5335 PRICE AVENUE, BUILDING 258
McCLELLAN, CA 95652
PHONE: (916) 614-6200
FAX: (916) 614-6250
WEB: http://mnrc.ucdavis.edu
SACRAMENTO, CA 95652
PHONE: (916) 614-6200
FAX: (916) 614-6250

UCDAVIS MNRC
McCLELLAN NUCLEAR RESEARCH CENTER

June 25, 2012

United States Nuclear Regulatory Commission
Attn: Document Control Desk
US Nuclear Regulatory Commission
Washington, D.C. 20555-001

Re: 2011 Annual Report for University of California Davis/ McClellan Nuclear Research Center, Docket No. 50-607, License No. R-130

To Document Control Desk:

Attached is the 2011 annual report for the McClellan Nuclear Research Center, submitted in accordance with the reporting requirements of the Technical Specifications document MNRC-0004-DOC-13 paragraph 6.7.1.

Thanks and Regards,

Dr. Barry M. Klein,
Director, McClellan Nuclear Research Center

A020
NRR

2011

ANNUAL REPORT

Docket Number 50-607
License Number R-130

1. Introduction

The University of California, Davis McClellan Nuclear Research Center (MNRC) consists of a research reactor and associated radiography and positioning equipment. This MNRC Annual Report is published each year in support of the license provided by the United States Nuclear Regulatory Commission (NRC). The aforementioned license is for the operation of a steady-state TRIGA™ reactor with pulsing capability.

It is the intent of this document to provide information relevant to the safe operation of the UCD/MNRC. A brief description of the MNRC facility and administration is followed by operational events and health physics information concerning this facility during CY 2011.

2. UCD/MNRC Facility Description

The UCD/MNRC is located on the McClellan Industrial Park site; the reactor is housed in Building 258. The McClellan Industrial Park site is approximately 2600 acres, located eight miles northeast of Sacramento, California.

The UCD/MNRC facility is a three level 14,720 sq. ft. rectangular-shaped enclosure that surrounds a 2 MW research reactor. The UCD/MNRC provides four neutron beams and four bays for radiography. All four bays are capable of using radiography film techniques, but Bays 1 and 3 will normally use electronic imaging devices. Space, shielding and environmental controls are provided by the enclosure for neutron radiography operations performed on a variety of samples. Adequate room has been provided to handle the components in a safe manner.

In addition to the radiography bays, the UCD/MNRC reactor also has several in-core facilities ranging from a pneumatic tube system to a central irradiation facility.

For more detailed information on the UCD/MNRC project, the reader is referred to the UCD/MNRC Safety Analysis Report.

3.0 UCD/MNRC Administration

UCD/MNRC Organization. The UCD/MNRC is licensed by the Nuclear Regulatory commission (NRC) to operate under the provisions of operating license R-130.

The University of California Regents have designated the Chancellor at UC Davis to be the license holder. The UCD Chancellor has in-turn delegated the Vice Chancellor for Research to be the licensee of record.

The UCD/MNRC is under the direction of the UCD/MNRC Director.

4.0 Facility Modifications (Section 50.59 of 10CFR Part 50), and experiments.

1. None

5.0 New Approved Experiments

1. K-4-49 Irradiation of natural Xe gas to produce low activity Xe-133
2. K-4-50 Irradiation of lubricant-coated aluminum coupons

6.0 Licensing and Regulatory Activities

6.1 NRC Items

a. The Nuclear Regulatory Commission (NRC) completed two inspections during the weeks of 28 February and 18 July.

6.2 Nuclear Safety Committee (UCD/NSC)

a. The Nuclear Safety Committee performed three audits: Security (11/14/2012), Radiation Safety (11/18/2012), and the Chairman's audit (12/9/2012)
b. Two NSC meetings were held: The NSC conducted their semi-annual meeting 29 July and 20 December at MNRC

7.0 OPERATIONS

OPERATING HISTORY:

TOTAL OPERATING HOURS THIS YEAR:	1385.47
TOTAL OPERATING HOURS:	45080.54
TOTAL MEGAWATT HOURS THIS YEAR:	1305.29
TOTAL MEGAWATT HOURS:	60108.10
TOTAL NUMBER OF PULSES PERFORMED THIS YEAR:	0
TOTAL NUMBER OF PULSES PERFORMED:	473

7.1 UNSCHEDULED REACTOR SHUTDOWNS and NOTED PROBLEM AREAS:

In 2011, there were four (4) unscheduled shutdowns at the MNRC reactor facility. The following is a list of the unscheduled shutdowns:

2011 REACTOR SHUTDOWNS

Type of Failures	Total Number
CSC	1
Other	3
TOTAL NUMBER OF SHUTDOWNS IN 2011	4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CSC	0	0	0	1	0	0	0	0	0	0	0	0
Other	0	0	1	0	0	0	2	0	0	0	0	0
Notes			1	2			3, 4					

Notes:
1: Secondary Cooling System pump failure
2: Net fault.
3: Bay Door/Shutter interlock actuation
4: Failure of Pneumatic Transfer System.

January

1. There were no unscheduled shutdowns in the month of January.
2. There were two callbacks to the facility in January
   a. Rod Withdrawal Prohibit (RWP) alert. The alert cleared upon acknowledgement.
   b. Stack Continuous Air Monitor (CAM) alert, cleared on acknowledgement.

February

1. There were no unscheduled shutdowns in the month of February.
2. There were two callbacks to the facility in the month of February.
   a. Two (2) Rod Withdrawal Prohibit (RWP) alerts. The alerts cleared upon acknowledgement.

