

DETROIT EDISON COMPANY
FERMI 2 NUCLEAR POWER PLANT
OPERATING LICENSE NO. NPF - 43

SEMIANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

for the period of

July 1, 1991 through December 31, 1991

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PREFACE

The Fermi 2 Nuclear Power Plant maintains a comprehensive program of monitoring and controlling the release of radioactive material from the site. The releases covered in this report are of three types: liquid releases, gaseous releases, and radioactive waste shipments.

In a liquid release, a tank containing radioactive water is sampled prior to discharge. Based on the analysis of this sample, both the amount of radioactivity in the tank and the potential radiation dose to a member of the public are determined, and these figures are compared to federal limits. In calculating the radiation dose, very conservative assumptions are used. For example, it is assumed that an individual eats 46 pounds of fish per year from Lake Erie directly offshore of the Fermi 2 plant. The tank may be released only after it is determined that no federal limits are exceeded. As the tank is released, the contents of the tank are diluted by clean water in a ratio of approximately 400 gallons of clean water to one gallon of tank water. The release is continuously monitored by radiation detectors. In the second half of 1991, there were three liquid releases, down significantly from previous years. This small number is due to the plant operating in a steady state condition since the second refueling ending in June 1991.

Radioactive gaseous releases occur as part of the normal operation of Fermi 2. There are six ventilation system release points, or "stacks", each of which is monitored by a sophisticated radiation monitor which continuously extracts a sample from the stack effluent. Since any gaseous radioactive material is diluted by the building ventilation air flow, the stack concentrations are small. In fact, radioactive material is not detected in most stack samples. All sample results are compared with federal limits to ensure they are not exceeded. If the amount of radioactivity in the effluent of any stack approaches a federal limit, an alarm will be activated in the Fermi 2 control room to alert operations personnel. After evaluating the situation, the operators may choose to order increased sampling, shut down building ventilation, or divert the effluent stream to a special gaseous treatment system so that federal limits are not exceeded. In the second half of 1991, gaseous releases were comparable to levels seen in previous non-cutage periods, reflecting stable operating conditions.

Radioactive shipments of solid waste from the Fermi 2 site consist of waste generated during water treatment, radioactive trash, and irradiated components. Federal regulations governing these shipments are extensive, and Fermi 2 also complies with internal procedures. Shipment destinations are either licensed burial sites or intermediate processing facilities. In the second half of 1991, Fermi 2 did not ship any radioactive waste due to the exclusion of Michigan licensees from the burial sites.

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1. INTRODUCTION

The Detroit Edison Fermi 2 Nuclear Power Plant is designed and operated in a manner which strictly controls and monitors the release of radioactive material to the environment in accordance with Nuclear Regulatory Commission (NRC) and Detroit Edison Company requirements. This Semiannual Radioactive Effluent Release Report, for the July through December 1991 period, is submitted in accordance with Fermi 2 Technical Specification 6.9.1.8 and NRC Regulatory Guide 1.21. This report provides the following information required by those references:

1. Summation of the quantities of radioactive material (in the form of gases and liquids) released from the plant (Sections 8 and 9)
2. Summation of quantities of radioactive material contained in solid waste packaged and shipped for off-site disposal (Section 10)
3. Changes to the Process Control Program (PCP) (Section 14)
4. Changes to the Offsite Dose Calculation Manual (ODCM) (Section 16)
5. A list and description of any unplanned releases of radioactive materials to unrestricted areas (Section 6)
6. A list of any new locations for dose calculation or environmental monitoring identified by the land use census (Section 15)
7. A list of effluent monitors which were inoperable for a period longer than that specified in Technical Specifications 3.3.7.11 and 3.3.7.12, and an explanation of why the time limit was exceeded (Section 12)
8. A description of events leading up to any liquid holdup tanks exceeding the limit of Technical Specification 3.11.1.4 (Section 18)
9. A description of any major changes to radioactive waste treatment systems (Section 17)
10. An assessment of the radiological impact on the public in terms of dose due to liquid and gaseous effluents, both to the maximally exposed individual and to the population with a 50 mile radius of the plant (Section 11)
11. A summary of 1991 meteorological data (wind speed and wind direction for different stability classes) which was used in calculating gaseous dispersion factors (Section 13)

2. REGULATORY LIMITS

The Nuclear Regulatory Commission limits on liquid and gaseous effluents are incorporated in the Fermi 2 Technical Specifications. These limits prescribe the maximum quantities and rates of release for radioactive effluents resulting from normal operation of Fermi 2. The limits are defined in several ways to limit the overall impact on persons living near the plant. The limits are described in the following sections.

A. Gaseous Effluents

1. Dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:
 - a. Noble gases

Less than or equal to 500 mrem/year to the total body
Less than or equal to 3000 mrem/year to the skin
 - b. Iodine 131, 133, tritium, and for all radionuclides in particulate form with half lives greater than 8 days

Less than or equal to 1500 mrem/year to any organ.
2. Air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary shall be limited to the following:
 - a. Less than or equal to 5 mrad for gamma radiation
Less than or equal to 10 mrad for beta radiation
-During any calendar quarter
 - b. Less than or equal to 10 mrad for gamma radiation
Less than or equal to 20 mrad for beta radiation
-During any calendar year
3. Dose to a member of the public from Iodine-131, 133, tritium, and all radionuclides in particulate form with half lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:
 - a. Less than or equal to 7.5 mrems to any organ
-During any calendar quarter
 - b. Less than or equal to 15 mrems to any organ
-During any calendar year

B. Liquid Effluents

1. The concentration of radioactive material released in liquid effluents to unrestricted areas shall be limited to the concentrations specified in Title 10 of the Code of Federal Regulations Part 20 (Standards for Protection Against Radiation), Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to $2E-4$ (.0002) microcuries/ml total activity.
2. The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to unrestricted areas shall be limited to the values in the following sections.

- a. Less than or equal to 1.5 mrem to the total body
Less than or equal to 5 mrem to any organ
-During any calendar quarter
- b. Less than or equal to 3 mrem to the total body
Less than or equal to 10 mrem to any organ
-During any calendar year

3. MAXIMUM PERMISSIBLE CONCENTRATION (MPC)

Fermi 2 Technical Specifications implement the MPC requirements of 10 CFR 20 and NRC Regulatory Guide 1.21 by means of the following limits:

A. Gases

The dose rate due to gaseous effluents is calculated in accordance with the Fermi 2 Offsite Dose Calculation Manual (ODCM). The maximum permissible dose rates for gaseous releases are defined in Fermi 2 Technical Specifications:

Technical Specification 3.11.2.1.a (Dose rate at the site boundary from noble gases):

- Less than or equal to 500 mrem/year to the total body
- Less than or equal to 3000 mrem/year to the skin

Technical Specification 3.11.2.1.b (Dose rate at the site boundary from I-131, I-133, and particulates with half lives greater than 8 days):

- Less than or equal to 1500 mrem/year to any organ

B. Liquids

Allowable liquid release rates are calculated in accordance with the Fermi 2 Offsite Dose Calculation Manual (ODCM). As required by Technical Specification 3.11.1.1, the maximum permissible concentrations (MPC) for liquids used for these calculations are taken from 10 CFR 20, Appendix B, Table II, Column 2. The most restrictive MPC is used in all cases. For dissolved and entrained gases the MPC of $2E-4$ microcuries/ml is applied. This MPC is based on the Xe-135 MPC in air (submersion dose, converted to an equivalent concentration in water as discussed in the International Commission on Radiological Protection (ICRP) Publication 2.

