The University of Michigan

MICHIGAN MEMORIAL – PHOENIX PROJECT
PHOENIX MEMORIAL LABORATORY FORD NUCLEAR REACTOR
ANN ARBOR, MICHIGAN 48109-2100

6 May 2003

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Licensee: Docket 50-2, License R-28

Subject: Annual Report for Period 01 January through 31 December 2001 - Revised

Dear Sir or Ma'am;

Enclosed is a revision to the written annual report required by Technical Specifications for the period of 01 January through 31 December 2001. The revision was primarily to report dosimetry information which was not available at the time of submission of the original report. Additionally, minor editorial changes were made to correct spelling and grammatical errors.

If there are any questions regarding this report, please feel free to contact me at (734) 764-6213.

Respectfully,

Christopher W. Becker
Nuclear Reactor Laboratory Manager

Encl: Report of Reactor Operations, Ford Nuclear Reactor January 1 - December 31, 2001 - Revised

Cc: American Nuclear Insurers
Town Center, Suite 300S
29 South Main Street
West Hartford, CT 06107-2430

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File: Correspondence 03-008
Annual Report 2001 - Revised
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FORD NUCLEAR REACTOR

Docket No. 50-2
License No. R-28

REPORT OF REACTOR OPERATIONS

Revised

This report reviews the operation of the University of Michigan's Ford Nuclear Reactor for the period January 1 to December 31, 2001. The report is to meet the requirement of Technical Specifications for the Ford Nuclear Reactor. The format for the sections that follow conforms to Section 6.6.1 of Technical Specifications.

The Ford Nuclear Reactor is operated by the Michigan Memorial Phoenix Project of the University of Michigan. The Project, established in 1948 as a memorial to students and alumni of the University who served and the 588 who died in World War II, encourages and supports research on the peaceful uses of nuclear energy and its social implications. In addition to the Ford Nuclear Reactor (FNR), the Project operates the Phoenix Memorial Laboratory (PML). These laboratories, together with a faculty research grant program, are the means by which the Project carries out its purpose.
The operation of the Ford Nuclear Reactor provides major assistance to a wide variety of research and educational programs. The reactor provides neutron irradiation services and neutron beamport experimental facilities for use by faculty, students, and researchers from the University of Michigan, other universities, and industrial research organizations. Reactor staff members teach classes related to nuclear reactors and the Ford Nuclear Reactor in particular and assist in reactor-related laboratories.

1. OPERATIONS SUMMARY

In January, 1966, a continuous operating cycle was adopted for the Ford Nuclear Reactor at its licensed power level of two megawatts. The cycle consisted of approximately 25 days at full power followed by three days of shutdown maintenance. In June, 1975, a reduced operating cycle consisting of ten days at full power followed by four days of shutdown maintenance was adopted. A typical week consisted of 120 full-power operating hours. In July, 1983, the reactor operating schedule was changed to Monday through Friday at licensed power and weekend shutdowns. Periodic maintenance weeks were scheduled during the year. In January, 1985, a cycle consisting of four days or 96 full-power operating hours per week at licensed power followed by three days of shutdown maintenance was established in order to eliminate the periodic shutdown maintenance weeks needed in the previous cycle. Beginning July 1, 1987, the reactor operating cycle returned to ten day operation at full power followed by four days of shutdown maintenance. This calendar year began with cycle 454 and ended with cycle 466. A typically cycle covers four weeks; two of the ten day - four day sequences.

The reactor operates at a maximum power level of two megawatts which produces a peak thermal flux of approximately $2x10^{13}$ n/cm^2/sec. An equilibrium core configuration consists of approximately 41 standard and 4 control, 19.75% enriched, plate-type fuel elements. Standard elements contain 167 gm of U235 in 18 aluminum clad fuel plates. Control elements, which have control rod guide channels, have nine plates and contain 83 gm of U235. Overall active fuel element dimensions are approximately 3"x 3"x 24".