March

1. There was one unscheduled shutdown in the month of March
   a. Loss of secondary flow during reactor startup to 50 watts. Found and repaired a damaged motor connection wire on the secondary pump motor.
2. There were two callbacks to the facility in March.
   a. Rod Withdrawal Prohibit (RWP) alert. The alert cleared upon acknowledgement.
   b. UPS fault and Fire Alarm Panel alarm, cleared upon acknowledgement and reset. Probable cause: temporary loss of facility power.

April

1. There was one unscheduled shutdown in the month of April.
   a. "Net Fault-Please Reboot" scram. Rebooted DAC and CSC computers, all indications sat
2. There were no callbacks to the facility in the month of April.
3. The Reactor Prestart failed twice during an attempt to perform for operations. The DAC and CSC computers were rebooted, and the subsequent Pre-Start passed successfully

May

1. There were no unscheduled shutdowns in the month of May.
2. There were five (5) callbacks to the facility in the month of May.
   a. There were four (4) callbacks for Rod Withdrawal Prohibit (RWP) alerts. All cleared upon acknowledgement.
   b. There was one (1) UPS fault, cleared upon acknowledgement.

June

1. There one (1) callback to the facility in June.
   a. Facility security trouble signal that did not affect Security alarms, resolved by the system contractor.

July

1. There were two unscheduled shutdowns in July.
   a. On 29 July, the reactor scrammed due to the Bay 4 door and shutter interlock. One limit switch did not actuate when the Bay 4 door was closed. Investigation showed that the door was not shut completely to actuate all 3 limit switches. Scram and interlock checks per 5420-M4 were performed to verify satisfactory operation of the interlock system. Operators were cautioned to insure the door was completely closed prior to releasing the door operating button.

b. The reactor was manually shutdown due to a failure of the Pneumatic Transfer System to function properly. See anomaly report.

2. There were three (3) callbacks to the facility in July.
   a. Multiple alerts and alarms associated with a power loss to the facility. All alerts/alarms cleared upon acknowledgement.
   b. Stack CAM alarm, spurious.
   c. Rod Withdrawal Prohibit alert, cleared upon acknowledgement

August

1. There were no unplanned shutdowns during the month of August.
2. There was one callback to the facility in the month of August.
   a. Spurious Security System alarm, no apparent cause found. Inspection of the facility showed no issues. Alarm reset

September

1. There were no unscheduled shutdowns in the month of September.
2. There were no callbacks to the facility in the month of September.

October

1. There were no unscheduled shutdowns during the month of October.
2. There was one callback to the facility in the month of October.
   a. CSC computer failure. See anomaly report.

November

1. There were no unscheduled shutdowns in November
2. There were three callbacks to the facility in November
   a. Two (2) Rod Withdrawal Prohibit alerts. Alert cleared on acknowledgement.
   b. Security system fault, determined to be spurious.

December

1. There were no unscheduled shutdowns in December.
2. There were three (3) callbacks to the facility in December.
   a. One (1) Rod Withdrawal Prohibit alert. Alert cleared on acknowledgement.
   b. Security system fault, determined to be spurious due to "phone glitch" according to the alarm company.
   c. Fire alarm system dialer alarm. Conditions were satisfactory in the facility. The alarm company reports a communications timer check failure, with the alarm sections performing satisfactory. NOTE: this alarm occurred again during operations a week later. Subsequent actions (January) included the alarm company shifting from cell backup to a landline backup. The problem was endemic throughout the company's customer base that use cell backup communications, due to a configuration change by the phone company. No further problems noted since shifting to a land line communications link.

3. The NM-1000 nuclear instrument is continuing to periodically show erratic indications at the bottom of the indicating range when the reactor is shut down. Low level readings occasionally fail to drop off as expected when the neutron source is removed from the core during prestart checks. Cycling the instrument power resolves the issue, with no failures following power cycling and rebooting the CSC and DAC computers. Troubleshooting is ongoing. No instrument

failure or component failure can be found at this time. In the region of operation where the problem is noted, the signal is in the micro amp range. The probable cause is signal noise generated somewhere within the system components, with the source of the noise still under investigation.

7.2 ANOMALIES:

During 2011, there were 2 reported anomalies at the MNRC facility. The specifics are listed below

July

There was one anomaly report issued during the month of July. Report is as follows:

13 July 2011-1329 hrs
Reactor operating at 1 Mw.

Anomaly Report
Failure of Rabbit to return to PTS hood (receiver)

Actions during anomaly

During the performance of experiment 11-2961 a Pneumatic Transfer System (PTS) run, the experiment did not return to the receiver automatically at the end of the run.

Experiment IR 11-2961 was sent into the core via the PTS system for 2 minutes at 1327 hrs.

The blower motor, spool valve, and controller all appeared to operate normally.

At 1329 hrs the PTS controller timed out and the spool valve shifted, but the experiment (i.e. rabbit) did not return to the receiver.

The reactor was directed to be shut down and attempts were made to recover the rabbit via manually operating the PTS controls. After several manual attempts the rabbit returned to the receiver. It took 11 minutesto recover the rabbit.

No obvious cause for the failure to return was noted.

Corrective actions

The PTS system will be thoroughly inspected. The blower motor, filter, receiver assembly and transport tubing will be checked to determine if any fault condition exists.

Prior to the next use of the PTS system, the system will be operationally testing several times utilizing rabbits of different masses to see if the failure can be repeated.

Follow up comments regarding the PTS system performance. The entire system was checked over and operationally tested with several different masses of rabbits. No failures were noted during these checks. Subsequent PTS operations have not resulted in a similar failure to date.

