UNIVERSITY OF CALIFORNIA, IRVINE

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

George E. Miller
Senior Lecturer Emeritus
Department of Chemistry and
Supervisor, Nuclear Reactor Facility

IRVINE, CA 92697-2025
(949) 824-6649
FAX: (949) 824-6082 or (949) 824-8571
Internet: GEMILLER@uci.edu

July 30th, 2015

US Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Re: Docket 50-326; License R-116
Annual Report Submittal, Tech Spec 6.7f

Gentlemen:

Please find enclosed the annual report for the UCI Nuclear Reactor Facility, covering the period July 1st 2014 through June 30th 2015.
Electronic copies are being provided as indicated below.
Thank you.

Sincerely,

George E. Miller

George E. Miller
Reactor Supervisor

Cc.,w/enc (*electronic copies)
American Nuclear Insurance, 95 Glastonbury Blvd, Glastonbury CT 06033, Policy NF-176
* Ken Janda, Dean of School of Physical Sciences, UCI
*Johnny Eads, US Nuclear Regulatory Commission
*Linh Tran, Project Manager, US Nuclear Regulatory Commission
*AJ Shaka, Chemistry Dept., Director, UCI Nuclear Reactor Facility
*Reactor Operations Committee Members, UCI

A020
NRR

U. C. IRVINE

Nuclear Reactor Facility

Annual Report

for

July 1st, 2014 to June 30th, 2015

Facility License R-116

Docket 50-326

Prepared in Accordance with Part 6.7f

of the Facility Technical Specifications

July, 2015

by

Dr. George E. Miller, Reactor Supervisor
Jonathan Wallick, Associate Reactor Supervisor and Nuclear Engineer

Section 1. Operations Summary (additional details given below)

Operation of this facility supports UCI research and education programs in the Department of Chemistry (CHEM) and the Department of Chemical Engineering and Material Science (ChEMS). Research is being conducted in application of radioisotopes as tracers and radiochemical analytical and separation techniques including applications to nuclear waste separations (ChEMS).

Reactor utilization, apart from operator training and maintenance, is for analytical sample irradiation and production of isotopic tracers. Analysis samples come from diverse origins related to forensic science, fossil fuels, geochemistry, art, and archaeological studies, chemical separations in nuclear fuel cycle experiments, chemical synthesis, industrial quality control, enzyme studies, trace element pollution studies, etc. The reactor is also used in class work by undergraduates learning tracer and activation analysis techniques using small quantities of short-lived activated materials. Enrollment in the Fall Quarter 2014 laboratory course in Radioisotope Techniques using the facility was 34 students with 3 graduate teaching assistants, who also learned these techniques. An additional class teaching the fundamentals of nuclear instrumentation was piloted in the Spring Quarter 2015, with ten students total in attendance.

Support for UCI faculty and students includes grants from NRC and DOE (NEUP and NSSA), and partnerships with national laboratories (PNNL, LLNL, LANL, and INL. Security upgrades are in the process of being finalized, which have been funded by the DOE GTRI program.

Use is also made of the facility by other educational institutions, both for research and for visits/tours. A modest Nuclear Science Outreach program (NSOP) using UCI students to present talks and a laboratory to middle and high school classes has been continued. This program has also involved tours, class demonstrations, and analyses of samples submitted by faculty.

Operations have remained steady as student use has become stable. Criticality was achieved for 253.95 hours, and the total energy generated was equivalent to 160.81 hours at full steady state power. 145 separate experiments were performed, and over 2880 samples were irradiated (sometimes multiple samples are included in a single capsule and are not always separately logged). 7 moderate level mixed isotope shipments were made, all Yellow II category, totaling 29.5 GBq of activity. Twenty-five relatively low power pulses were performed this year, all without incident. Six 50.59 changes were approved this year: (i) a new pressure monitoring system; (ii) replacement ion exchange resin tanks; (iii) water level meter recalibration; (iv) radiation monitor calibration procedure changes; (v) relocation of a pressure monitoring point for the new pressure monitoring system; (vi) experiment authorization amendment for increased activity production. No unusual surveillance results/activities were noted/conducted during this period. No new experiments have been approved this year.

A routine NRC inspection June 8th to the 11th of 2015, resulted in no Notices of Violation or follow-up items. In 2014-2015, Reactor Operations Committee meetings were held on October 15th, 2014 and February 17th, 2015 in accordance with Technical Specification requirements.