Fuel elements are retired after burnup levels of approximately 35-40% are reached. Fuel burnup rate is approximately 2.46 gm U235/day at two megawatts.

1.1 Facility Design Changes

Modification Request #144, *Installation of a 25 h.p. Pump-Motor Set into the Primary Coolant System*. The installed 20 h.p. primary coolant pump failed in early February 2001. A replacement 25 h.p. pump-motor set was installed. Testing showed that is was capable of providing over 1100 gallons per minute of primary coolant flow.

While performing the Safety Evaluation, a review of the Safety Analysis Report (SAR) found that the description of the primary coolant system states in part that: "The flow rate is between 900 and 1000 gallons per minute." The SAR also gives values of core excess reactivity and power defect, among other core parameters. Increased flow is expected to reduce power defect below the SAR stated value. This affects the determination of core excess reactivity.

The safety evaluation concluded that, until the power defect-core excess reactivity issue is resolved, it was best to throttle primary flow at about 1050 nominal gallons per minute under a Temporary Operating Instruction.

1.2 Equipment and Fuel Performance Characteristics

The reactor was refueled on April 13-16, 2001. Three new regular fuel assemblies and one new control fuel assembly were installed. Three regular fuel assemblies and one control fuel assembly were retired. The core excess reactivity, after refueling and performing rod calibrations, was 3.89% Δ k/k.

Four new regular fuel assemblies and one new regular fuel assembly were received on April 19, 2001 (ZBF-ZMZ-19)

The reactor was refueled on September 4-5, 2001. Three new regular fuel assemblies and one new control fuel assembly were installed. Three regular fuel assemblies and one control fuel assembly were retired. The core excess reactivity, after refueling and performing rod calibrations, was 3.89% Δ k/k.

Five new regular fuel assemblies were received on October 5, 2001. (ZBF-ZMZ-20)

Two new special fuel assemblies and two new special fuel assemblies were received on December 13, 2001. (ZBF-ZMZ-21)

No irradiated fuel shipments were made in 2001.

1.3 Safety-Related Procedure Changes

Safety-related procedures are those associated with operation, calibration, and maintenance of the primary coolant, the reactor safety system, the shim-safety rods, all scram functions, the high temperature auto rundown function, and the pool level rundown.

Calibration and Maintenance Procedures

1. CP-101 *Reactor Maintenance Schedule*, Rev 21 dated 08 Jan 01
   Identify the frequency requirements for routine maintenance items, and to set guidelines for scheduling routine and non-routine maintenance for shutdown periods.
   No substantial changes were made.
   The notable changes were 1) addition of SNM Inventory 2) addition of SNM-179 inventory 3) addition of calibrations for Keithley 261 I, Fluke 83 DVM, Fluke 83 III DVM, Ludlum 500 Pulser and Keithley 485 Picoammeter 4) addition of Cleaning Secondary Chemical Piping 5) LCR Hose-Cable replacement (even years) 6) addition of Map Pump Vane Replacement and 7) editing changes.

2. CP-218 *Magnet Power Supply Calibration*, Rev 4 dated 04 Jun 01.
   Provides a safe and consistent method for calibrating the scram system magnet power supply.
   No substantial changes were made.
   The notable changes were 1) relaxed limits on over current trip 2) spaces for Millimeter Model and Calibration dates and 3) editing changes for ease of understanding the procedure.

Operating Procedures

1. OP-102 *Reactor Shutdown*, Rev 18 dated 13 Jan 01.
   Provide consistent manipulation of controls and sequence of operations for routine reactor shutdown at the conclusion of an operating cycle or for a holiday.
   No substantial changes were made.
   The notable change was adding the requirement to "perform security checks per MP-203 *Security Area Surveillance*".

2. OP-201 *Building Checklist*, Rev 42 dated 16 May 01.
   Provide for specific requirements for items on the Building Checklist.
   No substantial changes were made.
   The notable change was adding data taking for an experiment.