October

There was one anomaly report issued during the month of October, as follows:

Anomaly Report For: Failure of the Control System Console (CSC) computer

Time: 27OCT2011 at 0325

Reactor conditions prior to the anomaly and what occurred during the anomaly:

The reactor was shutdown the previous afternoon. At 0325, the Law Enforcement Desk dispatcher received a Reactor Console alert, and notified a Senior Reactor Operator on the recall list.
Upon entry into the Reactor Control Room, it was noted that the CSC Hi Resolution monitor was blank, and the Status Monitor display was locked up, indicating the time as 0325.
By 0630, troubleshooting and rebooting the computer multiple times showed that the CSC computer was inoperable due to a failed CPU card.

What actions were taken to correct this anomaly?

The Reactor Supervisor contacted General Atomics, University of Texas at Austin, and the United States Geological Service (USGS) for information regarding their computer configurations, and to see if there were any spare CPU cards readily available. General Atomics was contracted to provide a computer tech/programmer to assist in the troubleshooting and repair. USGS sent two computers (DAC and CSC) from their facility that had been removed during their recent console upgrade.
The CPU card was tested and found to have completely failed. A replacement CPU card and Ethernet card were ordered and installed in the computer. Some editing of the CSC program was required to address the new Ethernet card. Editing was performed by the General Atomics programmer.
An extensive series of system retests including multiple prestart checks and parametric verifications, all satisfactory, resulted in the Reactor Supervisor releasing the reactor for return to full operation on 02NOV2011.

What corrective actions are needed to prevent this anomaly from reoccurring?

Component failure cannot be prevented. However, MNRC staff will obtain additional CPU and Ethernet cards for on hand spares. The Electronics Engineer has been tasked to configure the USGS computers to MNRC specs, and ghost the existing hard drives for installation in the spare computers. Any future occurrence of this type of problem will be managed by a computer swap out of both CSC and DAC computers to allow return to operation with minimum operational impact.

7.3 MAINTENANCE OTHER THAN PREVENTIVE:

January

1. There was no maintenance other than preventive performed in the month of January.

February

1. Adjusted Shim 1 control rod zero position. Operability checks satisfactory, rod drop time 0.39 seconds

March

1. Repaired a broken/burned wire connector on the Secondary Cooling System pump motor and replaced a blown fuse in the controller. Checked connector tightness on the other power/phase connectors on pump SAT.

2. Replaced expended Helium system supply bottle

April

1. There was no maintenance other than preventive performed in the month of April.

May

1. There was no maintenance other than preventive performed in the month of May.

June

1. There was no maintenance other than preventive performed in the month of June.

July

1. Replaced all 50 12 volt batteries in the UPS
2. Lifted unit, replaced curb under unit, installed flex joints and vent ducting, replaced gas line, reconnected AC-2 (Equipment Room ventilation).
3. Replaced security system fluorescent fixture on stack.
4. Replaced failed AC-7 (Bay 2 ventilation) compressor and recharged the system with refrigerant.
5. Installed new curb and new gas pack air conditioning unit for AC-8 (Bay 4 Radiography Control Room and Darkroom ventilation), installed new gas and condensate lines.
6. Replaced the Reactor Room Continuous Air Monitor (CAM) pump motor switch and pump motor.

August

1. Repaired failed insulation on 24v control wiring for AC-4 (Bay 1 ventilation), correcting ground issue that prevented operation.
2. Changed out Helium System supply bottle.

September

1. There was no maintenance other than preventive performed in the month of September

October

1. There was no maintenance other than preventive completed in the month of October.

November

1. Changed out Helium System supply bottle.
2. Replaced the CSC computer CPU and added an additional Ethernet card. General Atomics updated the software to the new card configuration. Retests SAT
3. Replaced the failed check source solenoid on the Reactor CAM Noble Gas channel

December

1. 1. MNRC completed the annual reactor maintenance shutdown during the month of December. Technical Specification required periodic maintenance as well as general maintenance was performed

2. Parametric values noted during testing are as follows:

Control Rod Worth:

Transient Rod: $1.85	Shim 1: $2.63	Shim 2: $2.65
Shim 3: $2.85	Shim 4: $3.09	Regulating Rod: $2.90

Control Rod Scram Drop Times:

Transient Rod: 0.37 sec Shim 1: 0.40 sec Shim 2: 0.37 sec

Shim 3: 0.41 sec Shim 4: 0.39 sec Regulating Rod: 0.39 sec

Shutdown Margin: $5.08

At Power Scram values: NPP-1000: 103% indicated, NM-1000: 104% indicated.

3. A nuclear instrument calorimetric calibration was performed. Both the NPP channel and the NM-10000 channel of Nuclear Instruments were adjusted based on results

4. Replaced the two north Demineralizer System expended resin bottles.

7.4 Training

January

1. One licensed operator received Facility Design and Operating Characteristics training.

February

1. Four licensed operators received Facility Design and Operating Characteristics training.
2. All licensed operators received Facility Instrumentation and Control training.

March

1. There was no scheduled training held in the month of March.

April

1. All facility personnel attended the annual ALARA and Security training.

May

1. RSO completed Advanced Radioactive Material Shipper Certification Training.
2. The Reactor Supervisor attended DOE Security training at the Oak Ridge Y-12 facility.

June

1. RSO attended RSO Roundtable for TRTR at Penn State

July

1. Reactor Supervisor attended conference at Oregon State University.
2. All SROs attended Radiation Safety for SRO training.
3. All SROs successfully completed the Annual Operators Examination.

