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June 22, 2006

United States Nuclear Regulatory Commission
Attn: Document Control Desk
1 White Flint North
11555 Rockville Pike
Rockville MD 20852

Re: 2005 Annual Report for University of California Davis/ McClellan Nuclear Radiation Center, Docket No. 50-067, License No. R-130

To Document Control Desk:

Attached is the 2005 annual report for the McClellan Nuclear Radiation Center, submitted in accordance with the reporting requirements of the Technical Specifications document MNRC-0004-DOC-13 paragraph 6.7.1.

Thanks and Regards,

Robert G. Flocchini PhD
Facility Director
McClellan Nuclear Radiation Center

A020

2005

ANNUAL REPORT

Docket Number 50-067
License Number R-130

1. Introduction

The University of California, Davis McClellan Nuclear Radiation 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 2005.

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, and reports to the Vice Chancellor for Research.

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

None of the 50.59 reviews performed in 2005 involved changes to either the Technical Specifications or the Safety Analysis report, but did/will require changes to facility or system drawings. As a result all of the 2005 50.59's were classified as Class III Facility Modifications.

	Facility Modification Number	Date Opened
1.	FM-III-05-01 Modification of Bay 3 Console and New CT Equipment Summary: Upgrade Computed Tomography equipment	1/12/05
2.	FM-III-05-02 Security System Upgrade	4/24/05
3.	FM-III-05-03 Upgrade HV Control Units, rebuild units	5/23/05
4.	FM-III-05-04 Exposure Vessel Modification for Neutron Irradiator	5/26/05
5.	FM-III-05-05 Install Milling Machine in Machine Shop Summary: Install necessary electrical service and permanently install a new milling machine in the Machine shop (silicon shed)	
6.	FM-III-05-06 Nova Scientific Fixture Summary: Install new fixturing in Bay 4 for the Nova Scientific Micro-Channel Plate and CID camera.	8/24/05
7.	FM-III-05-07 Pneumatic Fuel Handling Tool Summary: Manufacture a pneumatic fuel handling tool based on General Atomics design for use at the MNRC.	8/26/05
8.	FM-III-05-08 Classroom media upgrade Summary: Modify the classroom in the trailer to accommodate classroom multi-media training equipment consisting of the following: Computer, projection screen. Projector, document camera, speakers and a media control cabinet.	

5.0 New Approved Experiments

There were no new experiments approved in 2005, but there were several modifications to existing experiments:

a. Amendment 1 to K-4-45 (Irradiation of Natural Uranium Foils) increased the natural uranium content of each sample from 0.1g to 0.5g.

b. Amendment 2 to K-4-45 (Irradiation of Natural Uranium Foils). This amendment allows the addition of a new irradiation location in the NTD (silicon) position using a dry can. Previous approval for irradiation was in the Pneumatic Transfer System only.

6.0 Licensing and Regulatory Activities

6.1 NRC Items

a. During the year 2005, the UCD/MNRC terminated 2 Senior Reactor Operator Licenses.

b. In June of 2005, the Vice Chancellor for Research assumed the duties of Facility Director/Reactor Administrator.

c. In November of 2005, a new Facility Director was permanently in place.

6.2 Nuclear Safety Committee (UCD/NSC)

a. The annual NSC audit of the UCD/MNRC was conducted during the month of September.

b. The NSC met once during 2005: 20 July, 2005.

6.3 The Nuclear Regulatory Commission performed an inspection 5-9 December, 2005.

6.4 Department of Energy

a. The Department of Energy took ownership of the UCD inventory of TRIGA nuclear fuel elements on 3 October, 2005.

7.0 OPERATIONS

Reactor Operations noted a marked decrease in the number of unscheduled shutdowns due to CSC watchdog scrams. This can be attributed directly to the installation of new CSC and DAC computers. These computers have the latest General Atomics operating software installed.

OPERATING HISTORY:

TOTAL OPERATING HOURS THIS YEAR:	1710.53
TOTAL OPERATING HOURS:	36388.94
TOTAL MEGAWATT HOURS THIS YEAR:	2815.84
TOTAL MEGAWATT HOURS:	50826.14
TOTAL NUMBER OF PULSES PERFORMED THIS YEAR:	4
TOTAL NUMBER OF PULSES PERFORMED:	468

UNSCHEDULED REACTOR SHUTDOWNS:

In 2005, there were eighteen (18) unscheduled shutdowns at the MNRC reactor facility. The following is a list of the unscheduled shutdowns:

2005 REACTOR SHUTDOWNS

Type of Failures	Total Number
CSC	7
Other	11
TOTAL NUMBER OF SHUTDOWNS IN 2004	18

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CSC	5	1	0	0	0	0	1	0	0	0	0	0
Other	0	0	1	1	2	0	1	2	2	2	0	0
Notes	1	1	2	3	4,5		4,6	4,7	5,8	9,10		

Notes:
1: Lo-IC Net Com Fault.
2: S/D for Hand and Foot Monitor calibrations: lower background radiation levels
3: Cooling Tower fan motor failure
4: Bay shutter failures
5: UPS system failure.
6: NPP Hi and NPP Hi Voltage Low, spurious.
7: DAC database timeout .
8: Rabbit failure in the Pneumatic Transfer System during experiment
9: Investigate Irradiator Drive failure during experiment.

10: Commercial power lost region wide

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January

1. During the month of January, the reactor was shut down 5 times due to a Lo-IC NET COM fault on the High Resolution Monitor warning window.

2. For the Lo-IC NET COM faults personnel performed the following for each occurrence:

   a. Shut down the reactor.
   b. Rebooted the CSC computer.
   c. Resumed normal operation of the reactor.

3. During this period, Reactor Operations personnel were called back once for a UPS FAULT signal which had not locked in on the UPS. The probable cause was a grid power bump or surge.

February

1. During the month of February, the reactor was shut down once due to a Lo-IC NET COM fault on the High Resolution Monitor warning window. This issue was discussed with General Atomics, as it is an artifact of the console upgrade programming. We determined the cause of the fault was switching operators on the CSC computer. To stop the occurrence of faults during operation, Reactor Operators do not change the logged in operator after control rods are energized.

2. For the Lo-IC NET COM faults personnel performed the following for each occurrence:

   a. Shut down the reactor.
   b. Rebooted the CSC computer.
   c. Resumed normal operation of the reactor.

3. During this, Reactor Operations personnel were called back once for multiple alarms. The fire alarm company reported a large voltage bump across Northern California. All alarms were reset.

March

1. During the month of March, the reactor was shut down 1 time due to need to lower background levels for calibrating the Equipment Room Hand and Foot Monitor.

2. During this period, Reactor Operations personnel were called back 0 times.

April

1. During the month of April, the reactor was shut down 1 time due to the cooling tower fan motor failing. See the anomaly section for additional information.

2. During the period, Reactor Operations personnel were called back 0 times.

May

1. During the month of May, the reactor was shut down 1 time to investigate Bay 2 radiography console indications. The massive shutter was found riding on the "L" guide channel, causing the 15 amp motor fuse to blow. Radiography personnel dressed the channel and replaced the 15 amp fuse. The shutter operated satisfactorily, and starting/running current for the shutter motor were found to be normal. Reactor operations personnel performed all Bay 2 Scram and Interlock checks per OMM-5420. Operation was returned to normal. This is a recurring problem due to the Hillman Roller pads under the massive shutters are deteriorating because of age and use.