No follow-ups or incidents have been forthcoming regarding security or emergency response. One emergency drill / exercise has been held this past year involving the UCI EH&S radiological personnel, Orange County Fire Authority, UCI Police Department, Orange County Health Department, and reactor operators capitalizing on lessons learned in GTRI training at the Y-12 site. The drill was held on September 9th, 2015, to large success, involving all agencies previously named, running multiple instances of the drill with different subgroups.

Inspections/audits continue to be conducted quarterly by the Radiation Protection staff of EH&S at UCI. These have identified that frequency schedules have been properly maintained, and results continue to show absence of significant levels of contamination or personnel exposure. A new Radiation Safety Officer is currently being sought, as the previous individual has left UCI's EH&S team. The UCI Medical Center's Radiation Safety Officer is currently the acting Radiation Safety Officer while recruiting efforts are underway.

Several potential operators underwent training this year. One NRC operator examination has taken place this year, involving two new trainees and one SRO-Upgrade candidate. The examination took place from June 15th, 2015 to June 17th, 2015 and all candidates passed. As of June 30th 2015, 4 SRO's and 5 RO's were licensed and active. One SRO is currently inactive. By July 30th 2015, the complement of active licensed operators had increased to 5 SRO's and 6 RO's, with one RO gradating and about to leave.

Section 2. Data Tabulations for the Period July 1st, 2014 to June 30th, 2015

TABLE I.

Experiment Approvals on file	5
Experiments performed (including repeats)	145
Samples irradiated	2880
Energy generated this period (Megawatt hours)	40.20
Total, 69 element core = 127.00	
>74 element core = 1510.76	
Total energy generated since initial criticality	1637.76 Mwh
Pulse operation this period	25
Total reactor pulses to 6/30/2015	1010
Hours critical this period	253.95
Total hours critical to date	9602.50
Inadvertent scrams or unplanned shutdowns or events at power	7
Visitors to reactor - as individuals or in tour groups –	599
Maximum dosimeter recorded for visitors - all less than	0.2 mrem
Visiting researchers (Temporary Self Indicating Dosimeters)	17
Maximum exposure recorded at one visit	1.3 mrem
Visiting researchers (Thermoluminescent Dosimeters)	33
Students and teaching assistants in class, badged	37
Exposures reported for quarter (range: 0-0 mrem) average	0.0 mrem
Isotope Shipments this period (mixed act'n products = 0.80 Ci total)	7

TABLE II

Reactor Core Status 6/30/15 (core configuration changed as of 11/6/12)

Fuel elements in core (including 2 fuel followers)			84
Fuel elements in storage (reactor tank - used)			23
Fuel elements unused (4 instrumented elements + 1 element + 1 FFCR)			6
Graphite reflector elements in core			34
Graphite reflector elements in reactor tank storage			0
Water filled fuel element positions			2
Experimental facilities in core positions			5
Non-fuel control rods			2
Total core positions accounted for			127
Core excess, cold, no xenon (as of 6/30/2015)			$2.87
Control rod worths (calibrated 1/9/2015)	REG	$3.00	
	SHIM	$3.52	
	ATR	$1.73	
	FTR	$0.68	
	Total:	$8.93	
Maximum possible pulse insertion (calculated)			$2.41
Maximum peak power recorded			226 MW
Maximum peak temperature recorded in pulse (B-ring)			214.6^{o}C

Section 3.

Inadvertent Scrams, Unplanned Shutdowns, Events at Power

TABLE III.

Date	Time	Power	Type and Cause
2014			
07/08	09:32	75 W	Linear scram. The Linear power monitor initiated a scram when transitioning from the 75 W range to the 250 W range. The cause of the failure was initially thought to be too quick a reactor period. Restart was authorized by the SRO. However, upon restart, the Linear power monitor was not auto ranging properly, and the operator manually shut down the reactor. Troubleshooting utilizing the Test switch through all 18 ranges of the Linear power monitor showed no fault, and restart was authorized once more. The subsequent startup was successful without further issue. Root cause was determined to be a fault in the Test circuit potentiometer, which was cleared during troubleshooting.
07/22	11:29	100 mW	Period scram. While raising power to 1.5 W for training, a period scram occurred. Interference from a cellular phone was determined to be the root cause based on previous events with similar conditions and the presence of the device. Restart authorized by SRO after phone was removed from area.
07/23	10:50	75 mW	Period scram. A period scram occurred during a routine start up to 1.5 watts due to operator error of a first time operator. Trainee operator counseled on proper start up procedure, restart authorized by SRO.
07/29	11:25	100 mW	Period scram. While raising power to 1.5 W for training, a period scram occurred. Interference from a cellular phone was determined to be the root cause based on previous events with similar conditions and the presence of the device. Restart authorized by SRO after phone was removed from area.
09/10	09:36	75 mW	Period scram. A period scram occurred during a routine start up to 1.5 watts due to operator error of a first time operator. Trainee operator counseled on proper start up procedure, restart authorized by SRO.
10/21	08:01	250 mW	Linear scram. During routine start up, a Linear scram occurred when the instrument attempted to automatically switch between the 250 mW and 750 mW ranges. While troubleshooting, the event could not be reproduced and the instrument operated normally. Restart authorized by SRO.