4. AVERAGE ENERGY

The calculated site boundary dose rates for Fermi 2 are based on identification of individual isotopes and on use of dose factors specific to each identified isotope or a highly conservative dose factor. Average energy values are not used in these calculations, and therefore need not be reported.

5. MEASUREMENTS AND APPROXIMATIONS OF TOTAL ACTIVITY

As required by NRC Regulatory Guide 1.21, this section describes the methods used to measure the total radioactivity in effluent releases and to estimate the overall errors associated with these measurements. The effluent monitoring systems are described in Chapter 11.4 of the Fermi 2 Updated Final Safety Analysis Report (UFSAR).

A. Gaseous Effluents

1. Fission and Activation Gases

Samples are obtained from each of the seven plant radiation monitors which continuously monitor the six ventilation exhaust points and from the Offgas Vent Pipe which carries the gland seal condenser exhaust, mechanical vacuum pump exhaust, and treated offgas streams. The Offgas Vent Pipe effluent is released through one of the six ventilation exhaust points (the reactor building exhaust plenum). The fission and activation gases are quantified by gamma spectroscopy analysis of periodic samples.

The values reported in Section 9 are the sums of all fission and activation gases quantified at all monitored release points.

Considering the inherent variability in radiation measurement, the variability in effluent stream composition, and the uncertainties in effluent flow rate and instrument calibration, Detroit Edison estimates that the uncertainty of the fission and activation gas total release figures is less than plus or minus 8 percent.

2. Radiiodines

Samples are obtained from each of the seven plant radiation monitors, which continuously monitor the six ventilation exhaust points. The radiiodines are entrained on charcoal and then quantified by gamma spectroscopy analysis. For each sample the duration of sampling and continuous flow rate through the charcoal are used in determining the concentration of radiiodines. From the flow rate of the ventilation system a rate of release can be determined.

The values reported in Section 9 are the sums of all radiiodines quantified at all continuously monitored release points.

Considering the inherent variability in radiation measurements, the variability in effluent stream composition, and the uncertainty in sample and effluent flow rates, Detroit Edison estimates that the uncertainty of the total radiiodine release figures is less than plus or minus 5 percent.

3. Particulates

Samples are obtained from each of the seven plant effluent radiation monitors, which continuously monitor the six ventilation exhaust points. The particulates are collected on a filter and then quantified by gamma spectroscopy analysis. For each sample the duration of sampling and continuous flow rate through the filter are used in determining the concentration of particulates. From the flow rate of the ventilation system a rate of release can be determined.

Quarterly the filters from each ventilation release point are composited and then radiochemically separated and analyzed for Strontium (Sr)-89/90 using various analytical methods. If found these radionuclides are reported as total particulate activity.

The values reported in Section 9 are the sums of all particulates quantified at all monitored release points.

Considering the inherent variability in radiation measurements, the variability in effluent stream composition, and the uncertainties in instrument calibration and in sample and effluent flow rates, Detroit Edison estimates that the the uncertainty of the total particulate release figures is less than plus or minus 3 percent.

4. Tritium

Samples are obtained for each of the seven plant effluent radiation monitors which continuously monitor the six ventilation exhaust points. The sample is passed through a bottle containing water and the tritium is "washed" out to the collecting water. Portions of the collecting water are analyzed for tritium using liquid scintillation counting techniques. For each sample, the duration of sample and sample flow rate is used to determine the concentration. From the flow rate of the ventilation system a release rate can be determined.

The values reported in Section 9 are the sums of all tritium quantified at all monitored release points.

Considering the inherent variability in radiation measurement, the variability in effluent stream composition, and the uncertainties in instrument calibration, sample and effluent flow rates, and collection efficiency, Detroit Edison estimates that the uncertainty of total gaseous tritium release figures is less than plus or minus 34 percent.

5. Gross Alpha

The gaseous particulate filters from the seven plant effluent radiation monitors are stored for one week to allow for decay of naturally occurring alpha emitters. These filters are then analyzed for gross alpha radioactivity by gas proportional counting, and any such radioactivity found is assumed to be plant related. The quantity of alpha emitters released can then be determined from sample flow rate, sample duration, and stack flow rate.

The values reported in Section 9 are the sums of all alpha emitters quantified at all monitored release points.

Considering the inherent variability in radiation measurements, the variability in effluent stream composition, and the uncertainties in instrument calibration and in sample and effluent flow rates, Detroit Edison estimates that the uncertainty of the total gaseous gross alpha release figures is less than plus or minus 10 percent.

B. Liquid Effluents

The liquid radwaste processing system and the liquid effluent monitoring system are described in the Fermi-2 UFSAR.

1. Fission and activation products

Before the contents of each holding tank is discharged to the environment, a representative sample of the tank's contents is taken and retained. The sample allows for the determination of radioactive material concentrations and establishes the rate at which the radioactive material can be discharged to the environment.

At the end of the calendar quarter a composite sample is made of all discharge samples taken during the quarter. This composite sample consists of portions of each discharge sample which are proportional to the volumes discharged. The composite sample is analyzed for Iron (Fe)-55 and Strontium (Sr)-89/90. Radiochemical separations and various analytical methods are used to quantify the amounts of Sr-89/90 and Fe-55.

The values reported in Section 8 are the sums of all fission and activation products found in all batch releases. Also reported in Section 8 are the pre-dilution waste volume (the total volume of waste sample tanks released), the post-dilution waste volume (the total tank volume released plus the volume of circulating water released while the tanks were being released), and the total dilution volume discharged (the total volume of circulating water released during the reporting period).

Considering the inherent variability in radiation measurement and the uncertainties in volume measurements and instrument calibration, Detroit Edison estimates that the uncertainty in total liquid fission and activation product release figures is less than plus or minus 5 percent.

2. Tritium

Before the contents of each holding tank is discharged to the environment, a representative sample of the tank contents is taken and retained. At the end of the calendar month a composite sample is made of all discharge samples taken during the month. This composite sample consists of portions of each discharge sample which are proportional to the volumes discharged. The composite sample is analyzed for tritium by liquid scintillation counting.

The values reported in Section 8 sums all tritium quantified from all batch releases.

Considering the inherent variability in radiation measurement and the uncertainties in volume measurement and instrument calibration, Detroit Edison estimates the uncertainty in total tritium release figures is less than plus or minus 15 percent.

3. Dissolved and Entrained Gases

Prior to releasing liquid radioactive waste to the environment a sample is taken from the radwaste holding tank. This sample is representative of the tank's contents. The sample is examined using gamma spectroscopy to determine the dissolved and entrained noble gases.

The values reported in Section 8 are the sums of all radioactive gases found for all batch releases.

Considering the inherent variability in radiation measurement and the uncertainties in instrument calibration and volume measurements, Detroit Edison estimates that the uncertainty in total dissolved and entrained gas release figures is less than plus or minus 15 percent.

4. Gross Alpha

Before the contents of each holding tank is discharged to the environment, a representative sample of the tank's contents is taken and retained. At the end of the calendar month a composite sample is made of all discharge samples taken during the month. This composite sample consists of portions of each discharge sample which are proportional to the volumes discharged. The composite sample is analyzed for gross alpha radioactivity by gas proportional counting.

The values reported in Section 8 are the sums of the gross alpha radioactivity from all batch releases.

Considering the inherent variability in radiation measurement and the uncertainty in volume measurements and instrument calibration, Detroit Edison estimates that the uncertainty in total liquid gross alpha release figures is less than plus or minus 43 percent.