August

1. All appropriate facility personnel received forklift training for initial or annual recertification

September

1. Senior Reactor Operators and Reactor Operator trainees attended one session of Reactor Theory.

October

1. Senior Reactor Operators and Reactor Operator trainees attended four sessions of Reactor Theory.

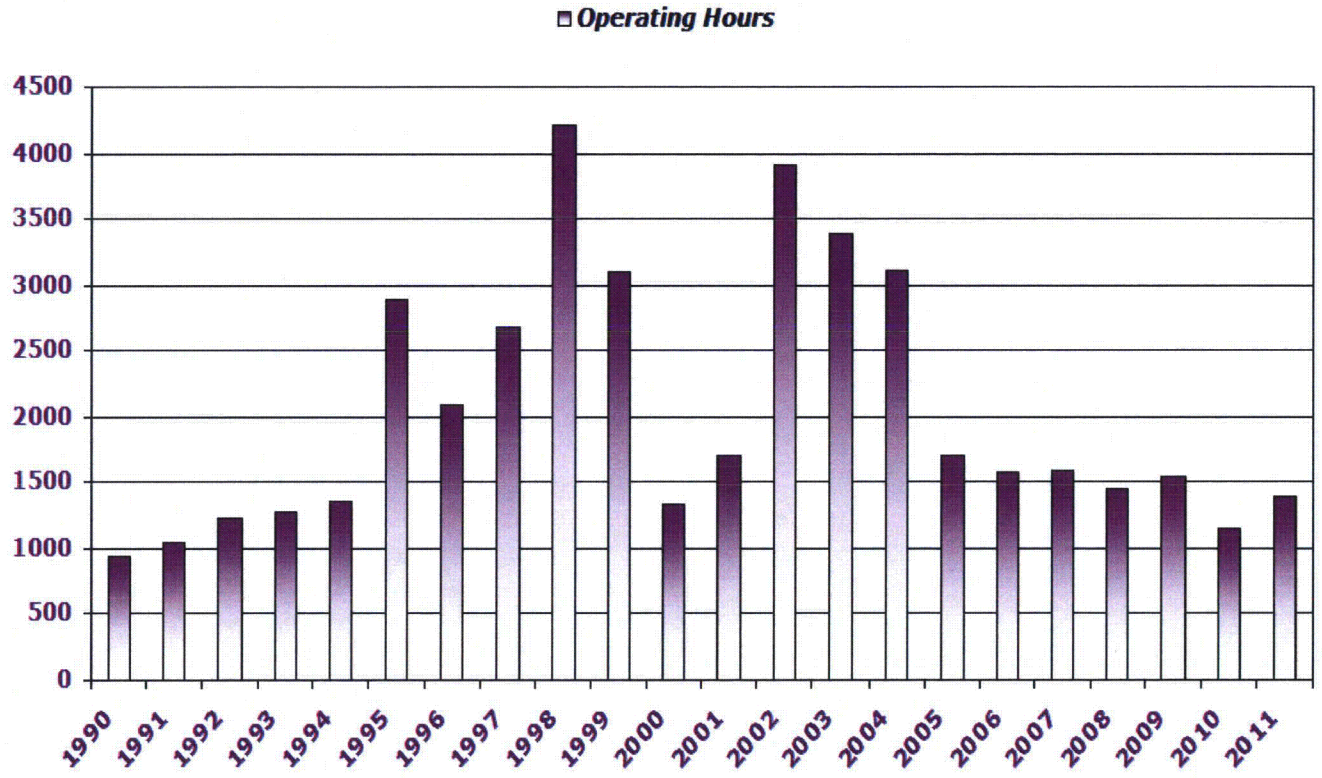
November