3. OP-102 *Reactor Shutdown*, Rev 19 dated 2 Jun 01.
   Provide consistent manipulation of controls and sequence of operations for routine reactor shutdown at the conclusion of an operating cycle or for a holiday.
   No substantial changes were made.
   The notable change was reordering of steps.

4. OP-301 *Building Power Failure*, Rev 7 dated 2 Jun 01.
   Lists the checks that must be made if a power failure is judged to have occurred.
   No substantial changes were made.
   The notable change was to add channel checks of Level Safety Channels A and B, Period Safety Channel C and Power Flow Coincidence Scrams to ensure Tech Spec 4.2.1 is satisfied.

1.4 Maintenance, Surveillance Tests, and Inspection Results as Required by Technical Specifications.

Maintenance, surveillance tests, and inspections required by Technical Specifications were completed at the prescribed intervals. Procedures, data sheets, and a maintenance schedule/record provide documentation.

1.5 Summary of Changes, Tests, and Experiments for Which NRC Authorization was Required.

None

1.6 Operating Staff Changes

The following reactor operations staff changes occurred:

New Hire	Position	Date
Shane Rye	Reactor Operator	March 12, 2001
John Dasch	Reactor Operator (50%)	September 10, 2001

Terminated	Position	Date
Benjamin Huck	Engineering Tech III	January 3, 2001

Safety Review Committee Changes

The following Safety Review Committee Changes occurred:

New Appointees	Position	Date
John Lee	Chairman	February 2, 2001
John King	Faculty Member (ex-chairman)	February 2, 2001
William R. Martin	Faculty Member	July 5, 2001

Removed Appointees	Position	Date
James E. Martin	Faculty Member	February 2, 2001

2. POWER GENERATION SUMMARY

The following table summarizes reactor annual power generation.

Cycle	Inclusive Dates	Operating Hours	Full Power Operating Hours	Megawatt Hours	Percent Availability
454	01/07/01 - 02/0/01	492.9	481.5	967.2	71.7
455	02/04/01 - 03/03/01	449.2	423.3	850.4	63
456	03/04/01 - 03/31/01	257.3	242.6	487.1	36.1
457	04/01/01 - 04/28/01	493.2	441.7	912.6	65.7
458	04/29/01 - 05/26/01	499.1	480.7	964.2	71.5
459	05/27/01 - 06/23/01	473.2	427.4	859.9	63.6
460	06/24/01 - 07/21/01	467.3	456.8	898.1	68
461	07/22/01 - 08/18/01	496.2	484.6	974.1	72.1
462	08/19/01 - 09/15/01	421.6	331.3	670.9	49.3
463	09/16/01 - 10/13/01	491.5	478.3	960.9	71.2
464	10/14/01 - 11/10/01	474.2	458.1	920.8	68.2
465	11/11/01 - 12/08/01	421.6	405.9	816.4	60.4
466	12/09/01 - 01/05/01	247.1	242.3	486.3	36.1
	Total:	5684.4	5354.5	10768.9	796.9

3. UNSCHEDULED REACTOR SHUTDOWN SUMMARY

The following table summarizes unscheduled reactor shutdowns.

3.1 Shutdown Type Definitions

Single Rod Drop and Multiple Rod Drop (NAR) - An unscheduled shutdown caused by the release of one or more of the reactor shim-safety rods from its electromagnet, and for which at the time of the rod release, no specific component malfunction and no apparent reason (NAR) can be identified as having caused the release.

Operator Action - A condition exists (usually some minor difficulty with an experiment) for which the operator on duty judges that shutdown of the reactor is required until the difficulty is corrected.

Operator Error - The operator on duty makes a judgment or manipulative error that results in shutdown of the reactor.

Process Equipment Failure - Shutdown caused by a malfunction in the process equipment interlocks of the reactor control system.