6. **ABNORMAL RELEASES**

For the purpose of this report, an abnormal release is any release of radioactive material not performed in accordance with the Fermi 2 license and implementing procedures. No abnormal releases occurred during the reporting period.

7. **BATCH RELEASES**

As required by Regulatory Guide 1.21, a summary of data for batch releases is provided below. The following batch liquid releases from radwaste holding tanks to the Circulating Water Decant Line occurred between July 1, 1991 and December 31, 1991 (all these releases occurred during July 1991):

Number of releases:	3
Total time for all releases:	1042 minutes
Maximum time for a release:	482 minutes
Average time for a release:	347 minutes
Minimum time for a release:	81 minutes

The only batch gaseous releases from Fermi 2 are the venting or purging of the primary containment (drywell) atmosphere. These venting or purging releases pass through the reactor building ventilation or standby gas treatment system and are monitored by the final effluent monitors for these pathways. Separate data on these venting or purging releases are not reported because the associated data are already included in the gaseous effluent release data (Section 5.A and Section 9).

8. LIQUID EFFLUENT SUMMARY

REPORT CATEGORY : SEMIANNUAL SUMMATION OF ALL RELEASES BY QUARTER
TYPE OF ACTIVITY : ALL LIQUID EFFLUENTS
REPORTING PERIOD : QUARTER 3 AND QUARTER 4

TYPE OF EFFLUENT	UNIT	QUARTER 3	QUARTER 4
A. FISSION AND ACTIVATION PRODUCTS			
1. TOTAL RELEASE (NOT INCLUDING TRITIUM, GASES, ALPHA)	: CURIES	8.33E-03	0.00E+00
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	: uCi/ml	6.36E-10	0.00E+00
3. MAXIMUM PERCENT OF TECHNICAL SPECIFICATION LIMIT FOR A SINGLE RELEASE	%	1.21E-01	0.00E+00
B. TRITIUM			
1. TOTAL RELEASE	: CURIES	6.55E-02	0.00E+00
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	: uCi/ml	5.00E-09	0.00E+00
3. PERCENT OF TECHNICAL SPECIFICATION LIMIT	%	3.25E-02	0.00E+00
C. DISSOLVED AND ENTRAINED GASES			
1. TOTAL RELEASE	: CURIES	6.01E-06	0.00E+00
2. AVERAGE DILUTED CONCENTRATION DURING PERIOD	: uCi/ml	4.59E-13	0.00E+00
3. PERCENT OF TECHNICAL SPECIFICATION LIMIT	%	4.47E-05	0.00E+00
D. GROSS ALPHA RADIOACTIVITY (Note: N.D. = No activity detected)			
1. TOTAL RELEASE	: CURIES	N.D.	N.D.
E. WASTE VOL RELEASED (PRE-DILUTION)			
	: LITERS	1.82E+05	0.00E+00
F. WASTE VOL RELEASED (POST-DILUTION)			
	: LITERS	6.72E+07	0.00E+00
G. TOTAL VOLUME DILUTION DISCHARGED			
	: LITERS	1.31E+10	9.19E+09

8. LIQUID EFFLUENT SUMMARY (continued)

REPORT CATEGORY : SEMIANNUAL LIQUID BATCH RELEASES
TYPE OF ACTIVITY : TOTALS FOR EACH NUCLIDE RELEASED
: ALL RADIONUCLIDES
REPORTING PERIOD : QUARTER 3 AND QUARTER 4

		BATCH RELEASES	
NUCLIDE	UNIT	QUARTER 3	QUARTER 4
ALL NUCLIDES			
H-3	CURIES	6.55E-02	0.00E+00
Cr-51	CURIES	4.07E-03	0.00E+00
Mn-54	CURIES	6.57E-04	0.00E+00
Co-58	CURIES	2.80E-04	0.00E+00
Co-60	CURIES	8.09E-04	0.00E+00
Zn-65	CURIES	1.56E-04	0.00E+00
Fe-59	CURIES	2.50E-06	0.00E+00
Xe-133	CURIES	1.73E-06	0.00E+00
Xe-135	CURIES	4.28E-06	0.00E+00
Fe-55	CURIES	2.36E-03	0.00E+00
Cs-134	CURIES	* < 2.5E-08	0.00E+00
Cs-137	CURIES	* < 3.1E-08	0.00E+00
Ce-141	CURIES	* < 2.8E-08	0.00E+00
Ce-144	CURIES	* < 1.5E-07	0.00E+00
Total for Period	CURIES	7.38E-02	0.00E+00

* Less than Lower Limit of Detection (LLD), i.e. the maximum sensitivity of measurement, in units of microcuries per milliliter (uCi/ml).

9. GASEOUS EFFLUENT SUMMARY

REPORT CATEGORY : SEMIANNUAL SUMMATION OF ALL RELEASES BY QUARTER
TYPE OF ACTIVITY : ALL AIRBORNE EFFLUENTS
REPORTING PERIOD : QUARTER 3 AND QUARTER 4

TYPE OF EFFLUENT	UNIT	QUARTER 3	QUARTER 4
A. FISSION AND ACTIVATION GASES			
1. TOTAL RELEASE	CURIES	1.95E+01	1.74E+01
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/sec	2.45E+00	2.19E+00
B. RADIOIODINES			
1. TOTAL IODINE - 131	CURIES	7.26E-04	7.74E-04
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/sec	9.13E-05	9.74E-05
C. PARTICULATES			
1. PARTICULATES (HALF-LIVES > 8 DAYS)	CURIES	1.21E-03	9.13E-04
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/sec	1.52E-04	1.15E-04
3. GROSS ALPHA RADIOACTIVITY	CURIES	9.13E-07	5.03E-07
D. TRITIUM (Note: N.D. = No activity detected)			
1. TOTAL RELEASE	CURIES	N.D.	N.D.
2. AVERAGE RELEASE RATE FOR PERIOD	uCi/sec	N.A.	N.A.

9. GASEOUS EFFLUENT SUMMARY (continued)

REPORT CATEGORY : SEMIANNUAL AIRBORNE CONTINUOUS RELEASES
TYPE OF ACTIVITY : FISSION GASES, IODINES, AND PARTICULATES
REPORTING PERIOD : QUARTER 3 AND QUARTER 4

GROUND LEVEL RELEASES			
NUCLIDE	UNIT	QUARTER 3	QUARTER 4
PARTICULATES			
Cr-51	: CURIES	: 8.89E-04	: 5.90E-04
Mn-54	: CURIES	: 1.13E-05	: 1.00E-05
Co-58	: CURIES	: 2.06E-05	: 1.78E-05
Co-60	: CURIES	: 6.99E-05	: 4.23E-05
Na-24	: CURIES	: 1.64E-03	: 2.35E-04
Zn-65	: CURIES	: 1.27E-05	: 2.31E-05
Tc-99m	: CURIES	: 6.46E-03	: 1.05E-03
Ba-139	: CURIES	: 1.76E-01	: 1.84E-01
Ba-140	: CURIES	: 1.71E-04	: 1.53E-04
La-140	: CURIES	: 1.06E-04	: 2.03E-04
Y-91m	: CURIES	: 1.45E-03	: 1.48E-03
Sr-91	: CURIES	: 2.08E-03	: 2.11E-03
Rb-89	: CURIES	: 1.65E-01	: 3.00E-01
Cs-138	: CURIES	: 6.99E-02	: 9.84E-02
Ag-110m	: CURIES	: * < 1.6E-13	: 8.94E-07
Re-188	: CURIES	: 7.81E-05	: * < 9.8E-14
Br-82	: CURIES	: 5.74E-05	: 5.38E-05
Sn-113	: CURIES	: * < 6.0E-14	: 5.27E-06
Sr-89	: CURIES	: 3.33E-05	: 7.06E-05
Sr-90	: CURIES	: 8.62E-07	: 4.61E-07
Cs-134	: CURIES	: * < 3.6E-14	: * < 3.6E-14
Cs-137	: CURIES	: * < 4.7E-14	: * < 4.7E-14
Ce-141	: CURIES	: * < 3.1E-14	: * < 3.1E-14
Ce-144	: CURIES	: * < 1.2E-13	: * < 1.2E-13
Total for Period	: CURIES	: 4.24E-01	: 5.88E-01