2015

04/02	13:01	150 mW	Period scram. A period scram occurred during a routine start up to 1.5 watts due to operator error during requalification training. The operator was counseled on proper start up procedure. Restart authorized by SRO.

Section 4
Maintenance and Surveillance and Other Incidents

The following non-routine maintenance/surveillance activities were carried out during this period. Any reactor operation related items have been included above and are not repeated here.

2014

Sept 11th — On September 11th, 2014, the water purification filters were replaced to correct an excessive differential pressure across the component due to particulate accumulation. Initial differential pressure was 11 psid, and after replacement it was observed to be <1 psid. The radiation level of the used filters was measured to be less than 0.05 mr/hr on contact. The filters were stored for drying and later gamma spectrometry assessment. No unexpected radioisotopes were found upon gamma spectrometry of the filters.

Oct 15th — On October 16th, 2014, a new pressure monitoring system was installed to replace the existing pressure gauges located throughout the purification and cooling systems. This new instrument is a digital meter with a selector switch mounted inside a waterproof enclosure near the water systems. Pressure inlet and outlet of the purification filters, outlets of the ion exchange tanks, inlet and outlet of the heat exchanger secondary side (no previous indications) are be monitored by this meter. A 50.59 form is on file for this change.

Oct 24th — On October 24th, 2014, the pool water level meter was recalibrated to measure in feet from the bottom of the pool rather than the arbitrary units it had indicated in up to that point. The two foot long detector was calibrated such that the top of the detecting range was level with the top of the pool, which is 25 feet deep, and the middle of the detector, 1 foot lower, was calibrated to indicate 24 feet. All calibrations were successful and agree with manual readings of current pool water level. The relative alarm level remained unchanged – now set at 24 feet above the pool bottom. A 50.59 form is on file for this change.

Oct 30th — On October 30th, 2014, the location of point number five for the pressure monitoring system was changed from the outlet of the chilled water side of the heat exchanger to the outlet of the cooling pump on the reactor coolant side of the heat exchanger. This provides comprehensive indication of a differential pressure between the two sides of the heat exchanger at the points of interest to prove that pressure of the chilled water side is always higher than that of the reactor coolant side. A 50.59 form is on file for this change.

Dec 17th — On December 17th, 2014, the Wide Range Linear Monitor was cleaned and inspected at the recommendation of the manufacturer to correct the intermittent issues present with the instrument's auto range-changing behavior. The maintenance was performed per the instrument's manual and operations were postponed until a new power calibration was performed. The instrument has been free of issues since.

2015

Jan 9th — On January 9th, 2015, the SHIM, REG, ATR, and FTR rod calibrations were performed. A new preliminary excess of $2.96 was found. Final results for rod worth were: SHIM $3.52 REG $3.00, ATR $1.73, FTR $0.68 for a total of $8.93. Final core excess was reported to be $2.90. On January 9th, 2015, power calibrations were also performed. 84.6% actual power was found for the previous setting of 80.0%, requiring adjustment of balance potentiometers on the channels. All instrumentation is now in correct alignment for calculated power level values.

May 4th — On May 4th, 2015, the water purification filters were replaced to correct an excessive differential pressure across the component due to particulate accumulation. Initial differential pressure was 18.3 psid, and after replacement it was observed to be 0.3 psid. The radiation level of the used filters was measured to be less than 0.05 mr/hr on contact. The filters were stored for drying and later gamma spectrometry assessment. No unexpected radioisotopes were found upon gamma spectrometry of the filters.

June 8th — On June 8th, 2015, the exhaust flow rate from the reactor room was noted to be intermittently low out of specification at 3206 CFM, failing to meet the minimum requirement of 3500 CFM. A trouble call to facilities management was placed and the condition was corrected on June 9th, 2015.

Section 5
Facility Changes and Special Experiments Approved

Six 10 CFR 50.59 changes have been implemented during the course of the last year.