Reactor Controls - Shutdown initiated by malfunction of the control and detection equipment directly associated with the reactor safety and control system.

Electrical Power Failure - Shutdown caused by interruption in the reactor facility electric power supply.

3.2 Summary of Unscheduled Shutdowns

12 Feb 01 The reactor was shut down due to a loss of external electrical power. The reactor was restarted without difficulty after electrical power was restored to the building. **Electrical Power Failure.**

04 April 01 The reactor was shut down due to a building alarm that was inadvertently actuated while an operator was checking the stack alarm relay. The reactor was restarted without difficulty after the relay was reset to normal. **Operator Error.**

26 April 01 The reactor was shut down due to a loss of external electrical power. The reactor was restarted without difficulty after electrical power was restored to the building. **Electrical Power Failure.**

11 Sept 01 The reactor was shut down in response to terrorist activity in the United States. Additional security precautions were implemented immediately. The reactor was restarted without difficulty. Additional security precautions continue to be in place. No actual security violations, breaches or threats have been experienced. **Operator Action.**

19 Sept 01 The reactor was shut down due to an electrical power flicker. The reactor was restarted without difficulty after electrical power was restored to the building. **Electrical Power Failure.**

04 Oct 01 The reactor was shut down due to operator interpretation of technical specifications after the radiation recorder chart paper motor stopped functioning. Further inspection revealed that the connector to the chart drive motor was loose, probably jostled when the chart paper was replaced. The connector was tightened and the chart drive returned to normal. The reactor was then restarted without difficulty. **Operator Action.**

3.3 Characterization of Unscheduled Shutdowns

Single Rod Drop (NAR)	0
Multiple Rod Drop (NAR)	0
Operator Action	2
Operator Error	1
Process Equipment Failure	0
Reactor Controls	0
Electric Power Failure	3
Total Unscheduled Shutdowns	6

4. CORRECTIVE MAINTENANCE ON SAFETY RELATED SYSTEMS AND COMPONENTS

24 Jan 01 Capstan drive for the filter paper on #2 Stack Map was found to be inoperable. The capstan was sanded where galling was occurring. The shear pin was also replaced.

02 Feb 01 The shear pin for #2 Stack Map failed. The shear pin was replaced.

05 Mar 01 While performing a calibration on magnet power supply S/N T0792673 for routine maintenance, Channel B high current trip circuit began oscillating. Replacement of the diode in the trip circuit was performed.

26 Mar 01 Pressure boundary on primary heat exchanger was broken for cleaning of the heat exchanger. The primary end bell was remounted then torqued to 20 ft-lbs, then 30 ft-lbs and finally to 45 ft-lbs.

02 Apr 01 Failure of magnet current on C rod when magnet cable was moved, during a fuel move. Repair was accomplished by replacing C magnet and cable with a spare.

30 Apr 01 Linear Level compensating voltage display was reading zero. A loose edge connection was found and replaced on the indicating circuit.

12 May 01 #2 Log Count Rate fission chamber was reading erratic. A new detector and connection were installed. The signal cable and hose were trimmed back due to degradation. In addition a new o-ring was installed.

26 Jun 01 Cooling water for the reactor air compressor would not shut off when the compressor stopped. The automatic shutoff solenoid valve was replaced.

27 Jun 01 The temporary rate meter for the Beam Hole Floor Map was replaced with a permanent rate meter.

17 Sep 01 Failure of #2 Primary Flow digital display. Proper operation of the rest of #2 Primary Flow instrument was verified by DC and AC voltage readings. The digital display was replaced and proper indication was noted with the primary pump on.

15 Oct 01 Random noise observed on all channels of the Temperature Recorder. Analog Gain and Analog/Digital conversion card was replaced with a spare card. The spare card would not function properly after recorder calibration and setup. The original card was installed and re-calibrated.