1. Senior Reactor Operators and Reactor Operator trainees attended one session of Reactor Theory.

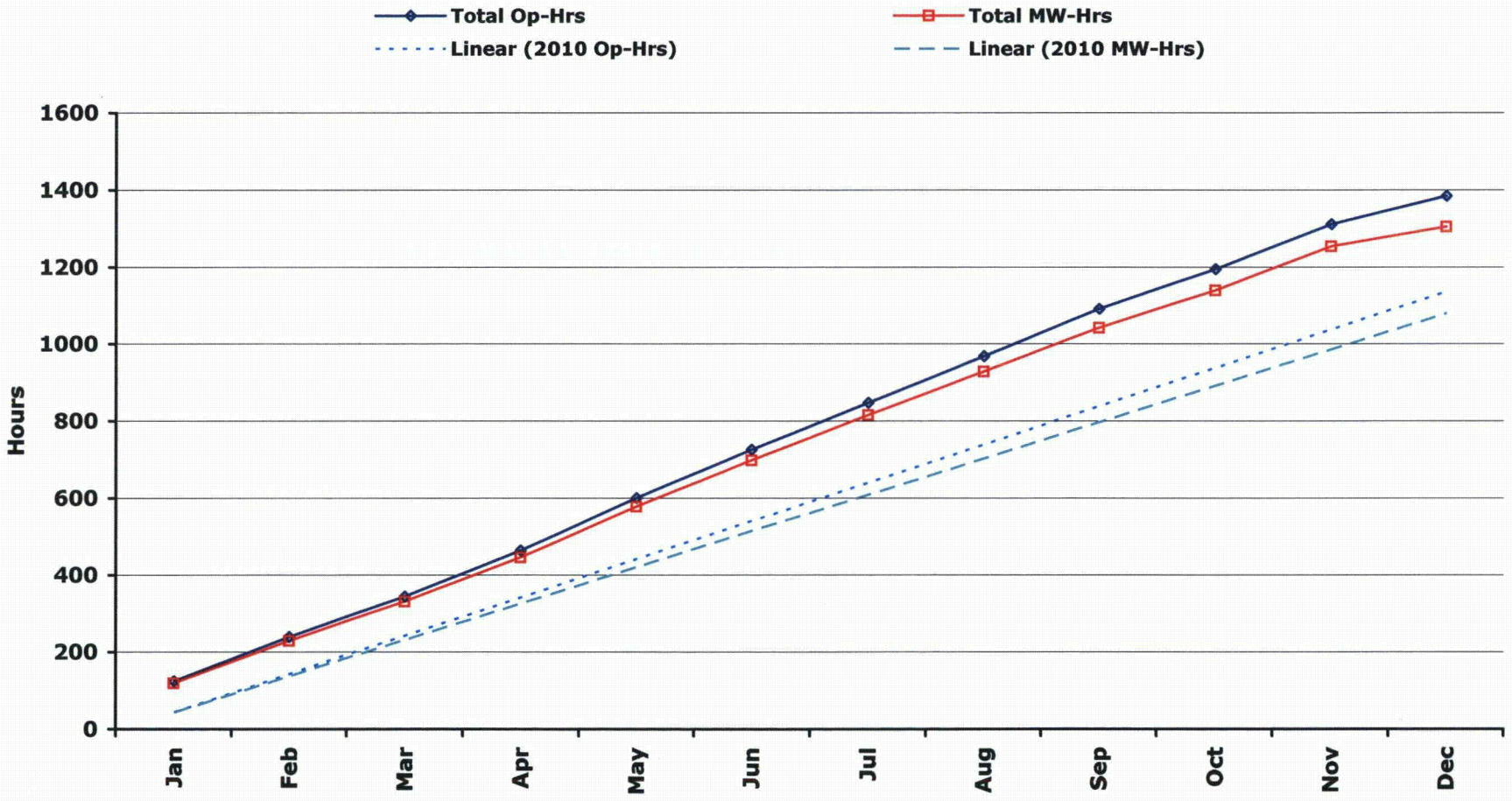
December

1. Senior Reactor Operators and Reactor Operator trainees attended Technical Specifications training
2. Senior Reactor Operators and Reactor Operator trainees attended Portable Air Sample Procedure training and the 2011 Emergency Drill.