2. On 26 May, the reactor scrammed due to a complete loss of power to the CSC. Additional information is presented in the anomaly section.

3. During the period, Reactor Operations personnel were called back 2 times. The first callback was for a security system fault. Operations personnel reset the alarm system.
The second callback was for a UPS fault message on the CSC. The apparent cause of the fault was a power bump to the building power supply. The Bay 2 radiography console was found to be de-energized, indicating the building had experienced a power transient sufficient to shutdown the bay console electronics. The operator cleared the alert, and verified that all reactor related electronics were functioning.

June

1. There were no unplanned shutdowns in June.

2. During the month June, Reactor Operations personnel were called back 2 times. The first callback was for a Bay CAM fault on low flow/cal. Indications were normal on the CAM at the time of Callback. The CAM was reset satisfactorily.
The second callback was for various CSC alarms and a Fire Alarm system trouble signal. The apparent cause of the fault was a power bump to the building power supply. All alarms were investigated and cleared. No valid alarms were found.

July

1. There were two unplanned shutdowns in July. The first was for troubleshooting the Bay 1 shutter, in which the shutter failed to close. The problem was resolved by performing a reset on the Bay 1 robot computer. The second unplanned shutdown was due to a scram, discussed in the anomalies section.

August

1. There were two unplanned shutdowns during the month of August. One shutdown was a DAC database timeout scram. Rebooting the DAC computer reset the scram. The other was a manual shutdown to investigate BAY 3 massive shutter failure. The motor overloads were found tripped. Scram and interlock checks were performed following resetting the overloads, sat.

September

1. There were two unplanned shutdowns during the month of September. One shutdown was due to a malfunctioning rabbit used in the PTS. Additional information is in the Anomaly Report section. A reactor scram occurred when the UPS circuitry caused the CSC and Auxiliary Panel to deenergize. This caused the scram magnets to deenergize, scramming the reactor. The UPS reset itself, allowing the affected instrumentation and computers to be reenergized and rebooted as necessary. An investigation by the Electronics Engineer shows no apparent cause. Attempts to reproduce the event failed.

October

1. There were two unplanned shutdowns during the month of October. The first was a shutdown to investigate the failure of the irradiator drive. The second was a scram caused by a wide spread commercial power outage. During the power outage, the UPS failed to pick up loads as required. An investigation, including a load test, was performed once power was restored. No cause of the UPS failure was found.

November

1. There were no unplanned shutdowns or callbacks during the month of November

December

1. There were no unplanned shutdowns or callbacks in the month of December.

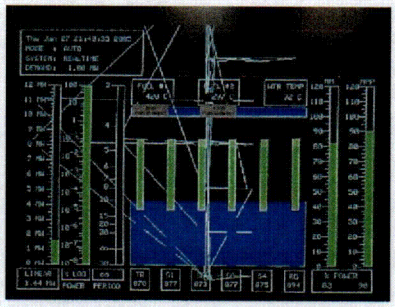
7.2 ANOMALIES:

During 2005, there were 12 reported anomalies at the MNRC facility. The specifics are listed below by month.

January

1. On 27 January, the CSC Hi-Resolution monitor began tracing white lines throughout the screen. The reactor operator notified the senior reactor operator, and observed the display and function of the monitor. All active regions of the monitor displaying dynamic parameters and indications updated properly. The senior reactor operator gave permission to continuing operations, since the lines did not interfere with either the display or function of the monitor. The facility director was apprised of the situation, and concurred with the senior reactor operator. Following the reactor

shutdown, the reactor operator rebooted the CSC. The problem did not reoccur. See attached photo:



April

1. On 7 April, the operator noted that the Cooling Tower Fan Proof light was not energized. The heat exchanger temperatures were climbing, so reactor power was reduced to less than 1.5 Megawatt to investigate. Investigation showed that the fan motor backup breaker was in the trip free position. The operator attempted to reset the breaker one time. The breaker tripped immediately upon resetting. The reactor was shutdown to continue investigating the problem. Operators discovered the cooling tower fan motor had a grounded phase.

   Reactor operations for low power irradiations below 1.5 megawatts was permitted while a new motor was found and delivered to the facility. The new motor was installed and tested 11 April.

May

1. Complete loss of power to the CSC console and Auxiliary Console. Anomaly report as follows:

   At 1448 hours on 26 May, 2005, the Reactor Control Room CSC Console and the Auxiliary console lost power. The result of which was a reactor scram and activation of the facility Evacuation horn.

   Operations personnel silenced the evacuation horn and verified the loss of power to the auxiliary console as the cause (not a manual activation, or a high radiation level in the reactor room). The loss of power to the reactor room RAM will cause the evacuation horn to sound.

   Additional personnel verified no output from the Uninterruptible Power Supply (UPS) and a "Lo Battery" indication. All control rods were visually verified fully inserted, confirming the reactor was shutdown.

   The UPS was manually shifted to bypass and CSC console power was restored. The DAC and CSC computers rebooted and all readings returned to normal for a shutdown reactor.

C01

The UPS was cycled manually, by opening its power supply breakers and the UPS responded as desired by picking up all of its loads with no observable transient or loss of power to supplied consoles/equipment. The UPS was then restored to normal service.

A complete visual inspection of the UPS cabinets was performed and no unusual indications or smells were detected.

Reactor operations were returned to normal the next morning.

Note: A similar anomaly occurred 26 September, 2004. No cause was determined for that occurrence either.

2. Unusual Operation of the Rod Control System

At 0922 hours on 31 May, 2005, the Reactor Operator experienced unusual indications and operations from the Reactor Console during the performance of a normal reactor startup.

While performing the startup, the Square Wave light energized when the key switch was moved from the ON to the RESET position and the regulating control rod withdrew 42-48 units. Operations personnel verified the Reg Rod was actually off the bottom. The control rod was scrammed and the rod dropped. This action was repeated 3 times with repeatable results occurring twice. The Senior Reactor Operator (SRO) directed the CSC/DAC computers be rebooted. In addition, the entire CSC console was de-energized.

After the console was powered up and the computers rebooted, the same unusual indications manifested themselves. After additional computer reboots and turning the CSC console off and on again, the CSC computer entered the prestart check mode and would not exit that mode. The computer performed several prestart checks on right after another before the computers were secured again. Further analysis by MNRC personnel determined the problem to be with the CSC DISO-64 board. This component was common to all observed problems. The CSC DISO-64 utility program confirmed unexpected outputs and some inconsistencies.

On 1 June, 2005, a replacement DISO-64 board was procured from General Atomics (GA) and installed. After some initial difficulty, (prestart checks self start again) the CSC DISO-64 and DOM-32 utility programs were performed satisfactorily. We were unable to reproduce the square wave and reg rod indications listed above.

On 2 June, 2005 the Startup Checklist was performed satisfactorily, operation of the CSC DISO-64 was again verified, and a complete visual inspection of the CSC and DAC cabinets (wiring and connections) was performed. Complete Rod Control Operability checks were performed sat.

During the retesting, we have been unable to duplicate the observed problems, all indications are normal, and the rod control interlocks all function correctly. After discussions with all SRO's and the Facility Director, permission was given to restart the reactor and return to normal operation, with a heightened sensitivity to expected responses.