* Less than the Lower Limit of Detection (LLD), i.e. the maximum sensitivity of measurement in units of microcuries per milliliter (uCi/ml)

9. GASEOUS EFFLUENT SUMMARY (continued)

REPORT CATEGORY : SEMIANNUAL AIRBORNE CONTINUOUS RELEASES
TYPE OF ACTIVITY : FISSION GASES, IODINES, AND PARTICULATES
REPORTING PERIOD : QUARTER 3 AND QUARTER 4

GROUND LEVEL RELEASES			
NUCLIDE	UNIT	QUARTER 3	QUARTER 4
FISSION AND ACTIVATION GASES			
Ar-41	CURIES	4.08E+00	2.98E+00
Xe-135m	CURIES	1.31E+00	1.31E+00
Xe-138	CURIES	3.13E+00	3.84E+00
Xe-135	CURIES	* < 2.7E-08	3.10E-01
Kr-85m	CURIES	2.72E+00	6.40E-01
Xe-137	CURIES	5.56E+00	3.58E+00
Kr-88	CURIES	1.46E+00	* < 8.4E-08
Kr-89	CURIES	* < 1.6E-06	4.38E+00
Xe-133	CURIES	1.22E+00	3.21E-01
Total for Period	CURIES	1.95E+01	1.74E+01
IODINES			
I-131	CURIES	7.26E-04	7.74E-04
I-132	CURIES	1.18E-03	4.73E-03
I-133	CURIES	3.78E-03	4.13E-03
I-134	CURIES	* < 1.6E-13	7.41E-04
I-135	CURIES	2.13E-03	1.09E-03
Total for Period	CURIES	7.82E-03	1.15E-02

* Less than the Lower Limit of Detection (LLD), i.e. the maximum sensitivity of measurement in units of microcuries per milliliter (uCi/ml)

10. SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

- A. Solid Waste Shipped Offsite for burial or disposal (not irradiated fuel): No shipments in this reporting period.
- B. Irradiated Fuel Shipments: No shipments in this reporting period.

11. RADIOLOGICAL IMPACT ON THE PUBLIC

A. Dose Due to Liquid Effluents

As discussed in Section 2.5.1 of the Fermi 2 Offsite Dose Calculation Manual, compliance with Technical Specification 3.11.1.2, which limits dose to a member of the public to any organ and to the total body due to liquid effluents, is evaluated by calculating the dose to a hypothetical individual who both eats fish from Lake Erie and drinks water extracted from Lake Erie at the water intake for the city of Monroe. Conservative assumptions from Regulatory Guide 1.109 are made about the quantity of fish and water consumed. The individual organ and total body doses for 1991 to this hypothetical individual were calculated according to Section 2.5.1 of the ODCM and are listed below.

<u>Organ</u>	<u>1991 Liquid Effluent Dose</u>
Bone	1.18 E-2 mrem
Liver	3.66 E-2 mrem
Thyroid	8.40 E-4 mrem
Kidney	2.29 E-2 mrem
Lung	6.85 E-4 mrem
GI-LLI	3.72 E-2 mrem
Total body	1.63 E-2 mrem

The highest organ dose, 3.72 E-2 mrem to the GI-LLI tracts, is 0.37% of the Tech Spec 3.11.1.2 annual organ dose limit; the total body dose, 1.63 E-2 mrem, is 0.54% of the Technical Specification 3.11.1.2 annual total body dose limit.

B. Dose Due to Gaseous Effluents

As discussed in Section 3.8.1 of the Fermi 2 Offsite Dose Calculation Manual, compliance with Technical Specification 3.11.2.3, which limits dose due to I-131, I-133, H-3, and particulates with half lives greater than 8 days in gaseous effluents to any organ of a member of the public, is evaluated by calculating the dose to a hypothetical individual in an age group which would receive the highest single organ dose of any member of the public. This hypothetical individual is an infant who is assumed to live at an offsite location which is known, based on the Land Use Census, to have milk animals. This infant is assumed to drink milk from these animals, and to also be exposed by the inhalation and ground plane pathways. The individual organ and total body doses to this individual due to I-131, I-133, H-3, and particulates with half lives greater than 8 days were calculated according to Section 3.8.1 of the ODCM and are listed below.

<u>Organ</u>	<u>1991 Gaseous Effluent Dose to Receptor with Highest Single Organ Dose</u>
Bone	5.39 E-4 mrem
Liver	4.71 E-4 mrem
Thyroid	7.32 E-2 mrem
Kidney	4.97 E-4 mrem
Lung	2.26 E-4 mrem
GI-LLI	2.51 E-4 mrem
Total body	3.31 E-4 mrem

The highest single organ dose to the maximally exposed receptor, 7.32 E-2 mrem to the thyroid, is 0.49% of the Technical Specification 3.11.2.3 annual dose limit.

C. Dose Due to Direct Radiation and Compliance with 40CFR190

Title 40, Part 190 of the Code of Federal Regulations requires that dose to an individual from the uranium fuel cycle be limited to 25 mrem/yr to the total body and 75 mrem/yr to the thyroid. The sources of fuel cycle dose not analyzed above are due to other fuel cycle facilities and dose due to direct radiation. As discussed in Section 4.2 of the Fermi 2 Offsite Dose Calculation Manual, no other fuel cycle facilities contribute significantly to dose in the vicinity of Fermi 2. With respect to direct radiation, none of the offsite TLD locations listed in Table 6.0-1 of the ODCM showed 1991 TLD readings which were consistently greater than the TLD readings at the control locations. Since other facilities and direct radiation did not contribute significantly to offsite dose, and since the preceding sections of this report show compliance with the more restrictive requirements of 10CFR50 Appendix I, Fermi 2 was in compliance with 40CFR190 in 1991.

D. Dose to Visitors on Site

As discussed in Section 4.0 of the Fermi 2 Offsite Dose Calculation Manual, "visitors" to the Fermi 2 site may receive dose due to their activities within the site boundary. For purposes of this analysis, visitors are members of the public who spend time within the site boundary and who do not do work associated with the operation of Fermi 2. The ODCM considers two categories of visitors: persons ice fishing on Lake Erie and persons spending time in the Fermi 2 Visitors Center.

Table 4.0-1 of the ODCM lists the maximum amount of time an individual is likely to spend in these activities and the exposure pathways which apply. An individual is assumed to spend 240 hours per year ice fishing near the site and 4 hours per year at the Visitors Center. Exposure by direct radiation from noble gases and by inhalation of radioactive particulates, iodines, and tritium are considered. The doses given below do not include dose due to the pathways already considered in part A of this section, namely dose due to water and fish ingestion.