16 Oct 01 The Basement door alarm circuit, red light socket on the control console shorted to ground. This caused current overload to burn up theannunciator flasher. The flasher (discrete components) was replaced with a new flasher (modular design) with equivalent function. The Basement door alarm light socket was replaced. The other light sockets on the control console were also checked.

29 Oct 01 Random noise continued to be observed on all channels of the Temperature Recorder. The 15 volt power supply on the Analog Gain and Analog/Digital conversion card was refurbished with replacement parts: Q, Q2, VR1, VR2, VR3, VR4, VR7, VR8, VR9, C25, C26.

29 Oct 01 Due to a NRC concern of the test signal current being >2.45 MW indicated, The scram setpoint was lowered to 2.30-2.40 Mw range and the test current signal adjusted to 2.40-2.45 Mw range on Safety Channel "A".

12 Nov 01 Due to a NRC concern of the test signal current being >2.45 MW indicated, the scram setpoint was lowered to 2.30-2.40 Mw range and the test current signal adjusted to 2.40-2.45 Mw range on Safety Channel "B".

5. CHANGES, TESTS, AND EXPERIMENTS CARRIED OUT WITHOUT PRIOR NRC APPROVAL PURSUANT TO 10CFR50.59(a)

Modification Request #144, *Installation of a 25 h.p. Pump-Motor Set into the Primary Coolant System*. The installed 20 h.p. primary coolant pump failed in earl February 2001. A replacement 25 h.p. pump-motor set was installed Testing showed that is was capable of providing over 1100 gallons per minute of primary coolant flow.

While performing the Safety Evaluation, a review of the Safety Analysis Report (SAR) found the the description of the primary coolant system states in part that: "The flow rate is between 900 and 1000 gallons per minute." The SAR also gives values of core excess reactivity and power defect, among other core parameters. Increased flow are expected to reduce power below the SAR stated value. This affects the determination of core excess reactivity.

The safety evaluation concluded that, until the power defect-core excess reactivity issue is resolved, it was best to throttle primary flow at about 1050 nominal gallons per minute under a Temporary Operating Instruction.

6. RADIOACTIVE EFFLUENT RELEASE

Quantities and types of radioactive effluent releases, environmental monitoring locations and data, and occupational personnel radiation exposures are provided in this section.

6.1 Gaseous Effluents - ^{41}Ar Releases

Gaseous effluent concentrations are averaged over a period of one year.

	Quantity	Unit
a. Total gross radioactivity.	4.31×10^{7}	µCi
b. Average concentration released.	1.27×10^{-7}	µCi/ml
c. Average release rate.	1.37	µCi/sec
d. Maximum instantaneous concentration during special operations, tests, and experiments.	Not Applicable	µCi/ml
e. Percent of ^{41}Ar ERL (Effluent Release Limits) (1.0×10^{-8} µCi/ml) without dilution factor.	1274	Percent
f. Percent of ^{41}Ar ERL with a dilution factor of 400.	3.18	Percent

6.2 Radiohalogen Releases

a. Total iodine radioactivity by nuclide based upon a representative isotopic analysis. (Required if iodine is identified in primary coolant samples or if fueled experiments are conducted at the facility). Based on this criteria, this section of the report is not required. The analysis is based on primary coolant activity following one week of decay.

Iodine-131 was not identified in the one week count of the primary coolant samples. Xenon-133 was not identified in the one week count of the primary coolant samples.
The pool water analyses show no indication of leaking fuel.

b. ^{131}Iodine releases related to steady state reactor operation (Sample C-3, main reactor exhaust stack).

	Quantity	Unit
1. Total ^{131}I release.	26	μCi
2. Average concentration released.	1.19×10^{-13}	μCi/ml
3. Percent of ^{131}I ERL (2.0×10^{-10} μCi/ml) without dilution factor.	0.06	Percent
4. Percent of ^{131}I ERL with 400 dilution factor.	0.00015	Percent

c. Radiohalogen releases related to combined steady state reactor operation and radiation laboratory activities (Sample C-2; combined secondary reactor exhaust and partial radiation laboratory exhaust).