July

1. At 0816 on 25 July, The reactor was shutdown, with the Operating Instruction paragraph 3.2 prestart checklist in progress. During the second rod movement (shim1), the regulating rod began moving with shim 1 as it was being raised for a scram test. The regulating rod continued to move out following the release of the "UP" button for shim 1. The operator scrammed the reactor, and both shim 1 and the regulating rods dropped as expected. No unusual movements were noted during the first rod withdrawal of the transient rod. Following a complete shutdown and reboot of the DAC, NM-1000, and the CSC, all control rod functions were satisfactory.
The prestart checklist was resumed, and during the interlock checks for pulse and square wave, the reactor scrammed and a "Cons ole Scram" message was displayed each time the square wave button was pressed following pulse button checks.

   Actions taken: Following the first instance, the entire instrumentation and control system was down powered and rebooted. This corrected the control rod issue. Following the square wave button instance, only the CSC computer was rebooted. After the reboot, the CSC utilities programs were run to insure all buttons were being recognized as the correct ones. These tests indicated system operation was normal. A complete prestart checklist was performed on the system with no errors or indications of "mal-operation". A complete rod operability check was performed, including rod drop times. All control rods passed the operability checks.
This was a manifestation of either computer instability, or the DISO-64 board in the CSC failing. Additional time is required to determine further corrective actions.

2. At 1026 on 26 July: The reactor was operating in automatic at 1.8 MW. Power was attained at 0913. There were no control or instrumentation issues during the prestart checks or the startup. At 1039 the control rod magnets deenergized, and the NPP Power Hi and NPP10000 Hi Voltage Lo scram messages appeared on the monitor. All control rods dropped.

   Actions taken to correct: A review of the history playback mode shows no rod motion or power spike displayed at the time of the first scram message. The CSC computer was rebooted. Scram function tests were performed for all NPP and NM channels. The prestart test program was run, and the NPP-1000 passed all checks. The Reactor Supervisor and the Electronics Engineer examined the unit and its wiring, finding nothing out of order. It was noted that the scram signals that shut down the reactor were not present on the instrument, indicating the source of the signal was something other than the NPP itself.

   Corrective actions required are unknown at this time. This is the second day in a row of issues with the CSC and/or the DAC that have resolved by rebooting the computer. The Electronics Engineer is contacting General Atomics at this time. This particular scram signal was common during shutdown periods prior to the CSC/DAC computer and program upgrade. This is the first time this signal has occurred, other than testing, since the upgrade. Note that the signal is the same pair of messages obtained during scram checks for the "Hi Voltage 2"channnel test.

August

1: On 4 August, the reactor operator was unable to perform the squarewave and pulse interlock checks during the prestart checklist. From the Anomaly Report:

Reactor and Plant conditions at the time of anomaly: Reactor shutdown. At 0707, the operator was unable to perform the checks of the Operating Instructions paragraph 1.2.F of the Startup Checklist. Each time the "Square Wave" or "Pulse" button on the CSC was pushed, a "Power Too Hi to Pulse" message comes up in the CSC Hi-Res monitor alert/alarm window. Additionally, a locked in UPS fault alert occurs, with the UPS indicating normal functions. Following a CSC computer reboot, several new alerts lock in: "1 KW interlock – YES", "Short Period RWP", UPS fault, and RWP Fault.

Actions taken to correct the anomaly: Attempted to reboot the CSC and DAC computers several times. Rebooting did not appear to work, so the entire electronics section was down powered and rebooted, including the CSC, DAC, NPP-1000 and NM-1000. Following reboot of the computers all locked in alarms cleared.
Several prestart checks and scram checks were performed satisfactorily, with no errors or indications of a problem.

What corrective actions needed?
Continue to troubleshoot and investigate cause. There are several potential issues, but none lock in or completely fail to where they can be identified. Continued surveillance and operations are needed until the component(s) fail and can be found. All of the electrical circuit checks performed to date show no problems.

2: On 15 August, the reactor operator was unable to complete the prestart checklist due to console scrams while shifting from "Manual" to "Pulse" or "Squarewave". From the Anomaly Report:

Plant conditions: At 0700, the Reactor Prestart checks were in progress. When the operator attempted to shift from "Manual" to "Pulse" or "Square Wave", a "Console Manual Scram" message was received in the Alert Window of the hi -res monitor. The scram magnets de-energized, and the control rod under test dropped. All other aspects of the prestart passed successfully.

Corrective actions: The Electronics Engineer performed a circuit trace, and found that the PS-1 power supply for the DISO-64 board was reading lower than the expected 12 VDC. After consultation with General Atomics, a work order was issued to change out the power supply. Following the power supply replacement, a full set of system utilities were run to verify the CSC control buttons and circuits worked properly, as well as a prestart check. All were successful.

What can be done to prevent future occurrences: The Electronics Engineer performed voltage checks on installed power supplies to verify no other unit was failing. No additional work is necessary. Components fail through use. Particular

attention to power supply issues will be applied if future control circuitry problems arise.

3: On 17 August, the reactor operator was unable to complete the prestart checklist due to failing CSC watchdog circuit. From the Anomaly Report:

Plant Conditions: The reactor was shutdown during prestart checks. At 0730, the operator was unable to complete the checklist due to failing on the CSC watchdog circuit. The scram test was successful for the watchdog, but the alarm would not clear following removal of the signal.

Corrective Actions: Troubleshooting indicated that the cause of the failure was a sticking relay on the RLY08 circuit board in the CSC. The scram would occur as expected during testing, but the relay stuck to the point where removing the alarm did not reset the relay.
Very minor mechanical agitation (tapping) would reset the relay following removal of the test signal. The scram occurred every time a signal was inserted. Operations were allowed to continue until a replacement for the RLY08 board was available. The replacement board was installed 8/24/05. Retests performed following the board replacement were all successful.

What can be done to prevent future occurrences: Not Applicable. Components fail through use

September

On 2 September, a rabbit broke in the PTS system during an irradiation. From the Anomaly Report:

Rx conditions prior to, and what happened: Reactor conditions were power at 1 MW steady state in automatic to perform 2 rabbit shots. The first rabbit contained sodium carbonate in two separate vials to measure and characterize the flux in the rabbit terminus. Two additional vials, and a third partial, were used as spacers inside the rabbit.
The rabbit was shot at 1433 for 20 seconds. Upon returning to the receiver, the radiation levels were much less than expected. After the receiver cover was lifted and the rabbit removed, it was discovered the end of the rabbit had broken off, and the vials were nowhere to be seen. The blower was turned off, and the system was taken out of "Enable" by the reactor operator.

Actions taken to correct the anomaly: The PTS system tubing was broken at the last joint above water, and the terminus was removed from the core to minimize the possibility of melting the poly vials. The system was allowed to decay over the weekend.
Several attempts to retrieve the vials failed. These included a "tape ball" on a fish wire, and polyflo tubing connected to tygon hose and a vacuum source. Inspection of the receiver showed the vials and the broken piece of the rabbit in the receiver. The only explanation for the location is that they had been in the tubing and fell during the system manipulations for disassembly.
Inspection of the failed rabbit showed that the wall thickness on the "nose" varied quite a bit between sides.

A radiograph of 6 "old" vials and 6 "new" vi als show that the wall thickness in the new vials can vary from 0.041 to 0.094 inches. General Atomics supplied the "new rabbits" about a year ago. This is the first failure.