Based on these assumptions, the maximum dose in 1991 to a visitor at the Visitors Center is 7.54 E-6 mrem to total body and 8.92 E-6 mrem to the maximally exposed organ (thyroid). The maximum dose in 1991 to an ice fisherman is 1.15 E-3 mrem to the total body and 1.37 E-3 mrem to the maximally exposed organ (thyroid).

E. Population Dose

Dose to the population within a fifty mile radius of Fermi 2 due to 1991 gaseous and liquid effluents was calculated.

For liquid effluents, the fish ingestion and drinking water pathways were considered. Since there is no significant commercial fishery in the Michigan waters of Lake Erie, the dose due to fish ingestion was assumed to be due to ingestion by the local population of the entire sport fish catch in these waters. Parameters from Regulatory Guide 1.109 were used, as was the UFSAR dilution factor of 100. The dose due to water ingestion was determined by assuming that all residents served by the Monroe water intake drink at the average rate given by Regulatory Guide 1.109, and by using the UFSAR dilution factor to the intake of 77. The population total body dose due to drinking water was estimated to be 3 mrem, and the total body dose due to fish ingestion was estimated to be 27 mrem, for a total estimated population total body dose due to liquid effluents of 30 mrem.

For gaseous effluents, the code MICROAIRDOS was used to estimate the population dose. Inputs to the code were 1991 gaseous release data, wind direction and wind speed frequencies for each stability class, population in each of 10 segments of each of 16 sectors, stack release specifications, etc. The estimated 1991 collective effective dose due to gaseous effluents is 160 mrem.

F. Site Boundary Air Dose

Gamma and beta dose to air at the site boundary due to noble gases must be calculated to evaluate compliance with Technical Specification 3.11.2.2. In 1991, gamma air dose was 1.63 E-2 mrad , and beta air dose was 1.62 E-2 mrad . These doses represent 0.16% and 0.08% of the Technical Specification 3.11.2.2 gamma and beta annual air dose limits, respectively.

12. RADIATION INSTRUMENTATION

Fermi 2 Technical Specifications 3.3.7.11, Radioactive Liquid Effluent Monitoring Instrumentation, and 3.3.7.12, Radioactive Gaseous Effluent Monitoring Instrumentation, require that those monitors which exceed the time specified for out of service status be reported in the next Semiannual Effluent Release Report. During this reporting period, July through December of 1991, the time specified in the action statements for these monitors was not exceeded.

13. METEOROLOGICAL DATA SUMMARY

The meteorological monitoring system is described in the Fermi 2 UFSAR. In accordance with Regulatory Guide 1.21, data recorded by that system is provided here to permit the Nuclear Regulatory Commission to assess the radiological impact of Fermi 2 releases independently. The data format required by Regulatory Guide 1.21 is used. Appendix A contains the meteorological data tables.

14. CHANGES TO THE PROCESS CONTROL PROGRAM (PCP)

As required by the Fermi 2 license, the operator (Detroit Edison) is required to establish a program that will reasonably assure the complete processing of radioactive wastes. This program assures that processed wastes are completely solidified and are free of standing water. Changes to the PCP Manual are provided to document changes to established conditions and to ensure that controls are in place to assure that radioactive waste is solidified.

During this reporting period, July through December of 1991, a complete rewrite of the PCP Manual was approved. Subsequently, a minor change to the PCP Manual was approved which changed the name of Chem Nuclear Systems Incorporated procedure SD-OP-090-48306 to reflect the fact that a Fermi-specific version of this procedure had been approved. The new name of this procedure is Process Control Program for Cement Solidification of Oil, Oily Sludges and Oil Residues at Fermi 2. The latest revision of the PCP Manual is contained in Appendix B.

15. CHANGES TO DOSE CALCULATION AND ENVIRONMENTAL MONITORING LOCATIONS

During this reporting period, the TLD at location T-11 was moved to the corner of Milliman and Jefferson Roads due to a high vandalism rate at the former location.

16. CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL (ODCM)

During this reporting period, July through December of 1991, the ODCM was not revised.

17. MAJOR CHANGES TO RADIOACTIVE WASTE SYSTEMS

During this reporting period, July through December of 1991, there were no major changes to the liquid, gaseous, or solid radioactive waste treatment systems.

18. LIQUID HOLDUP TANKS EXCEEDING LIMITS

Fermi 2 Technical Specification 3.11.1.4 requires that the quantity of radioactive material contained in any outside temporary tank shall be limited to 10 curies, excluding tritium and dissolved or entrained noble gases. During this reporting period, July through December of 1991, this activity limit for such tanks was not exceeded.

APPENDIX A: METEOROLOGICAL DATA TABLES

JOINT FREQUENCY DISTRIBUTION (JFD) AT
THE 10-METER LEVEL
1991

PROGRAM: JFD VERSION: PC-1.1

PRINTOUT OF INPUT CONTROL DATA

TITLE: DECO FERNI2 JFD AT 10-METERS FOR 1991
BEGIN DATE: 91 1 1 1
END DATE: 91 12 31 24
OPTION TO PRINT MONTHLY JFDS: NO
OPTION TO PRINT SEASONAL JFDS: NO
OPTION TO PRINT STABILITY BY HOUR OF DAY: NO
OPTION TO PLACE JFD IN FILE FORMATTED FOR FAVAR/X00000: YES
OPTION TO USE 12 WIND SPEED CLASSES
INPUTTED WIND SPEED CLASSES IN MPH : .75 2.50 4.50 6.50 8.50 11.50 14.50 18.50 23.50 30.50 39.50 .00

PRIMARY MEASUREMENTS BASED ON:

WIND SPEED MEASURED AT 10.0 METERS IN MPH
BAD WIND SPEED DATA CODED: 999.90
WIND SPEED THRESHOLD: .75 MPH
WIND DIRECTION MEASURED AT 10.0 METERS
BAD WIND DIRECTION DATA CODED: 999.0
STABILITY BASED ON 1-A, 2-B, ..., 7-G
BAD STABILITY CODED: 8.0

BACK-UP MEASUREMENTS BASED ON:

NO BACKUP WIND SPEED MEASUREMENTS
NO BACKUP WIND DIRECTION MEASUREMENTS
NO BACKUP STABILITY MEASUREMENTS

WIND SPEED HEIGHT TO BE USED FOR JFD: 10.00 METERS

CONVERSION FACTOR TO CONVERT SIGMA RANGE TO SIGMA THETA: 6.0

FORMAT TO READ INPUT DATA: (412,F5.1,F3.0,10X,F1.0,27X,A6,I11,A3,A3,I27,A1)

FIRST DATA RECORD READ: FERNI2 91 1 1 1 0.0 220.0 4.0

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 10 METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS A

STABILITY BASED ON 1-A, 2-B, ..., 7-G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.76- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 4.50	1	2	1	0	2	1	4	0	1	0	0	0	0	0	1	1	14
4.51- 6.50	3	1	7	4	6	6	8	2	0	1	0	0	1	3	7	5	54
6.51- 8.50	4	2	11	13	16	9	10	1	5	1	0	0	8	10	11	11	125
8.51-11.50	1	7	8	7	16	9	8	0	2	7	0	0	8	10	16	9	130
11.51-14.50	0	2	6	4	15	10	0	0	0	9	0	0	5	23	8	0	96
14.51-18.50	0	0	0	4	8	0	0	0	0	1	0	0	0	10	4	0	37
18.51-23.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.51-30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
TOTAL	9	14	33	32	63	35	30	3	8	22	26	30	22	56	47	26	456