1. Total C-2 stack radiohalogen releases.

Br-80m	2495	μCi
Br-82	2542	μCi
I-131	501	μCi
Hg-203	8	μCi

2. Average concentration released.

	Quantity	Unit
Br-80m	2.07×10^{-11}	μCi/ml
Br-82	2.10×10^{-11}	μCi/ml
I-131	4.15×10^{-12}	μCi/ml
Hg-203	6.33×10^{-14}	μCi/ml

3. Percent of ERL without the dilution factor.

Br-80m	0.10	Percent
Br-82	0.42	Percent
I-131	2.07	Percent
Hg-203	0.01	Percent

4. Percent of ERL with a dilution factor of 400.

Br-80m	0.00025	Percent
Br-82	0.00105	Percent
I-131	0.00518	Percent
Hg-203	0.00002	Percent

d. Total Facility Release of Radiohalogens.

1. Total facility radiohalogen releases.

Br-80m	2,168	μCi
Br-82	3,885	μCi
I-125	727	μCi
I-131	2,920	μCi
Hg-203	48	μCi

1. Average concentration released.

Br-80m	3.42×10^{-12}	μCi/ml
Br-82	6.13×10^{-12}	μCi/ml
I-125	1.15×10^{-12}	μCi/ml
I-131	4.61×10^{-12}	μCi/ml
Hg-203	7.59×10^{-13}	μCi/ml

3. Percent of ERL without the dilution factor.

	Quantity	Unit
Br-80m	0.07	Percent
Br-82	0.123	Percent
I-125	0.302	Percent
I-131	2.305	Percent
Hg-203	0.008	Percent
TOTAL	2.755	Percent

4. Percent of ERL with a dilution factor of 400.

Br-80m	0.00004	Percent
Br-82	0.00031	Percent
I-125	0.00096	Percent
I-131	0.00576	Percent
Hg-203	0.00002	Percent
TOTAL	0.00709	Percent

6.3 **Particulate Releases**

Particulate activity for nuclides with half lives greater than eight days.

a. Total gross radioactivity.	103	µCi
b. Average concentration.	1.64×10^{-13}	µCi/ml
c. Percent of ERL (1.0×10^{-12} µCi/ml) without dilution factor.	16.41	Percent
d. Percent of ERL with a dilution factor of 400.	0.041	Percent

Gross alpha activity is required to be measured if the operational or experimental program could result in the release of alpha emitters.

e. Gross alpha radioactivity.	Not Required

6.4 **Liquid Effluents**

No radioactive liquid effluents were released from the facility in 2001.

6.5 **Accident Evaluation Monitoring**

The accident evaluation monitoring program for the Ford Nuclear Reactor facility consists of direct radiation monitors (TLD), air sampling stations located around the facility, and selected water and sewer sampling stations.

a. **TLD Monitors**

TLDs located at stations to the north (lawn adjacent to the reactor building), northeast (fluids), east (Beal Avenue), south (Glazier Way), and west (School of Music) of the reactor facility are collected and sent to a commercial dosimetry company for analysis.

Location	Direction	Annual Total (mrem)	Quarterly Mean (mrem)
FNR Lawn	North	53.5	13..4
Fluids	Northeast	37.2	9.3
Beal	East	51.2	12.8
Glazier Way	South	40.6	10.1
School of Music	West	38.6	9.7
Environmental Control (UM Botanical Gardens)		38.0	9.5

b. **Dust Samples**

Five air grab samples are collected weekly from continuously operating monitors located to the north (Northwood Apartments), east (Industrial and Operations Engineering), northeast (Laundry), south (Institute of Science and Technology), and west (Media Union) of the reactor facility. Each filter sample is counted for net beta activity. There are 51 samples included in this report for each location except Laundry. The Laundry monitoring station has been discontinued. It was shut down on October 29, 2001 and only has 42 samples for 2001. Gas proportional counter backgrounds have been subtracted from the concentrations reported. Environmental background (University of Michigan Botanical

Gardens) has not been subtracted from the mean radioactivity concentrations shown below.