Corrective actions needed to prevent anomaly in future: General Atomics has been notified of the rabbit failure. Discussions with other reactor facilities indicate this is not an unknown phenomenon at other facilities. Further use of this batch of rabbits will be determined on a case by case basis. General Atomics is investigating the cause of the poor molding, and will try to get a new batch made.
One possible action is to radiograph representative samples of the new batch prior to use

October

1: On 5 October, operators were unable to pull a fuel element out of the upper grid plate during the course of the annual fuel inspections. From the Anomaly Report:

During the course of this annual fuel inspection, the fuel element in position A-5 would not move and could not be removed from the core.

Using binoculars and a high intensity light from the tank surface a small set screw was observed between the fuel element and the upper grid plate causing the jamming.

Operations personnel utilized a variety of items to attempt to remove/recover the set screw, but eventually the element was successfully rotated causing the set screw to fall along side the element thus freeing it up to be removed. This occurred on 10/06/05. Fuel element 10677 was successfully removed from grid position A-5 and visually inspected satisfactorily. This fuel element also passed the fuel inspection straightness gage check satisfactorily.

After element was removed from position A-5, a detailed visual inspection of the visible part of the lower grid plate was performed using high intensity lights and binoculars from the tank surface. This inspection failed to locate the set screw on the lower grid plate indicating that it passed through the grid plate to the reactor tank bottom. Currently UCD/MNRC does not possess the capability to inspect beneath the reactor core and reflector assembly.

The source of the set screw is most probably from a collar located on the installed neutron source located in grid position B-8. In late 2004 the test source collar had slid up on the test source and had to be repositioned (see anomaly report 10/08/04). During this event it was noted that one of the set screws (one of three) would not turn (galled) and the decision was made to replace the collar. After the collar was replaced it was noted that there were only two set screws on the removed collar. No one observed when the set screw became separated from the collar. One other possible source of the set screw is the transient control rod linkage. This linkage contains several setscrews similar to the one observed on the fuel element. There is a recollection by operations personnel that during at least one annual control rod inspection and possibly during transient control rod repairs that a set screw was dropped into the tank and never visually located.

This problem was identified because the decision to verify that all fuel elements could be removed from the upper grid plate when several elements were difficult to remove during a planned fuel shuffle to increase core excess.

2: On 31 October, the operator was unable to remove the test source from the upper grid plate to conduct the prestart checklist. From the Anomaly Report:

On 10/31/05 at 0900 while attempting to pull the test source for the prestart checks, the operator found the test source stuck in the upper grid plate. Several attempts were made to free the source, including starting pumps to vibrate the source. The source did not move.
Additional operators utilizing different techniques (angled pulls on the wire, slow steady pulls, and quick pulls) eventually resulted in freeing the stuck source.
The sourced was reinstalled and removed from its grid plate location several times with no further evidence of sticking.

Visual checks of the test source collar show signs of wear and also indicate that all three set screws are still installed.

The Reactor supervisor granted permission to continue with the startup checks and normal reactor operations.

A review of the component drawings for the test source collar and the upper grid plate holes show a very close match to the beveled angles of the mating/seating surfaces of both items.
A new collar will be manufactured and installed at a later date. A review of the design of the collar will be performed and an evaluation made to see if changes to the design are required.
Operators will continue to handle the test source carefully to minimize the impact damage to the collar and to try top prevent further sticking

7.3 MAINTENANCE OTHER THAN PREVENTIVE:

January

1. Replaced two drive belts on HV-2
2. Changed out He supply bottle
3. PG&E changed out the building gas supply meter due to reported unusual sounds during operation

February

1. Performed rod drop time as part of the acceptance testing for the CSC/DAC computer replacement
2. Replaced the air compressor motor controller in the Silicon Shed
3. Installed Evacuation Horns in the two exterior sheds and trailer per FM-III-05-03.

4. Repaired leaks in the Secondary Cooling Tower pan.

March

1. Replace failed pump power switch in the Reactor Room Continuous Air Monitor (CAM) .
2. Troubleshoot and repair %1 Scram Test Channel.

April

1. Replace failed Secondary Cooling Tower Fan Motor.
2. Replaced a failed emergency light fixture power supply battery in the counting lab
3. Replaced failed Reactor Room CAM air pump motor power switch. The switch failed after less than one month of operation.

May

1. Adjust and check rod position indication bottom limit switch for the transient rod.
2. Replaced batteries in 3 emergency exit light units that failed monthly checks.
3. Replaced damaged blower belt in AC-3.
4. Replaced a cracked fan drive belt on EF-2

June

1. Demineralizer System resin bottles, south set, changed out and removed for shipment
2. Replace damaged drive belt on AC-2.
3. Replaced CSC DISO64 board with on hand spare
4. Replaced failed lockbox master keyed switch on Bay 1 interlock lockbox.
5. Relamped the Equipment Room fluorescent fixtures
6. Replaced burned out blower motor in AC-8

July

1. Trouble shot robot and Bay 1 biological shutter malfunction. Found PIC overload tripped. Reset PIC, robot and shutter functioned sat

2 T/S and repair front gate magnetic latch.

3. Replaced the master key in several Radiography Bay key interlock boxes so that all doors now use the same master key.

4. Replaced all ball joints on stack damper actuator arm.

5. Updated weekly source level after removing rad items stored in Demineralizer Cage area.

6. Replaced failed backflow preventer for building water supply

August

1. Contractor replaced a sensor in the security system. The sensor had caused several security system faults as it was failing

2. Replace failed control system console master power switch.

3. Replace the Demineralizer system city water inlet 0.35 micron particulate filter

4. Removed NPP-1000, shipped to General Atomics for troubleshooting, and reinstalled. Failed on Power level trip function.

5. Replace failing 12VDC power supply for the DISO-64 board in the CSC.

6. Replaced helium supply bottle regulator.

7. Troubleshoot and repair CSC watchdog circuit failure. Replaced CSC RLY08 ckt board.

8. Replace worn belts in HV-1.

9. Install new metallic pre-filters in HV-1, 2, and 3.

10. Replace failing air pump motor in the Reactor Room Continuous Air Monitor.

September

1. Remove terminus, disassemble tubing, remove broken rabbit. See the anomaly section.

2. Reconnected broken wire in the Zone 1 section of the security system, retested system sat

3. Replace expended He supply bottle.

4. Calibrated the CSC strip chart recorder.

5. Calibrated the argon channel on the Bay Continuous Air Monitor (CAM).

6. Replaced Bay CAM CRT display and source checked sat.

7. Repaired print head and slider on the Reactor Room CAM.

8. T/S and Repair Staging Area #2 Radiation Area Monitor (RAM) indicating lights

October

1. Performed the annual maintenance shutdown during the month of October. Included in the shutdown cycle was a fuel movement that installed five new fuel elements, and took five out of service. Three elements were removed due to end of lifecycle, and two elements failed inspection criteria for straightness. Annual fuel and control rod inspections were included in this evolution. See the anomaly report for 5 October. Rod calibration checks and rod drop time checks were performed following all fuel and rod maintenance.

2. Contractors retrofitted HV units with upgraded climate control equipment per FM III-05-03. Facility Modification FM III-05-03 completed satisfactory

3. Replaced 3.6vdc battery on NM-1000 processor I/O memory board. The NM-1000 would lose setpoint values on loss of power, which was corrected by replacing this battery.