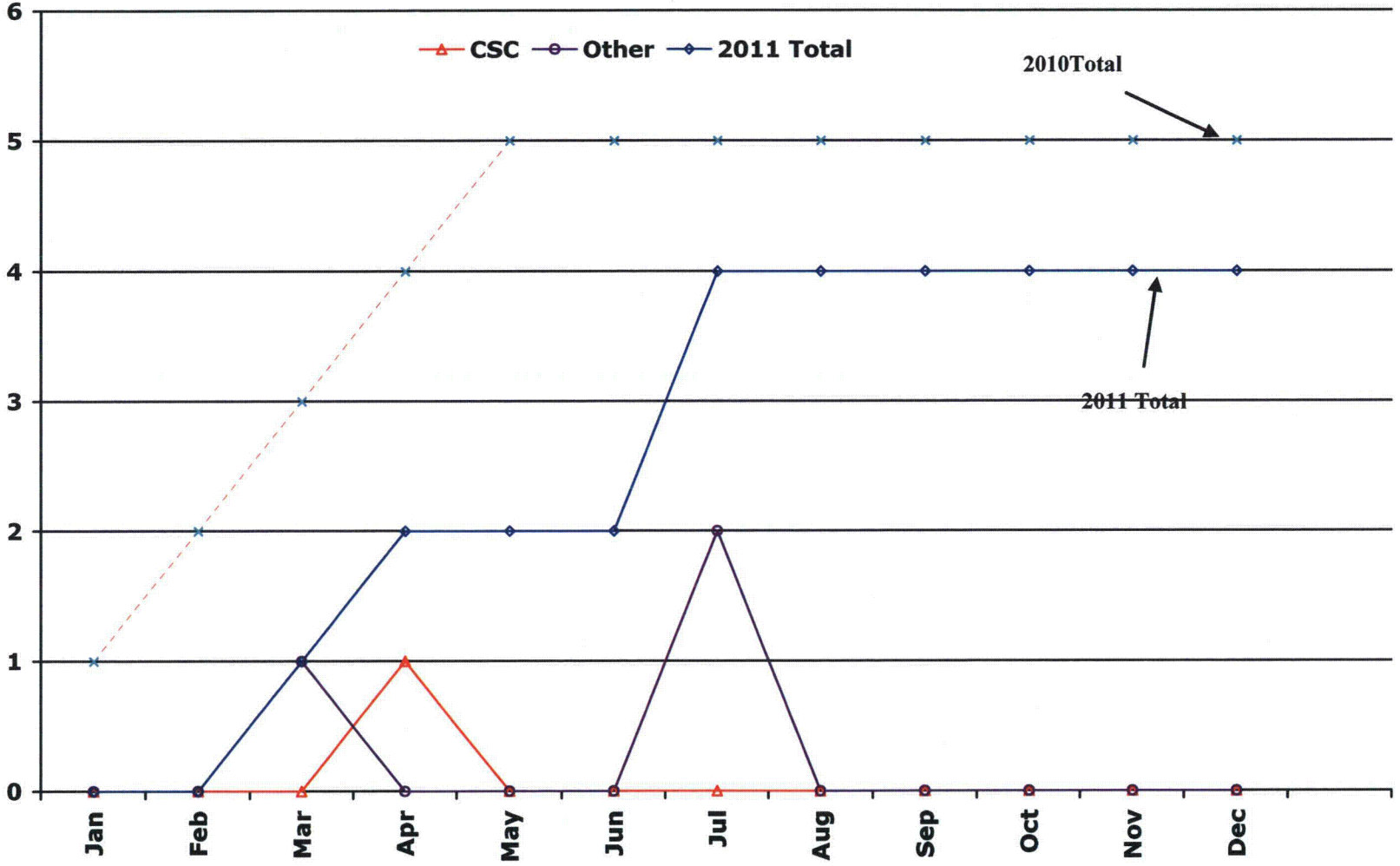
UCD/MNRC Operating History



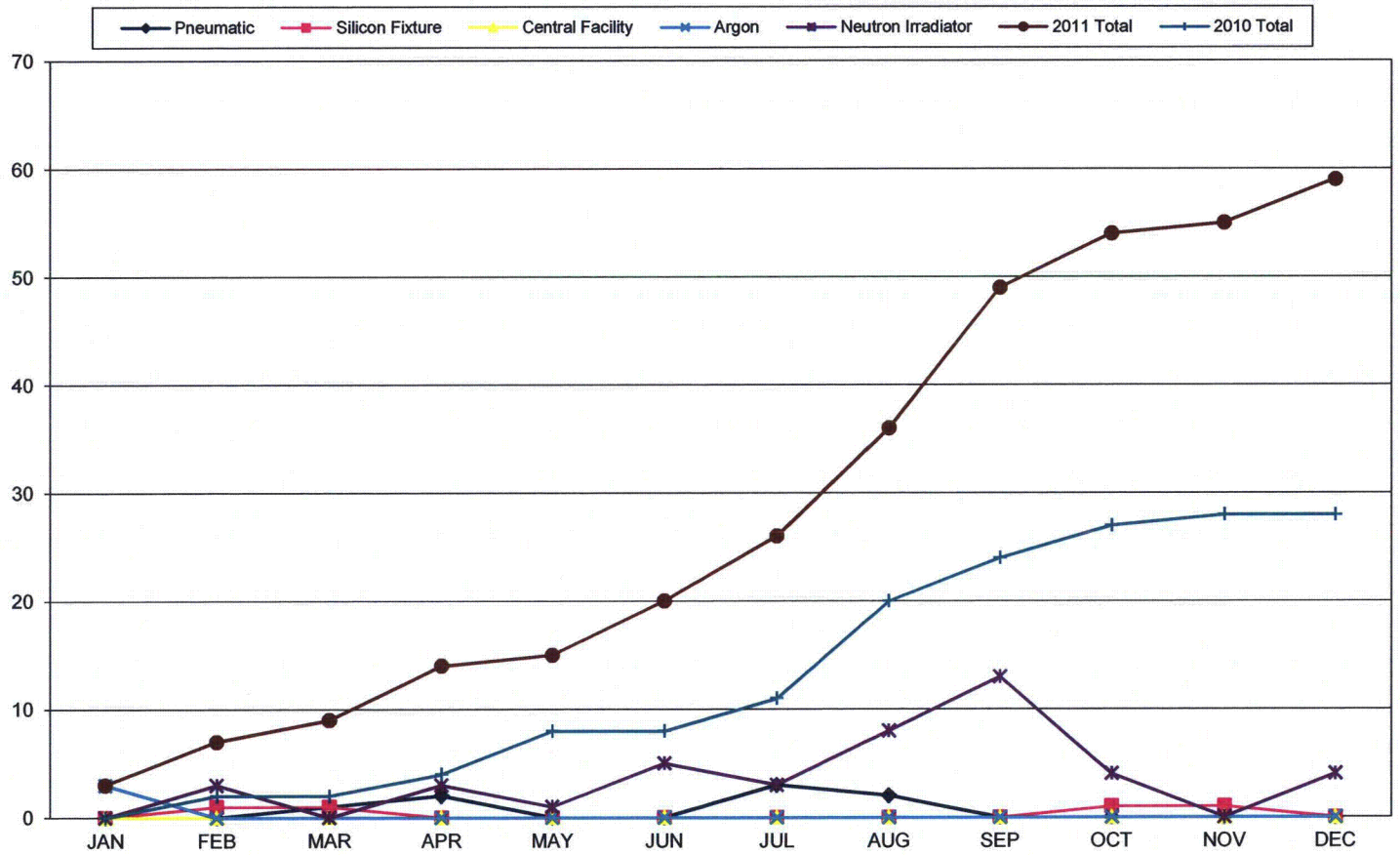
Reactor Hours (2011)