Station Description	Mean Concentration	Unit
Northwood (N)	1.86×10^{-14}	μCi/ml
Industrial and Operations Engineering (E)	2.28×10^{-14}	μCi/ml
Media Union (W)	2.15×10^{-14}	μCi/ml
Institute of Science and Technology (S)	2.11×10^{-14}	μCi/ml
Laundry (NE)	1.92×10^{-14}	μCi/ml
Environmental Control (Background)	2.34×10^{-14}	μCi/ml

The result of air sampling expressed in percentages of the Effluent Release Limits are shown below.

Station Description	Percent ERL	Unit
Northwood (N)	1.86	Percent
Industrial and Operations Engineering (E)	2.28	Percent
Media Union (W)	2.15	Percent
Institute of Science and Technology (S)	2.11	Percent
Laundry (NE)	1.95	Percent
Environmental Control (Background)	2.34	Percent

c. **Water Samples**

No radioactive liquid effluents were released from the facility in 2001.

d. **Sewage Samples**

No radioactive liquid effluents were released from the facility in 2001.

e. **Maximum Cumulative Radiation Dose**

The maximum cumulative radiation dose which could have been received by an individual continuously present in an unrestricted area during reactor operations from direct radiation exposure, exposure to gaseous effluents, and exposure to liquid effluents:

1. Direct radiation exposure to such an individual is negligible since a survey of occupied areas around the reactor building shows insignificant radiation dose rates above background from the reactor.

2. Airborne Effluents

The airborne effluents from the reactor and the contiguous laboratory facility are as follows:

Isotope	Total Release (μCi)	Concentration (μCi/ml)	%ERL Undiluted	% ERL Diluted
Ar-41	43100000	1.27×10^{-07}	1,273.64	3.18410
Br-80m	2168	342×10^{-12}	0.02	0.00004
Br-82	3885	6.13×10^{-12}	0.12	0.00031
Hg-203	48	7359×10^{-14}	0.01	0.00002
I-125	727	1.15×10^{-12}	0.38	0.00096
I-131	2920	4.61×10^{-12}	2.31	0.00576
Gross Particulate	103	1.64×10^{-13}	16.41	0.04104
TOTAL			1,292.89	3.23223
Equivalent Radiation Dose (mrem)				1.62

The total airborne effluent releases are well within the allowed release concentrations when the conservative dilution factor of 400 is applied.

The equivalent total dose from all airborne effluent releases is well below the 10 mrem per year constraint described in NRC Information Notice 97-04, "Implementation of a New Constraint on Radioactive Air Effluents."

3. Liquid Effluents

No radioactive liquid effluents were released from the reactor and the contiguous laboratory facility in 2001.

f. If levels of radioactive materials in environmental media, as determined by an environmental monitoring program, indicate the likelihood of public intake in excess of 1% of those that could result from continuous exposure to the concentration values listed in Appendix B, Table 2, 10CFR20, the facility is required to estimate the likely resultant exposure to individuals and to population groups and the assumptions upon which those estimates are based. Exposure of the general public to 1 ERL would result in a whole body dose of 50 mrem. The maximum public dose based on airborne and liquid effluent releases of 3.23% ERL is 1.62 mrem. This dose is based on a member of the public being continuously present at the point of minimum dilution near the reactor building.

6.6 Occupational Personnel Radiation Exposures

Individuals for whom the annual whole body radiation exposure exceeded 500 mrem (50 mrem for person under 18 years of age) during the reporting period:

A Cook . . . . 735 mrem   R. Blackburn . . . . 538 mrem

This includes facility personnel including faculty, students and experimenters.