4. Changed out NPP units and performed a calorimetric satisfactorily.

November

1. Replaced EF-3 suction HEPA pre-filter due to failure

2. Contractor performed repairs to roofing membrane over the Reactor Room, and several split seams.

December

1. Replaced drive belts and realigned motor bedplate for EF-3 motor (Pneumatic Transfer System exhaust blower).

2. Replaced burned out mainline contactors in AC-11.

3. Replaced the depleted helium supply bottle.

7.4 Training

January

1. Reactor Operations personnel attended the following training:
   a: Safety Topics Briefing: Amendment 7 to License No. R-130.
   b: Normal, Abnormal, and Emergency Procedures.

February

None

March

1. All personnel attended annual ALARA training.

April

None

May

1. All facility personnel attended training in May reviewing the 2004 Security Drill findings and corrective actions.

June

None

July

1. All personnel attended EH&S refresher training

2. Two facility personnel (Senior Reactor Operator and Experiment Coordinator) attended Basic Level Transportation Training per 49CFR, 172.7 for dangerous goods shipping training

August

1. Reactor Operator trainees received documented training in the following areas Calorimetric, Technical Specifications.

2. Operations and facility training this month included HP procedures Rev 14 safety and security training, and Fuel and Fuel Handling.

September

1. During the month of September, Reactor Operations personnel attended the following training:
   a Operations and Reactor Operator trainees attended three lectures in a series on Reactor Physics and Theory
   b. Two facility personnel attended Fed-Ex IATA training for Dangerous Goods shipping.

October

1. During the month of October, Reactor Operations personnel attended the following training:
   a: Operations and Reactor Operator trainees attended three lectures in a series on Reactor Physics and Theory.

b: Radiography and Operations personnel attended training on Bay 3 modifications conducted by the LLNL consultant Dan Schneberk

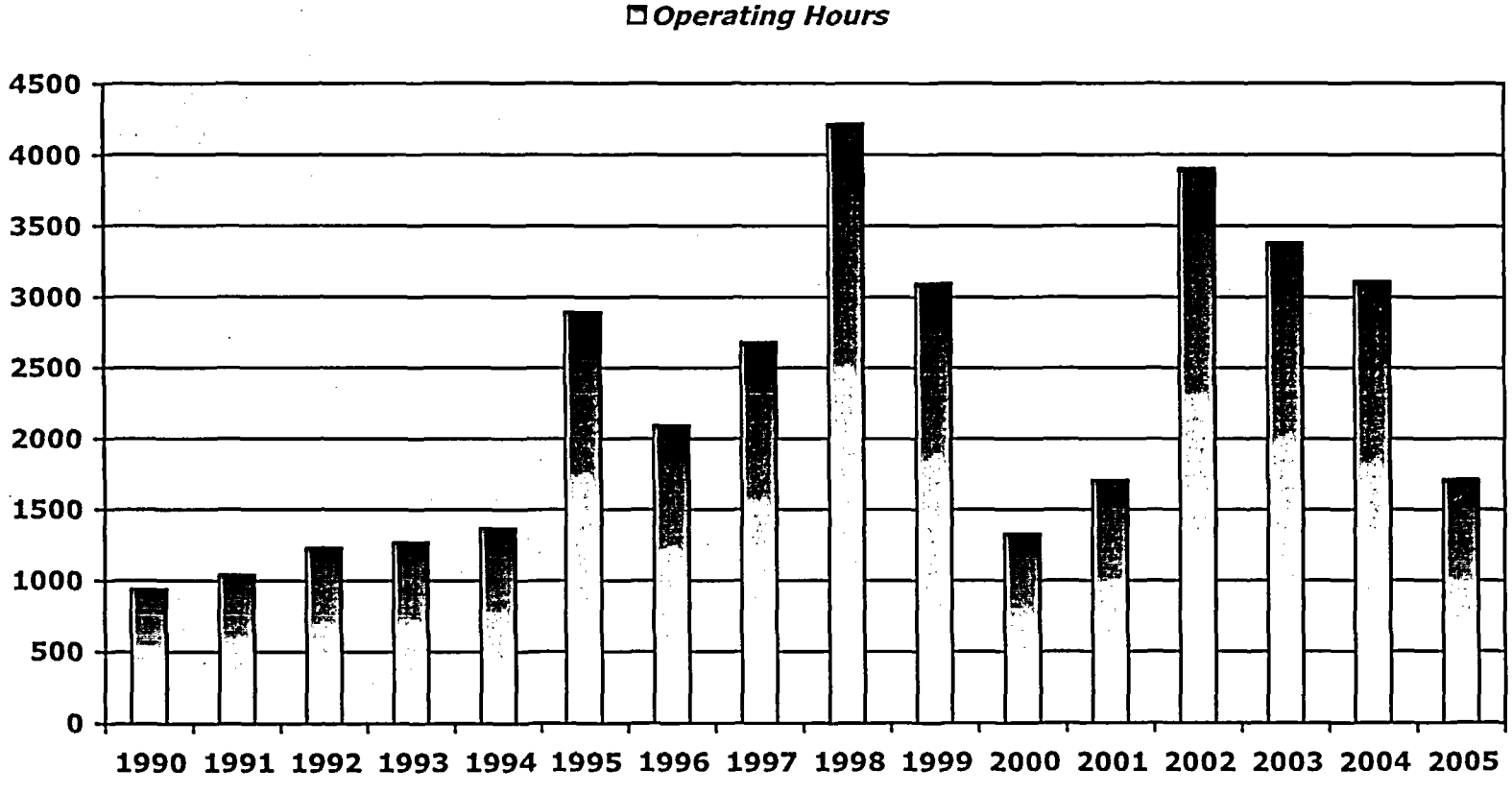
November

1. During the month of November, Reactor Operations personnel attended the following training:
   a: Operators and Reactor Operator trainees attended three lectures in a series on Reactor Physics and Theory
   b: Radiography and Operations personnel attended training on Reactor Maintenance Procedure MNRC-DOC-0007 changes
   c: Senior Reactor Operators attended training on the latest revision to the Emergency Procedures.
   d Senior Reactor Operators attended Technical Specifications refresher training.:
   e: Senior Reactor Operators attended training on use of Dosicard dosimetry.