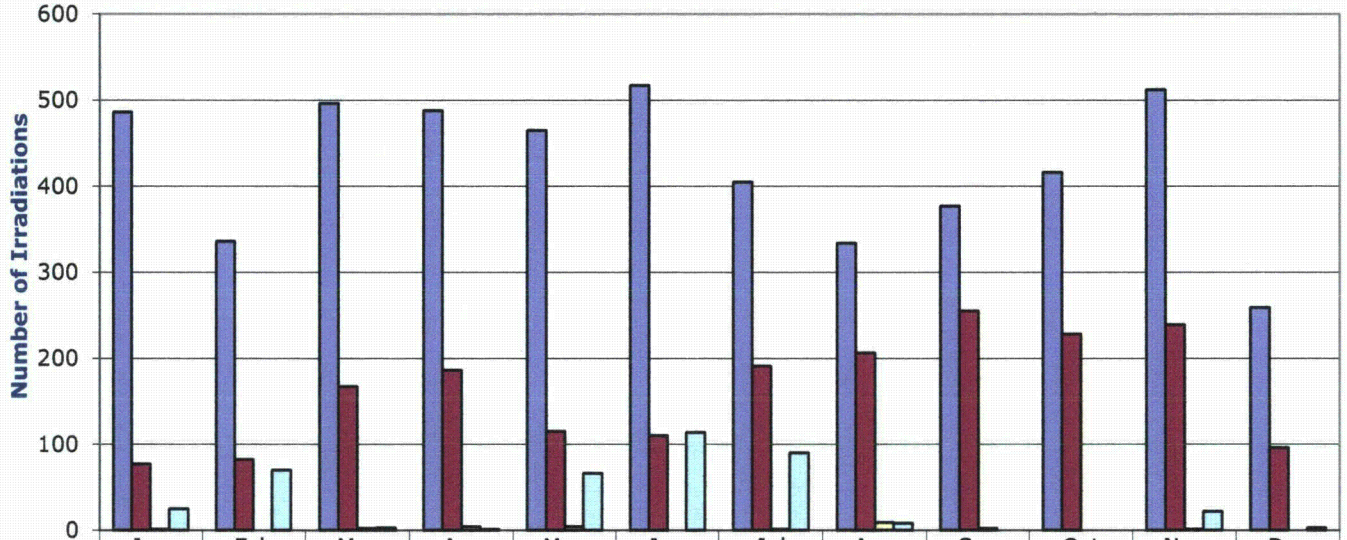
Unschedule Reactor Shutdowns 2011



Reactor Tank Irradiation Facilities
Total Number of Irradiations Completed (2011)



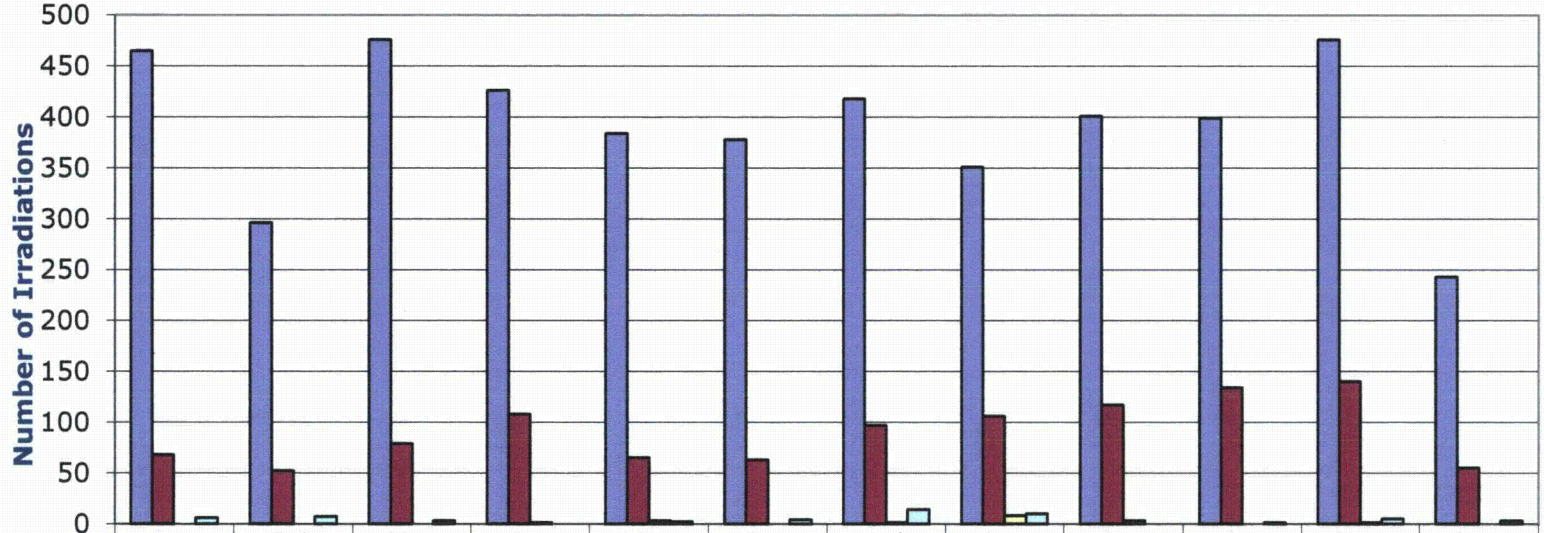
Bay Utilization (Shutter Operations) 2011



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bay 1	486	336	496	488	465	517	405	334	377	416	512	259
Bay 2	77	82	167	186	115	110	191	206	255	228	239	96
Bay 3	1	0	2	4	4	0	1	9	2	0	1	0
Bay 4	25	70	3	1	66	114	90	8	0	0	22	3

Months

Bay Irradiations Completed 2011



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bay 1	465	296	476	426	384	378	418	351	401	399	476	243
Bay 2	68	52	79	108	65	63	97	106	117	134	140	55
Bay 3	0	0	0	1	3	0	1	8	3	0	1	0
Bay 4	6	7	3	0	2	4	14	10	0	1	5	3

8.0 Radioactive Effluents

A summary of the nature and amount of radioactive effluents released or discharged to the environment beyond the effective control of the MNRC, as measured at or prior to the point of such release or discharge, include the following:

8.1 Liquid Effluents

No liquid effluents were released during 2011.

8.2 Airborne Effluents

Airborne radioactivity discharged during 2011 is tabulated in Table 1 below.

