	.0000	.0101	8.66
NNW	.0000	.0010	.0000	.0023	.0036	.0035	.0000	.0008	.0000	.0000	.0000	.0000	.0112	8.55
TOTAL	.0000	.0056	.0000	.0333	.0564	.0839	.0000	.0524	.0012	.0000	.0000	.0000	.2327	10.42

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY F

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0005	.0025	.0000	.0050	.0008	.0000	.0001	.0000	.0000	.0000	.0089	9.18
NNE	.0000	.0000	.0008	.0020	.0000	.0023	.0005	.0000	.0000	.0000	.0000	.0000	.0057	8.25
NE	.0000	.0000	.0003	.0003	.0000	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0012	8.13
ENE	.0000	.0000	.0003	.0007	.0000	.0004	.0007	.0000	.0000	.0000	.0000	.0000	.0021	9.10
E	.0000	.0000	.0000	.0003	.0000	.0004	.0003	.0000	.0002	.0000	.0000	.0000	.0013	12.01
ESE	.0000	.0000	.0000	.0003	.0000	.0008	.0009	.0000	.0007	.0000	.0000	.0000	.0027	13.23
SE	.0000	.0000	.0000	.0003	.0000	.0008	.0005	.0000	.0003	.0000	.0000	.0000	.0019	12.03
SSE	.0000	.0000	.0003	.0007	.0000	.0011	.0017	.0000	.0003	.0000	.0000	.0000	.0041	11.13
S	.0000	.0000	.0003	.0009	.0000	.0008	.0009	.0000	.0001	.0000	.0000	.0000	.0030	9.80
SSW	.0000	.0000	.0005	.0018	.0000	.0020	.0019	.0000	.0002	.0000	.0000	.0000	.0065	10.02
SW	.0000	.0000	.0003	.0025	.0000	.0020	.0009	.0000	.0001	.0000	.0000	.0000	.0058	8.88
WSW	.0000	.0000	.0010	.0038	.0000	.0025	.0003	.0000	.0001	.0000	.0000	.0000	.0077	7.65
W	.0000	.0000	.0003	.0032	.0000	.0031	.0003	.0000	.0001	.0000	.0000	.0000	.0070	8.45
WNW	.0000	.0000	.0005	.0042	.0000	.0025	.0002	.0000	.0000	.0000	.0000	.0000	.0075	7.71
NW	.0000	.0000	.0018	.0027	.0000	.0016	.0002	.0000	.0000	.0000	.0000	.0000	.0064	6.64
NNW	.0000	.0000	.0008	.0027	.0000	.0016	.0007	.0000	.0000	.0000	.0000	.0000	.0059	7.89
TOTAL	.0000	.0000	.0077	.0288	.0000	.0275	.0113	.0000	.00021	.0000	.0000	.0000	.0775	8.85

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE

DETROIT EDISON 60-METER TOWER
FREQUENCY OF OCCURRENCE OF WIND SPEED BY WIND DIRECTION
STABILITY G

WIND SPEED CLASS (MPH)

	CALMS	0.5 - 2.5	2.5 - 4.5	4.5 - 6.5	6.5 - 8.5	8.5 - 11.5	11.5 - 14.5	14.5 - 18.5	18.5 - 23.5	23.5 - 30.5	30.5 - 39.5	MORE THAN 39.5	TOTAL	AVERAGE SPEED (MPH)
N	.0000	.0000	.0000	.0000	.0049	.0025	.0005	.0000	.0000	.0000	.0000	.0000	.0079	8.39
NNE	.0000	.0000	.0003	.0000	.0011	.0015	.0002	.0000	.0000	.0000	.0000	.0000	.0031	8.60
NE	.0000	.0000	.0000	.0000	.0004	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0006	5.96
ENE	.0000	.0000	.0000	.0000	.0000	.0002	.0002	.0000	.0000	.0000	.0000	.0000	.0004	12.18
E	.0000	.0000	.0000	.0000	.0003	.0002	.0006	.0000	.0000	.0000	.0000	.0000	.0011	11.85
ESE	.0000	.0000	.0003	.0000	.0003	.0002	.0002	.0000	.0001	.0000	.0000	.0000	.0011	8.61
SE	.0000	.0000	.0000	.0000	.00011	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012	7.05
SSE	.0000	.0000	.0000	.0000	.0004	.0004	.0005	.0000	.0001	.0000	.0000	.0000	.0014	11.07
S	.0000	.0000	.0003	.0000	.0009	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0014	7.07
SSW	.0000	.0000	.0005	.0000	.0003	.0007	.0002	.0000	.0001	.0000	.0000	.0000	.0017	8.30
SW	.0000	.0000	.0000	.0000	.0029	.0002	.0003	.0000	.0000	.0000	.0000	.0000	.0035	7.76
WSW	.0000	.0000	.0003	.0000	.0018	.0015	.0003	.0000	.0001	.0000	.0000	.0000	.0039	8.62
W	.0000	.0000	.0000	.0000	.0029	.0019	.0000	.0000	.0000	.0000	.0000	.0000	.0048	8.20
WNW	.0000	.0000	.0008	.0000	.0042	.0011	.0000	.0000	.0000	.0000	.0000	.0000	.0061	6.86
NW	.0000	.0000	.0008	.0000	.0038	.0020	.0000	.0000	.0000	.0000	.0000	.0000	.0066	7.42
NNW	.0000	.0000	.0000	.0000	.0042	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0057	7.69
TOTAL	.0000	.0000	.0033	.0000	.0295	.0139	.0033	.0000	.0003	.0000	.0000	.0000	.0504	8.10

PERIOD OF RECORD: 4/15/74 – 10/15/74

ANALYSES FOR ELEVATED PORTION OF SPLIT-H SOURCE