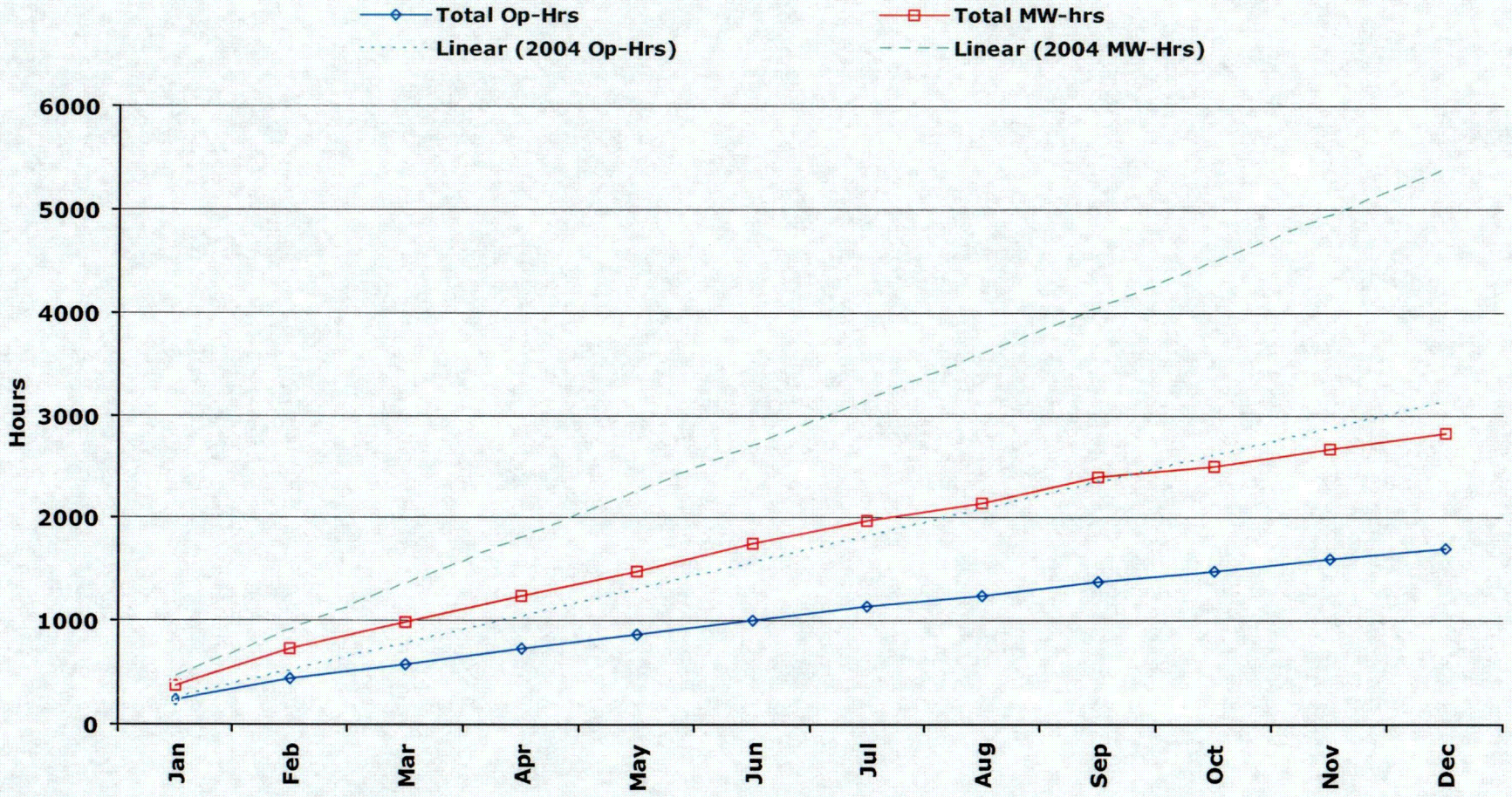
December

1. Operations personnel and Reactor Operator trainees attended 2 sessions in the ongoing Physics/Reactor Theory series, completing all training in this series.

UCD/MNRC Operating History

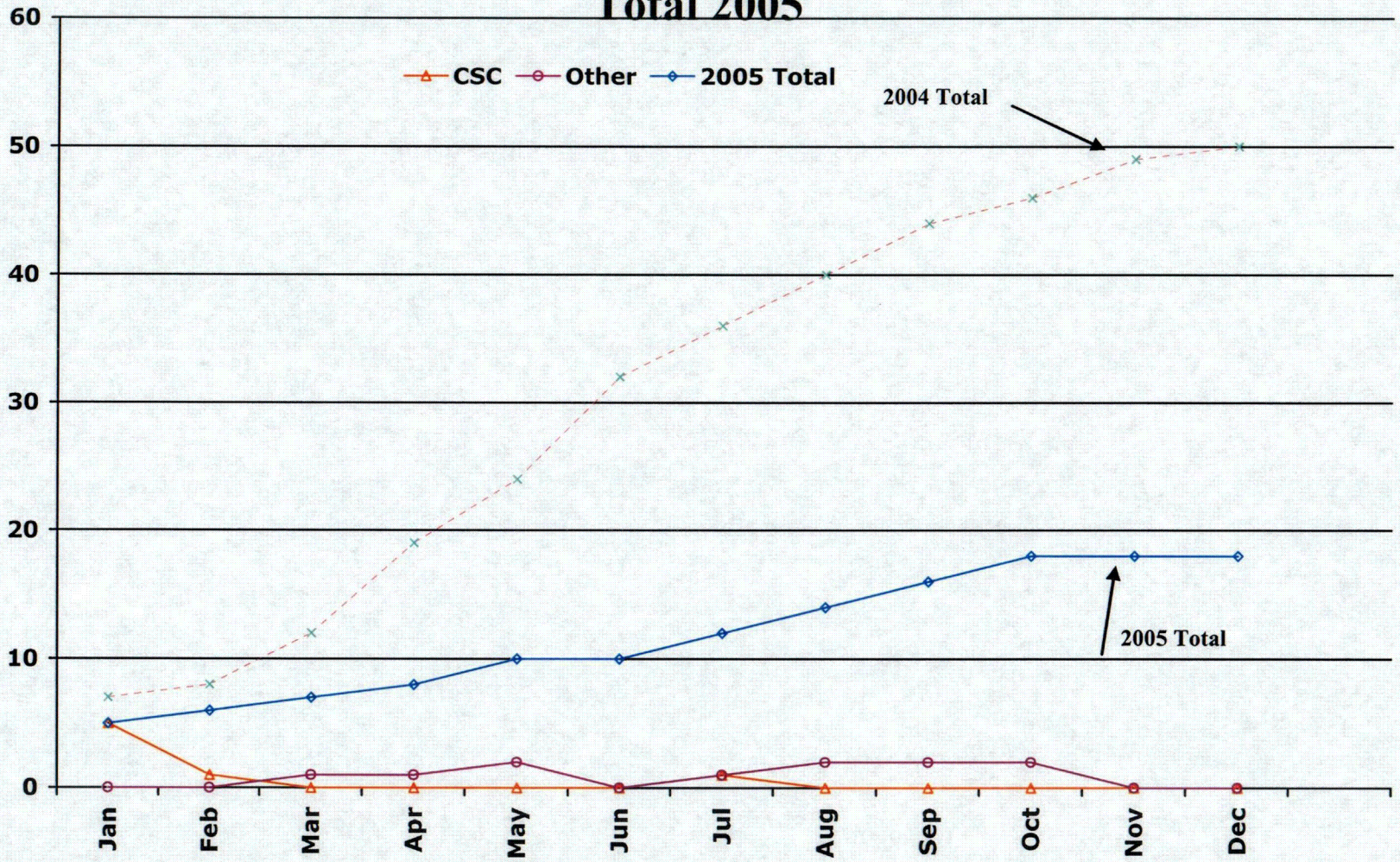


Reactor Hours (2005)