STABILITY CLASS B

STABILITY BASED ON 1-A, 2-B, ..., 7-G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.76- 2.50	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2.51- 4.50	1	0	4	4	3	0	0	0	2	0	0	1	1	0	3	2	21
4.51- 6.50	6	4	7	0	7	8	8	4	5	4	4	1	4	8	6	2	78
6.51- 8.50	1	0	9	5	8	14	13	4	13	11	7	10	3	7	8	20	133
8.51-11.50	3	5	2	5	4	18	9	3	6	25	19	16	12	10	2	5	144
11.51-14.50	2	1	1	2	6	6	1	0	0	8	6	7	5	6	3	0	54
14.51-18.50	1	0	0	2	7	3	0	0	0	3	8	0	0	1	1	0	26
18.51-23.50	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	3
23.51-30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	15	10	23	19	35	49	31	11	26	51	45	35	25	33	23	29	460

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 10-METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS C

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	WW	WNW	TOTAL
CALM																	0
.76- 2.50	1	1	1	0	1	0	0	0	1	0	1	0	0	1	1	1	0
2.51- 4.50	4	2	3	3	1	2	4	3	5	2	3	3	2	8	3	3	51
4.51- 6.50	4	10	8	7	7	9	14	11	13	7	5	10	13	9	13	10	150
6.51- 8.50	4	2	5	2	11	18	23	13	15	11	13	16	16	9	12	14	104
8.51-11.50	5	5	11	12	12	9	21	13	6	23	29	17	19	8	10	3	201
11.51-14.50	6	3	2	6	11	8	1	0	1	17	17	9	8	9	1	0	99
14.51-18.50	5	1	1	1	4	0	0	0	1	1	21	1	2	5	2	0	45
18.51-23.50	0	0	0	0	2	0	0	0	0	1	9	1	0	0	0	0	13
23.51-30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	29	26	31	31	49	46	63	40	42	62	98	57	60	47	42	30	751

STABILITY CLASS D

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	WW	WNW	TOTAL
CALM																	8
.76- 2.50	4	8	3	5	6	4	2	8	6	5	8	8	6	6	10	5	94
2.51- 4.50	22	21	19	11	10	23	11	21	7	15	14	51	28	26	29	25	333
4.51- 6.50	34	23	32	24	23	37	50	35	37	37	51	96	78	47	54	63	721
6.51- 8.50	38	8	72	38	41	68	60	59	58	52	86	64	82	50	48	71	895
8.51-11.50	51	28	92	91	43	45	39	28	31	87	109	78	48	33	39	42	884
11.51-14.50	31	17	25	33	46	31	13	6	19	52	94	29	25	22	5	11	459
14.51-18.50	23	8	5	22	33	3	2	2	4	24	35	18	20	14	2	0	215
18.51-23.50	0	0	0	0	3	1	0	0	0	7	12	5	3	0	0	0	33
23.51-30.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	203	113	248	227	204	212	177	159	162	279	410	349	290	198	187	217	3643

PROGRAM: JFD VERSION: PC-1.1

DECD FERM12 JFD AT 10-METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS E

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	TOTAL
CALM																6
.76- 2.50	8	8	3	8	2	1	8	7	8	9	14	23	19	21	13	9
2.51- 4.50	43	23	17	9	11	11	14	27	31	33	88	88	48	65	59	161
4.51- 6.50	27	14	18	15	18	40	23	17	38	68	74	75	49	29	39	600
6.51- 8.50	15	9	29	25	22	46	25	21	35	88	71	18	18	18	6	8
8.51-11.50	11	9	8	15	10	27	31	20	62	96	56	8	7	9	1	2
11.51-14.50	1	3	0	0	1	6	2	10	12	29	25	1	0	2	1	0
14.51-18.50	0	0	0	0	2	1	0	1	7	15	6	0	0	0	0	32
18.51-23.50	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	4
23.51-30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	105	64	75	72	66	132	103	103	194	339	336	213	141	144	119	2325

STABILITY CLASS F

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	TOTAL
CALM																14
.76- 2.50	7	5	3	4	1	4	2	7	12	10	7	13	12	20	10	7
2.51- 4.50	16	8	0	0	3	6	2	2	14	27	31	40	38	37	30	32
4.51- 6.50	10	4	0	1	5	20	12	9	14	24	7	3	0	7	8	11
6.51- 8.50	3	0	0	3	11	17	15	11	24	41	2	0	0	0	0	0
8.51-11.50	0	0	0	0	5	9	5	18	32	39	1	0	0	0	0	127
11.51-14.50	0	0	0	0	0	1	2	5	4	10	0	0	0	0	0	109
14.51-18.50	0	0	0	0	0	1	2	1	2	4	0	0	0	0	0	22
18.51-23.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
23.51-30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	36	17	3	8	25	58	40	53	102	155	48	56	50	64	48	827

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 10-METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS 6

STABILITY BASED ON 1-A, 2-B, ..., 7-G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	WW	WNW	TOTAL
CALM																	0
.76 - 2.50	3	2	0	0	0	0	1	0	1	2	2	2	4	10	11	5	43
2.51 - 4.50	18	0	0	0	1	4	2	0	0	3	3	5	16	37	26	31	146
4.51 - 6.50	9	0	0	0	1	4	5	1	1	8	2	0	0	3	0	7	41
6.51 - 8.50	2	0	0	0	0	0	7	7	2	6	0	0	0	0	0	0	24
8.51 - 11.50	0	0	0	0	3	6	9	11	6	2	0	0	0	0	0	0	37
11.51 - 14.50	0	0	0	0	0	1	1	3	0	0	0	0	0	0	0	0	5
14.51 - 18.50	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
18.51 - 23.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23.51 - 30.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30.51 - 39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	32	2	0	0	5	15	25	24	10	21	7	7	20	50	37	43	296

STABILITY CLASS ALL

STABILITY BASED ON 1-A, 2-B, ..., 7-G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 10.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	WW	WNW	TOTAL
CALM																	28
.76 - 2.50	24	24	10	17	10	9	13	22	28	26	32	56	41	58	45	26	431
2.51 - 4.50	105	56	44	27	31	47	37	53	60	80	139	188	133	173	151	127	1451
4.51 - 6.50	93	56	72	51	67	124	120	79	108	149	143	185	145	106	127	155	1780
6.51 - 8.50	67	21	126	86	109	172	153	116	152	213	180	117	127	94	85	124	1942
8.51 - 11.50	71	54	121	130	93	123	122	93	145	279	226	129	96	68	68	61	1877
11.51 - 14.50	40	26	34	45	79	63	20	24	36	125	149	53	43	62	18	11	828
14.51 - 18.50	29	9	6	29	54	8	4	6	14	48	76	23	22	30	9	0	367
18.51 - 23.50	0	0	0	4	4	1	0	0	1	9	24	6	3	1	0	0	53
23.51 - 30.50	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
30.51 - 39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	429	246	413	389	447	547	469	393	544	929	970	747	608	592	503	504	8758

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 10-METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