The first change was for a new pressure monitoring system installation in order to replace the aging pressure gauges used for indication throughout the purification and cooling systems. This new instrument is a digital meter with a selector switch mounted inside a waterproof enclosure near the water systems. Pressure inlet and outlet of the purification filters, outlets of the ion exchange tanks, inlet and outlet of the heat exchanger secondary side (no previous indications) are to be monitored by this meter.

The second change analyzed and approved was for the intended replacement of the ion exchange resin tanks used in the purification system. The screening process was completed for installation of new tanks with the same type of resin used previously, however the acquisition and installation of the tanks is still in process. It is anticipated that this change will be completed within the next calendar quarter.

The third change was to recalibrate the water level meter to indicate in feet instead of arbitrary units to add ease of use for operators. The alarm and warning set points were reprogrammed to be the same as before and will lose no functionality. Start up and shutdown check lists were also updated to reflect these changes.

The fourth change was a change to the procedures used to calibrate the new radiation monitoring system installed at the reactor facility, which required a modified calibration procedure to satisfy maintenance requirements. Calibrations, as recommended by the manufacturer, need only take place at 2 year intervals. The procedure also needed to be amended to exclude the provisions for performing channel tests, as this digital, computer based system has no capability to inject a test signal to the instruments.

The fifth change was to relocate a pressure detector for the new pressure monitoring system mentioned in the first 50.59 change of the year. The location of point number five for the pressure monitoring system was changed from the outlet of the chilled water side of the heat exchanger to the outlet of the cooling pump on the reactor coolant side of the heat exchanger. This provided comprehensive indication of a differential pressure between the two sides of the heat exchanger at the points of interest to prove that pressure of the chilled water side is always higher than that of the reactor coolant side.

The sixth and final change of the year was an amendment to a long standing experiment authorization for Professor Nilsson and his research group in the department of the Chemical Engineering and Materials Science. The experiment authorization was amended to include a provision to allow an exception to previously limited isotope production. Specifically, the amendment allowed an experiment in which up to 1 Ci of I-128, which has a 25 minute half-life, to be produced through normal irradiation procedures using the reactor. The authorization was granted after approval from the Radiation Safety Officer and the Reactor Operations Committee. Additional precautions were be prescribed and observed in order to allow this amendment.

Section 6. Radioactive Effluent Release.

(a) Gases.

The major direct release to the environs is Argon-41 produced during normal operations. Very small amounts of other gases may be released from irradiated materials in experiments.

Releases are computed based on original measurements at point of origin within the facility and taking only dilution into account. Since much of the release is from operation of the pneumatic transfer system for samples, this is a conservative estimate in that assumption is made that all use of the PT is at full steady state power level (250 kW) when, in fact, considerable use is with the reactor at a lower power level. In view of the small numbers involved, and the fact that an integrated dose check is provided by an environmental dosimeter ($CaSO_4$-Dy) hanging directly in the exhaust at the point of stack discharge, it is considered unnecessary to provide further checks of these estimates. The dosimeter data confirm that an individual standing directly in the exhaust flow for one year would receive an additional submersion dose from the exhaust less than the reliability limit of the dosimeters, or less than 20 mrem per year. The dosimeter data are presented separately in Section 7, Table IV. Over the years that data have been collected, the accumulated exposure at the exhaust locations have been lower than for "control" points because of lower masses of concrete structures in the vicinity. In fact the data have been consistently at 20-25 mrem per year below background level, so confidence of exposure less than 5 mrem over background seems possible.

Release estimates based on operational parameters are as follows:

(1) Operation of pneumatic transfer system (7/1/14-6/30/15):

a. Minutes of operation:	665.7 minutes
b. Release rate assumed:	6.0×10^{-8} microcuries/mL
c. Flow rate of exhaust air:	1.2×10^{8} mL/min
d. Dilution factor:	0.01
Total release computed: (a x b x c x d) =	4.79×10^{1} microcuries

(2) Release from pool surface (7/1/14-6/30/15):

a. Total hours of operation at full power (Effective Full Power Hours) = 160.81 hours

b. Release rate assumed:	1.0×10^{-8} microcuries/mL
c. Flow rate of exhaust air:	1.2×10^{8} mL/min
d. Dilution factor:	0.01
Total release computed: (a x 60 x b x c x d)	= 1.16×10^{2} microcuries
e. Total of (1) and (2) emission in 1 year	**= 1.64×10^{2} microcuries**

f. Total effluent released in 1 year (525960 minutes/yr. x c x d) = 6.31×10^{11} mL

Concentration averaged over 12 months (e/f) = ~< 2.59×10^{-10} microcuries/mL
Since 2×10^{-9} microcuries/mL provides an annual exposure for <u>constant immersion</u> of 10 mrem, this corresponds to < 1.0 mrem potential additional radiation exposure to an individual standing breathing in the effluent stack <u>for the entire year</u>.