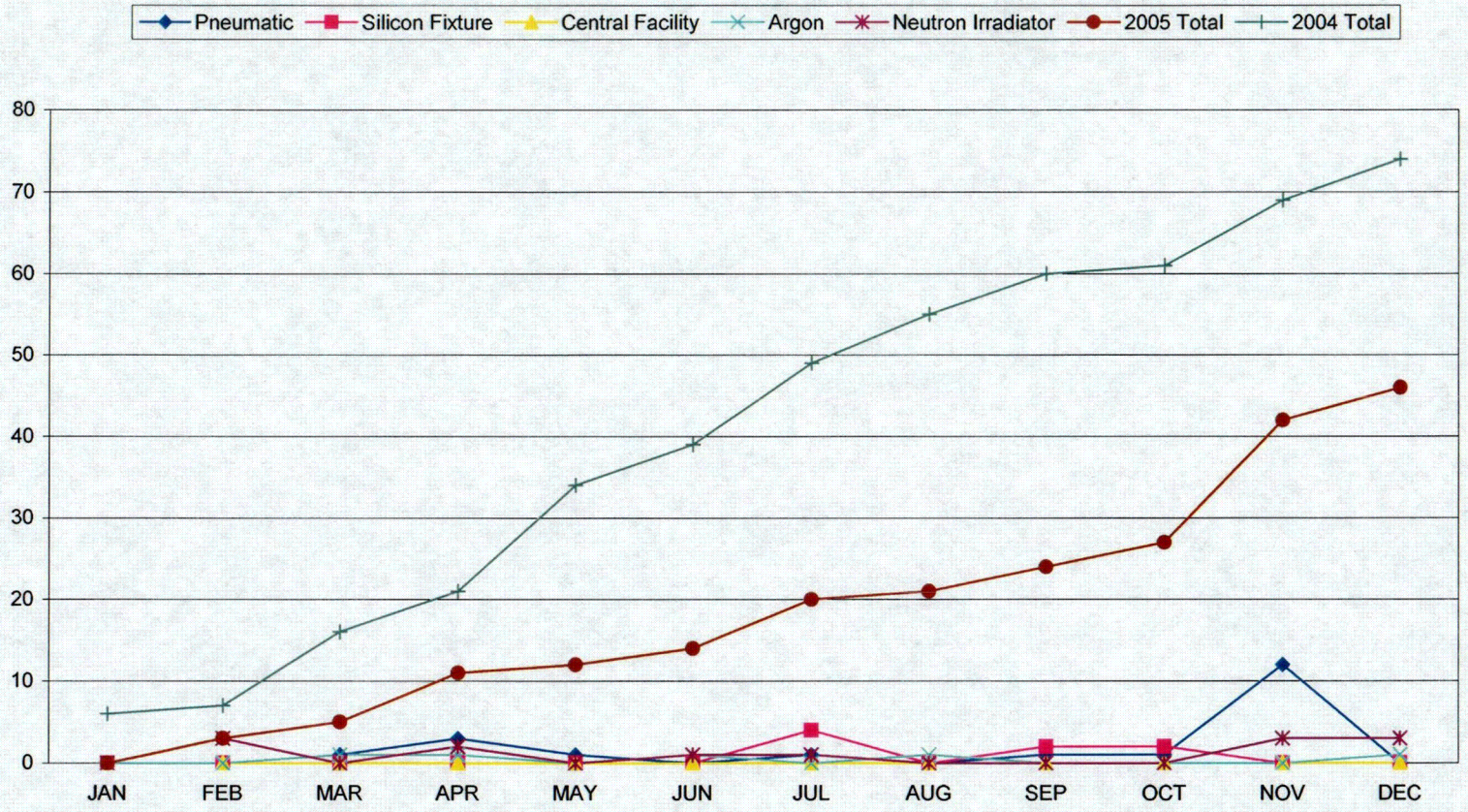
C02

Unscheduled Shutdowns-- Total 2005



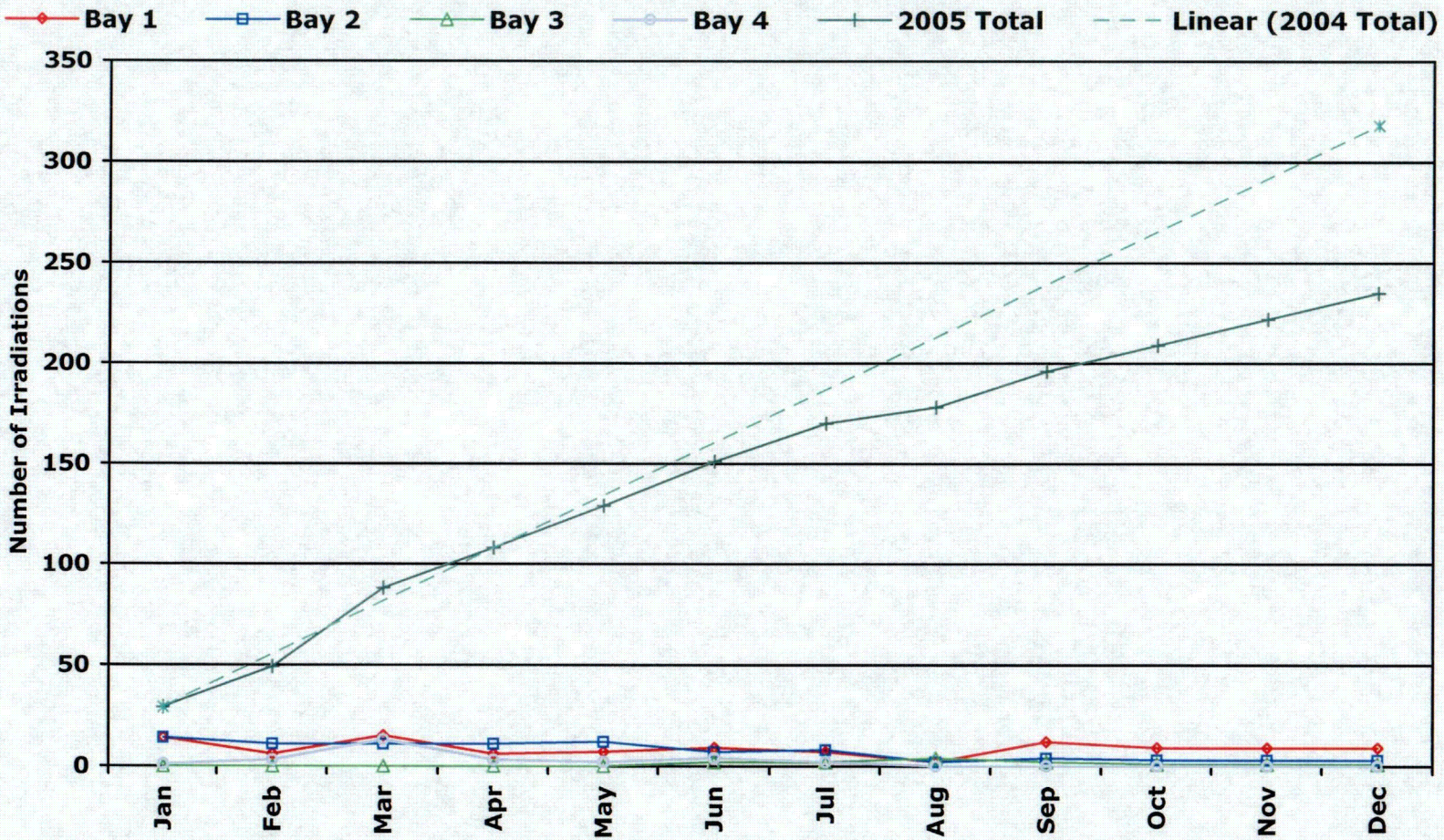
C03

Reactor Tank Irradiation Facilities
Total Number of Irradiations Completed (2005)



COX

Bay Irradiations Completed (2005)



C05

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

Liquid effluents released during 2005 are summarized on a monthly basis in Table 1 below.