STABILITY BASED ON 1=A,2=B,.....,7=G

WIND MEASURED AT: 10.0 METERS

WIND THRESHOLD AT: .75 MPH

TOTAL NUMBER OF OBSERVATIONS: 8760

TOTAL NUMBER OF VALID OBSERVATIONS: 8758

TOTAL NUMBER OF MISSING OBSERVATIONS: 2

PERCENT DATA RECOVERY FOR THIS PERIOD: 100.0 %

MEAN WIND SPEED FOR THIS PERIOD: 7.6 MPH

TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

*** ANNUAL ***

PERCENTAGE OCCURRENCE OF STABILITY CLASSES						
A	B	C	D	E	F	G
5.21	5.25	8.58	41.60	26.52	9.44	3.40

DISTRIBUTION OF WIND DIRECTION VS STABILITY																	
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	CAW	
A	9	14	33	32	63	35	30	3	8	22	26	30	22	56	47	26	0
B	15	10	23	19	35	49	31	11	26	51	45	35	25	33	23	29	0
C	29	26	31	31	49	46	63	40	42	62	98	57	60	47	42	55	0
D	203	113	248	227	204	212	177	159	162	279	410	349	200	108	187	217	8
E	105	66	75	72	66	132	103	103	104	339	336	213	141	144	119	109	6
F	36	17	3	8	25	58	40	53	102	155	48	56	50	64	48	50	14
G	32	2	0	0	5	15	25	24	10	21	7	7	20	50	37	43	0
TOTAL	429	246	413	389	447	547	469	393	544	929	970	747	608	592	503	504	28

HALLIBURTON NUS CORPORATION

ATR/RADIOLOGICAL PROGRAMS DEPARTMENT

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PROGRAM: A.D. VERSION: PC-1.1

LAST DATA RECORD READ: FERN12 91 12 31 24 3.5 172.0 3.0

OUTPUT FILE NAME :JFD10M91.OUT

JOINT FREQUENCY DISTRIBUTION (JFD) AT
THE 60-METER LEVEL

1991

PROGRAM: JFD VERSION: PC-1.1

PRINTOUT OF INPUT CONTROL DATA

TITLE: DECO FERM12 JFD AT 60-METERS FOR 1991

BEGIN DATE: 91 1 1 1

END DATE: 91 12 31 24

OPTION TO PRINT MONTHLY JFDS: NO

OPTION TO PRINT SEASONAL JFDS: NO

OPTION TO PRINT STABILITY BY HOUR OF DAY: NO

OPTION TO PLACE JFD IN FILE FORMATTED FOR PAVAN/KODQ000: NO

OPTION TO USE 12 WIND SPEED CLASSES

INPUTTED WIND SPEED CLASSES IN MPH : .75 2.50 4.50 6.50 8.50 11.50 14.50 18.50 23.50 30.50 39.50 .00

PRIMARY MEASUREMENTS BASED ON:

WIND SPEED MEASURED AT 60.0 METERS IN MPH

BAD WIND SPEED DATA CODED: 999.00

WIND SPEED THRESHOLD: .75 MPH

WIND DIRECTION MEASURED AT 60.0 METERS

BAD WIND DIRECTION DATA CODED: 999.0

STABILITY BASED ON 1=A, 2=B, ..., 7=G

BAD STABILITY CODED: 8.0

BACK-UP MEASUREMENTS BASED ON:

NO BACKUP WIND SPEED MEASUREMENTS

NO BACKUP WIND DIRECTION MEASUREMENTS

NO BACKUP STABILITY MEASUREMENTS

WIND SPEED HEIGHT TO BE USED FOR JFD: 60.00 METERS

CONVERSION FACTOR TO CONVERT SIGMA RANGE TO SIGMA THETA: 6.0

FORMAT TO READ INPUT DATA: (412,T30,FS,1,F3,0,T27,F1,0,T55,A6,T40,A3,A3,T27,A1)

FIRST DATA RECORD READ: FERM12 91 1 1 1 14.5 223.0 4.0

PROGRAM: JFD VERSION: PC-1.1

DECO FERMIZ JFD AT 60-METERS FOR 1991

SITE IDENTIFIER: FERMIZ

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS A

STABILITY BASED ON 1-A,2-B,....,7-G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	TOTAL
CALM																
.76- 2.50	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2.51- 4.50	0	2	0	0	1	1	1	1	0	0	0	1	0	0	0	1
4.51- 6.50	1	0	2	2	3	1	3	1	0	0	0	0	0	0	1	8
6.51- 8.50	4	2	4	9	8	2	9	1	0	1	0	0	0	0	1	16
8.51-11.50	4	1	8	10	20	16	9	2	4	6	0	3	5	5	13	42
11.51-14.50	1	2	6	6	9	3	0	0	0	6	3	5	5	7	8	113
14.51-18.50	0	3	10	4	9	7	1	0	0	7	6	10	12	15	11	65
18.51-23.50	0	1	8	3	14	0	0	0	0	3	4	10	5	19	6	102
23.51-30.50	0	0	0	0	4	0	0	0	0	0	2	11	0	11	5	73
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	33
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
TOTAL	10	11	38	34	68	31	23	5	4	23	15	41	27	59	45	456

STABILITY CLASS B

STABILITY BASED ON 1-A,2-B,....,7-G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	TOTAL
CALM																
.76- 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.51- 4.50	1	3	0	1	1	0	0	0	0	0	0	0	0	1	0	8
4.51- 6.50	2	1	2	4	6	4	4	2	1	3	2	1	1	3	1	38
6.51- 8.50	3	3	3	1	4	9	5	5	5	4	1	2	2	4	2	54
8.51-11.50	2	1	6	9	16	12	12	2	8	15	5	3	3	7	5	115
11.51-14.50	1	0	6	1	3	5	5	1	0	15	7	11	5	7	7	83
14.51-18.50	1	2	3	6	6	8	1	0	0	15	10	14	10	11	3	89
18.51-23.50	1	1	1	3	8	2	0	0	0	4	2	10	9	3	2	46
23.51-30.50	0	0	0	0	3	0	0	0	0	2	4	10	0	4	2	25
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	11	11	21	19	47	40	27	10	14	58	31	52	30	36	26	460

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 60 METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS C

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	WW	WNW	TOTAL
CALM																	0
.76- 2.50	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	3
2.51- 4.50	4	1	1	0	1	3	1	2	1	2	0	2	0	2	1	1	22
4.51- 6.50	2	3	3	0	4	5	4	10	5	4	4	3	0	8	1	2	66
6.51- 8.50	3	5	4	4	7	16	11	9	11	4	3	4	4	4	3	1	93
8.51-11.50	2	5	5	8	12	8	26	23	12	14	3	13	10	10	14	15	180
11.51-14.50	3	5	7	12	5	5	1	3	4	13	19	10	13	7	8	5	120
14.51-18.50	6	2	4	5	8	4	1	0	1	11	19	11	22	4	11	1	110
18.51-23.50	5	2	1	2	13	2	0	0	0	6	15	21	13	5	4	0	91
23.51-30.50	2	1	0	0	3	0	0	0	0	1	11	15	5	9	3	0	50
30.51-39.50	0	0	0	0	0	0	0	0	0	1	6	7	1	1	0	0	16
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	27	25	25	39	53	43	44	47	37	56	80	86	68	51	45	25	751

STABILITY CLASS D

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.00 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	WW	WNW	TOTAL
CALM																	0
.76- 2.50	2	4	2	4	2	1	2	2	0	2	3	2	0	0	3	1	30
2.51- 4.50	4	3	5	6	4	9	15	8	5	4	6	5	3	5	4	7	93
4.51- 6.50	19	13	17	14	20	29	20	25	11	6	7	11	10	8	13	16	230
6.51- 8.50	19	12	21	27	11	23	25	38	32	21	9	31	15	15	19	16	334
8.51-11.50	27	14	36	53	34	42	44	55	32	40	43	54	66	38	47	55	674
11.51-14.50	42	20	71	81	35	33	24	18	32	54	65	84	84	30	43	61	777
14.51-18.50	44	15	75	39	32	33	16	9	19	38	82	106	74	53	41	40	716
18.51-23.50	27	14	19	19	55	25	0	3	23	40	100	100	35	18	17	16	511
23.51-30.50	10	7	9	4	24	8	0	0	2	21	38	39	34	26	4	0	226
30.51-39.50	0	0	0	0	0	0	0	0	0	4	7	16	20	0	0	0	48
>39.50	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	4
TOTAL	194	102	255	248	217	194	146	158	156	230	361	451	335	193	191	212	3643