TABLE 1
2011 SUMMARY OF AIRBORNE EFFLUENTS

MONTH	TOTAL EST. QUAN. Ar-41 RELEASED (Ci)	EST.MAX AVG. CONC. OF Ar-41 IN UNRESTRICTED AREA [1] (uCi/ml)	FRACTION OF APPLICABLE 10CFR20 Ar-41 CONC. LIMIT FOR UNRESTRICTED AREA [1] (%)	EST. DOSE [2] FROM Ar-41 FOR UNRESTRICTED AREA [1] (mrem)	FRACTION OF APPLICABLE 10CFR20 DOSE LIMIT FOR UNRESTRICTED AREA [1] (%)	TOT. EST. QUANTITY OF ACT. IN PART. FORM WITH HALF-LIFE >8 DAYS (Ci)	AVERAGE CONC. OF PART. ACT. RELEASED WITH HALF-LIFE > 8 DAYS (uCi/ml)
JAN	1.12	5.97E-11	0.6%	3.64E-01	3.64%	NONE	NONE
FEB	1.08	5.77E-11	0.6%	3.52E-01	3.52%	NONE	NONE
MAR	1.61	8.58E-11	0.9%	5.23E-01	5.23%	NONE	NONE
APR	1.47	7.84E-11	0.8%	4.77E-01	4.77%	NONE	NONE
MAY	1.07	6.40E-11	0.6%	3.90E-01	3.90%	NONE	NONE
JUN	1.12	5.95E-11	0.6%	3.62E-01	3.62%	NONE	NONE
JUL	1.19	6.32E-11	0.6%	3.85E-01	3.85%	NONE	NONE
AUG	1.21	6.46E-11	0.6%	3.93E-01	3.93%	NONE	NONE
SEP	1.15	6.11E-11	0.6%	3.72E-01	3.72%	NONE	NONE
OCT	1.13	6.03E-11	0.6%	3.67E-01	3.67%	NONE	NONE
NOV	1.39	7.39E-11	0.7%	4.50E-01	4.50%	NONE	NONE
DEC	0.96	5.10E-11	0.5%	3.11E-01	3.11%	NONE	NONE
TOT	14.49	7.79E-10	-	4.74	-	NONE	NONE
AVG	1.21	6.50E-11	0.6%	4.0E-01	3.95%		

(1) This location is 240 meters downwind which is the point of maximum expected concentration based on the worst case atmospheric conditions (see MNRC SAR Chapter 11).
(2) Based on continuous occupancy and the calculation techniques used in Appendix A of the MNRC SAR (Ar-41 at 2.3E-10 uCi/ml continuous for one year equals 1.4 mrem).
(3) 10CFR20 Limit for concentration is 1E-8 (Appendix B, Table 2); Limit for dose is 100mrem/year (20.1301)

8.3 Solid Waste

No waste shipments were made in 2011

9.0 Radiation Exposure

Radiation exposure received by facility operations personnel, facility users, and visitors during 2011 is summarized in Table 2 below.

TABLE 2
2011 SUMMARY OF PERSONNEL RADIATION EXPOSURES

	NUMBER OF INDIVIDUALS	AVERAGE TEDE PER INDIVIDUAL (mrem)	GREATEST INDIVIDUAL TEDE (mrem)	AVERAGE EXTREMITY (mrem)	GREATEST EXTREMITY (mrem)
FACILITY PERSONNEL	7	13	50	24	105
FACILITY USERS	15	1.6	4	*	*
VISITORS	1250	<1	8	*	*

* Extremity monitoring was not required.

10.0 Radiation Levels and Levels of Contamination

Radiation levels and levels of contamination observed during routine surveys performed at the MNRC during 2011 are summarized in Table 3 below.

TABLE 3
2011 SUMMARY OF RADIATION LEVELS AND CONTAMINATION LEVELS DURING ROUTINE SURVEYS

	AVERAGE (mrem/hr)	HIGHEST (mrem/hr)	AVERAGE (dpm/100cm^2)	HIGHEST (dpm/100cm^2)
OFFICE SPACES	<0.1	<0.1	<800(1)	<800(1)
REACTOR CONTROL RM	<0.1	<0.1	<800(1)	<800(1)
RADIOGRAPHY CONTROL RM	<0.1	<0.1	<800(1)	<800(1)
COUNTING LAB	<0.1	<0.1	<800(1)	<800(1)
STAGING AREA	<0.1	<0.1	<800(1)	<800(1)
COMPOUND	<0.1	<0.1	<800(1)	<800(1)
EQUIPMENT RM	0.45	68	<800(1)	<800(1)
DEMINERALIZER AREA	30	300	<800(1)	<800(1)
REACTOR RM	5	620	<800(1)	<800(1)
SILICON STORAGE SHED	<0.1	<0.1	<800(1)	<800(1)
RADIOGRAPHY BAYS	*2.0	*1500	<800(1)	<800(1)

(1) <800 dpm/100 cm^2 = Less than the lower limit of detection for a swipe survey.
* Due to Bay 1 Storage Areas; most other areas and other bays are significantly lower

11.0 Environmental Surveys

Environmental surveys performed outside of the MNRC during 2011 are summarized in Tables 4 & 5 below. The environmental survey program is described in the MNRC Facility Safety Analysis Report.

TABLE 4
2011 SUMMARY OF ENVIRONMENTAL TLD RESULTS
(WITH NATURAL BACKGROUND(1) SUBTRACTED)

	AVERAGE (mrem)	HIGHEST (mrem)
ON BASE (OFF SITE 1-20 & 64)	5	25
ON SITE (SITES 50 – 61 & 65-71)	7	17

(1) Natural background assumed to be the off base (Sites 27-42) average of 28 mrem.

TABLE 5
2011 SUMMARY OF RADIOACTIVITY IN WELL WATER

	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)	Cs-137 (pCi/l)
AVERAGE	<MDA	4.18E+00	<MDA	<MDA
HIGHEST		4.52E+00		

MDA is the minimum detectable activity at the 95% confidence level.
The MDA range for the analyzed radionuclides (pCi/L).

	MIN	MAX
Alpha	1.18E+00	1.72E+00
Beta	2.09E+00	3.17E+00
Tritium	3.17E+02	3.44E+02
Cs-137	2.08E+00	7.65E+00