TABLE 1

2005 SUMMARY OF LIQUID EFFLUENTS

MONTH	TOTAL ACT. RELEASED (Ci)	DETECTABLE GAMMA NUCLIDE(S)	SPECIFIC ACT. OF EACH DETECT-ABLE RADIO-NUCLIDE (uCi/ml)	TOTAL ACT. OF EACH DETECT-ABLE RADIO-NUCLIDE (Ci)	AVG. CONC. OF RAD. MATL. AT POINT OF RELEASE (uCi/ml)	FRACTION OF 10CFR20 LIMIT	TOTAL VOL. OF EFFLUENT WATER (INCLUDING DILUENT) RELEASED (gal)
JAN	0	NONE					
FEB	0	NONE					
MAR	0	NONE					
APR	0	NONE					
MAY	0	NONE					
JUN	0	NONE					
JUL	0	NONE					
AUG	0	NONE					
SEP	0	NONE					
OCT	0	NONE					
NOV	0	NONE					
DEC	0	NONE					

8.2 Airborne Effluents

Airborne radioactivity discharged during 2005 is tabulated in Table 2 below.

TABLE 2
2005 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 APPLI 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	11.43	1.52E-06	6.7	3.38E-01	.34	NONE	NONE
FEB	8.83	1.30E-06	5.7	2.89E-01	.29	NONE	NONE
MAR	7.78	1.03E-06	4.5	2.30E-01	.23	NONE	NONE
APR	8.09	1.07E-06	4.7	2.39E-01	.24	NONE	NONE
MAY	6.36	8.42E-06	3.7	1.88E-01	.19	NONE	NONE
JUN	6.77	8.97E-06	3.9	2.00E-01	.20	NONE	NONE
JUL	7.58	1.00E-06	4.4	2.24E-01	.22	NONE	NONE
AUG	3.45	4.57E-07	2.0	1.02E-01	.10	NONE	NONE
SEP	4.04	5.35E-07	2.4	1.19E-01	.12	NONE	NONE
OCT	1.80	2.38E-07	1.0	5.32E-02	.05	NONE	NONE
NOV	3.84	5.09E-07	2.2	1.14E-01	.11	NONE	NONE
DEC	3.04	4.03E-07	1.8	9.01E-02	.09	NONE	NONE
TOT	73	9.80E-06		2.19	2.19	NONE	NONE
AVG	6.08	8.17E-07	3.6	1.82E-01	.18		

(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).

8.3 Solid Waste

Solid waste packaged and transferred for disposal during 2005 is summarized in Table 3 below.

TABLE 3
2005 SUMMARY OF SOLID WASTE

TOTAL VOL. (cu. ft.)	TOTAL ACTIVITY (mCi)	DATE OF SHIPMENT	DISPOSITION
51.19	330.651	3/29/05	Thomas Gray & Assoc Orange, CA
100.2	191.548	6/16/05	Environmental Mgmt & Controls Turlock, CA

9.0 Radiation Exposure

Radiation exposure received by facility operations personnel, facility users, and visitors during 2005 is summarized in Table 4 below.

TABLE 4
2005 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	27**	118	507	414[1]	1194
FACILITY USERS	3	0	0	*	*
VISITORS	759	0.63	20	*	*

* Extremity monitoring was not required.
** Reduced to 17 as of 04/01/06, then to 14 as of 10/01/06
1 – only seven persons received extremity exposure this year

10.0 Radiation Levels and Levels of Contamination

Radiation levels and levels of contamination observed during routine surveys performed at the MNRC during 2005 are summarized in Table 5 below.

TABLE 5
2005 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	0.4	<800(1)	<800(1)
STAGING AREA	<0.1	0.15	<800(1)	<800(1)
COMPOUND	<0.1	0.6	<800(1)	<800(1)
EQUIPMENT RM	1.5	148	<800(1)	<800(1)
DEMINERALIZER AREA	25	1010	<800(1)	<800(1)
REACTOR RM	8.0	140	<800(1)	<800(1)
SILICON STORAGE SHED	<0.1	1.0	<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 2005 are summarized in Tables 6-9 below. The environmental survey program is described in the MNRC Facility Safety Analysis Report.

TABLE 6
2005 SUMMARY OF ENVIRONMENTAL TLD RESULTS
(WITH NATURAL BACKGROUND(1) SUBTRACTED)

	AVERAGE (mrem)	HIGHEST (mrem)
ON BASE (OFF SITE 1-20 & 64)	6	18
ON SITE (SITES 50 – 62 & 65-71)	23	84

(1) Natural background assumed to be the off base (Sites 27-42) average of 29mrem.

TABLE 7
2005 SUMMARY OF RADIOACTIVITY IN WELL WATER

	ALPHA (pCi/l)	BETA (pCi/l)	TRITIUM (pCi/l)	Cs-137 (pCi/l)
AVERAGE	<MDA	<MDA	<MDA	<MDA
HIGHEST	<MDA	3.40	<MDA	<MDA

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

	MIN	MAX
Alpha	1.40	3.18
Beta	2.53	3.23
Tritium	208	346
Cs-137	4.21	9.46

As stated in a memorandum dated 20Jan2005 to the UCD/MNRC Director from the RSO, the following changes to the Health Physics Program took place in 2005:

Changes in the bioassay program:

As of 19 Jan 2005 whole body counting of MNRC personnel will no longer occur.
Whole body counting is no longer readily available to the MNRC personnel and after 15 years of counting, no individual received a detectable burden above background from activities at the MNRC, therefore this form of bioassay will be discontinued. An evaluation of MNRC activities reveals the most likely uptake of a radioactive isotope would be in the thyroid and the most effective method of detection is with a thyroid count using a sodium iodide probe. This procedure will remain active and will be used when necessary.

Changes in the environmental monitoring program:

Direct Radiation Measurements:
As of 31 Dec 2003 all direct radiation measurements at monitoring sites 1-20, 27, 28, 31 38, 40, 42, 50-6, 64, 65-69, and 71 were discontinued. The data collected was not meaningful nor was it being utilized.

Airborne Radioactive Particulate Measurements:
As of 31 Dec 2003, all airborne particulate measurements at monitoring sites 6, 7, 8, 10, 13, 18 and 50 were discontinued. The data collected was not meaningful nor was it being utilized.

Measurements of Radioactivity in Soil:
As of 31 Dec 2004, all soil samples at monitoring sites 1, 2, 5, 6, 7, and 12 were discontinued. The data collected was not meaningful and was not representative of MNRC activities. A review of 10years of data did not reveal anything significant above background levels of radioactive material. All data will be maintained for historical reference.

Measurements of Radioactivity in Vegetation:
As of 31 Dec 2004, all vegetation samples at monitoring sites 1, 2, 5, 6, 7 and 12 were discontinued. The data collected was not meaningful and was not representative of MNRC activities. A review of 10 years of data did not reveal anything significant above background levels of radioactive

material. All data will be maintained for historical reference.

Measurements of Radioactivity in Well Water:
As of 19 Jan 2005 all well water samples will be collected in duplicate from the City well at Site 42. This site is the nearest downstream potable water source The duplicate samples will be retained until the analysis results of the sample sent to the vendor are received.

Personnel Surveys:
As of 19 January 2005, the hand and foot monitors located at the exits to staging area #1, staging area #2 and staging area #4 will no longer be used. Fifteen years of survey data resulted in no detection of loose contamination. These pieces of equipment will remain operational and used only when necessary.

Contamination Surveys:
As of 19 Jan 2005, the frequency of the contamination exit survey was changed from once a shift to once daily. No removable activity at these locations was detected after fifteen years of data collection.