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 60-METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/1/91

*** ANNUAL ***

STABILITY CLASS E

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.00 METERS

SPEED

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	0
CALM																		
.76- 2.50	1	0	1	2	1	0	1	0	3	1	2	0	1	1	0	1	1	15
2.51- 4.50	4	4	3	4	9	6	7	8	4	3	2	3	3	6	4	4	4	74
4.51- 6.50	5	7	17	14	7	4	8	7	7	12	11	5	6	4	4	9	127	
6.51- 8.50	16	13	24	13	6	16	23	20	13	18	16	13	7	10	12	19	239	
8.51- 11.50	21	15	24	28	17	20	19	30	23	35	60	60	28	25	34	35	474	
11.51- 14.50	21	14	20	12	15	28	29	20	14	52	81	111	69	37	44	38	605	
14.51- 18.50	10	21	11	9	13	21	16	14	28	78	107	77	30	26	11	9	481	
18.51- 23.50	1	2	1	1	11	10	5	5	32	65	61	20	11	10	0	0	235	
23.51- 30.50	0	0	0	0	0	6	0	1	10	10	18	6	0	1	1	0	53	
30.51- 39.50	0	0	0	0	0	0	0	0	2	12	5	0	0	0	0	0	19	
>39.50	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
TOTAL	79	76	101	83	79	111	108	105	136	286	363	296	155	120	110	115	2323	

STABILITY CLASS F

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.00 METERS

SPEED

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	NW	MMW	TOTAL
CALM																		0
.76- 2.50	2	1	0	0	3	2	1	1	0	0	1	0	1	0	0	0	1	33
2.51- 4.50	2	1	5	2	3	2	1	0	2	5	2	1	3	0	1	1	2	32
4.51- 6.50	1	5	5	3	3	1	2	7	10	5	5	4	4	2	4	4	3	64
6.51- 8.50	9	5	10	3	3	7	4	14	8	4	3	2	8	7	1	7	95	
8.51- 11.50	13	5	5	2	3	6	7	8	14	10	15	15	5	9	13	14	144	
11.51- 14.50	15	3	0	0	4	6	7	7	6	5	18	19	16	17	22	21	166	
14.51- 18.50	2	0	0	0	2	17	11	6	21	21	39	9	18	2	7	4	159	
18.51- 23.50	0	0	0	0	2	3	4	3	25	56	14	0	0	0	0	0	107	
23.51- 30.50	0	0	0	0	0	2	2	2	12	19	4	0	0	0	0	0	41	
30.51- 39.50	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	6	
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL	44	20	25	10	23	46	39	48	98	130	102	50	55	37	48	52	827	

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 60 METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY CLASS C

STABILITY BASED ON 1=A,2=B,...,7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.0 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	TOTAL
CALM																
.76- 2.50	0	2	0	0	0	1	0	0	0	1	0	1	1	0	2	0
2.51- 4.50	0	2	6	3	0	2	0	1	0	1	0	1	3	1	0	9
4.51- 6.50	2	6	9	0	2	1	2	1	3	2	1	2	0	3	2	20
6.51- 8.50	3	5	3	1	1	2	1	1	2	6	1	1	2	7	4	37
8.51-11.50	8	6	8	1	0	0	1	1	1	6	4	3	3	6	9	44
11.51-14.50	1	6	0	0	0	1	1	1	1	3	4	4	6	10	3	64
14.51-18.50	1	0	0	0	0	2	1	4	14	5	4	1	3	0	2	40
18.51-23.50	0	0	0	0	0	3	2	3	9	8	1	0	0	0	0	38
23.51-30.50	0	0	0	0	0	3	6	7	1	3	0	0	0	0	0	26
30.51-39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>39.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	15	27	26	5	3	15	14	19	31	34	15	9	18	27	22	298

STABILITY CLASS ALL

STABILITY BASED ON 1=A,2=B,...,7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 60.0 METERS

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NNW	TOTAL
CALM																
.76- 2.50	5	8	3	6	6	5	4	3	4	4	6	3	3	2	5	0
2.51- 4.50	15	16	20	16	19	23	25	20	12	15	10	13	12	15	10	71
4.51- 6.50	32	35	55	45	45	36	43	53	37	32	30	26	21	26	28	257
6.51- 8.50	57	45	69	58	40	75	78	88	71	58	33	53	38	44	50	578
8.51-11.50	77	47	92	111	102	104	118	121	94	125	130	151	114	100	135	901
11.51-14.50	84	50	110	112	71	81	57	50	57	148	197	240	198	115	135	1704
14.51-18.50	64	43	103	57	70	92	47	33	83	175	287	228	169	111	86	1856
18.51-23.50	34	20	30	28	103	45	11	14	91	182	197	161	73	55	29	1695
23.51-30.50	12	8	9	4	34	19	8	10	25	56	77	81	39	51	15	1089
30.51-39.50	0	0	0	0	0	0	0	0	2	22	19	25	21	4	0	94
>39.50	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	5
TOTAL	380	272	491	438	490	480	401	392	476	817	967	985	688	523	487	8758

PROGRAM: JFD VERSION: PC-1.1

DECO FERM12 JFD AT 60-METERS FOR 1991

SITE IDENTIFIER: FERM12

DATA PERIOD EXAMINED: 1/ 1/91 - 12/31/91

*** ANNUAL ***

STABILITY BASED ON 1=A, 2=B, ..., 7=G

WIND MEASURED AT: 60.0 METERS

WIND THRESHOLD AT: .75 MPH

TOTAL NUMBER OF OBSERVATIONS: 8760

TOTAL NUMBER OF VALID OBSERVATIONS: 8758

TOTAL NUMBER OF MISSING OBSERVATIONS: 2

PERCENT DATA RECOVERY FOR THIS PERIOD: 100.0 %

MEAN WIND SPEED FOR THIS PERIOD: 13.5 MPH

TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
5.21	5.25	8.58	41.60	26.52	9.44	3.40

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	10	11	38	34	68	31	23	5	4	23	15	41	27	59	45	22	0
B	11	11	21	19	47	40	27	10	14	58	31	52	30	36	26	27	0
C	27	25	25	39	53	43	44	47	37	56	80	86	68	51	45	25	0
D	194	102	255	248	217	194	146	158	156	230	361	451	335	193	191	212	0
E	79	76	101	83	79	111	108	105	136	286	363	296	155	120	110	115	0
F	44	20	25	10	23	46	39	48	98	130	102	50	55	37	48	52	0
G	15	27	26	5	3	15	14	19	31	34	15	9	18	27	22	18	0
TOTAL	380	272	491	438	490	480	401	392	476	817	967	985	688	523	487	471	0

HALLIBURTON NUS CORPORATION

AIR/RADIOLOGICAL PROGRAMS DEPARTMENT

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PROGRAM: JFD VERSION: PC-1.1

LAST DATA RECORD READ: FERM12 91 12 31 24 4.8 175.0 3.0

API-ENDIX B: PROCESS CONTROL PROGRAM MANUAL