Exhaust is diluted by a factor of 100 before release and the mixed plume is released at ~100 feet above the roof level (200 feet above surrounding ground).

(b) Liquids and Solids.

Liquid and solid wastes from utilization of by-product materials are disposed through a university contract. Waste is transferred to the custody of UCI Environmental Health and Safety (EH&S). Disposals to this custody are given below. It is important to note that activity values are estimated at the time of transfer to EH&S control. Since few shipments are being made from campus, decay to negligible levels occurs for all medium-lived radionuclides. Teaching course items (used for training in liquid scintillation counting techniques) may be a mixture of reactor generated byproducts and purchased materials (exclusively ^{14}C and ^{3}H).

DRY WASTES:

Three transfers of 2 cubic foot containers of dry waste were disposed during this period (7/1/14 through 6/30/15), estimated at a total quantity in 6 cu ft of 18.1 microcuries of mixed activation products (measured as ^{60}Co equivalent at time of transfer).

LIQUIDS:

One transfer of a 2.5 gallon liquid constituent was made this year. The contents of the container included 670 microcuries of ^{3}H along with 0.05% trace elements of NaF.

Section 7.

Environmental Surveillance.

Calcium Sulfate/Dysprosium thermoluminescent dosimeters are in place at 12 locations around the UCI Campus for environmental monitoring purposes. These are now provided by Mirion Technologies, Irvine, California (formerly Global Dosimetry Systems). The environmental packs have three chips in each pack which are averaged for exposure recording. Mirion runs multiple control samples in addition to the locations listed below. All dosimeters are housed in small metal lock-boxes (except for locations 10 and 12). The table below lists the locations. One dosimeter is located in a radiochemistry laboratory in Engineering Tower, Room 521 (#12), for a total of 12.

Routine contamination surveys consisting of wipe tests and G-M surveys have shown mostly a "clean" facility with significant, removable contamination only in areas coming into direct contact with samples removed from the reactor, and on sample handling tools. Trash is surveyed before disposal and not disposed unless found to be free of removable and fixed contamination.

Table of Locations for Environmental Dosimeter Packs.

1. South Reactor Facility Perimeter
2. West Reactor Facility Perimeter
3. North Reactor Facility Perimeter
4. Reactor Facility Main Air Exhaust
5. Rowland Hall, First Floor Hallway Over Reactor Facility
6. McGaugh Hall Top Floor
7. Langson Library Top Floor
8. Reines Hall Top Floor
9. Reactor Facility Emergency Exhaust Duct
10. On-campus Housing
11. Rowland Hall Building Fume Hood Exhaust Duct
12. Engineering Tower Room 521

TABLE IV.

Environmental Dosimetry Data.
2014-2015
Average Total Exposures in mrem (including "control background")

Location.	Quarter				Annual	Prior year	Excess(14-15) over control
	2/14	3/14	4/14	1/15	Total 2014/15	Totals 2013/14	mr ANNUAL
1. S. Facility perimeter	29	25	24	29	107	123	-2
2. W. Facility perimeter	30	27	27	32	116	192	+7
3. N Facility perimeter	34	28	28	33	123	133	+14
4. Facility main air exhaust	23	21	19	25	88	100	-21
5. Hallway over facility	24	22	21	26	93	107	-16
6. McGaugh Hall top floor	26	24	24	28	102	111	-7
7. Langson Library top floor	32	29	29	33	123	134	+14
8. Reines Hall top floor	28	26	24	29	107	119	-2
9. Facility emer. exhaust	23	21	21	25	90	102	-19
10. On-campus housing	24	22	21	25	92	109	-17
11 Facility fume hood exh.	24	21	20	24	89	104	-20
12 Engineering Tower 521	25	22	22	25	94	105	-15
Background control -Mirion	28	23	27	31	109	115	0

Discussion

Raw data is presented here, along with controls and prior year comparisons. Within this range, the data vary with significant consistency. Locations 1, 3, and 9 are usually the highest, 10 the lowest. Data for this year reflects several issues:

- Location 7 is on the top floor of a large building and may experience greater cosmic flux, as well as concrete releases.
- Location 1 is a hallway with an extremely low occupancy rate. (See additional note below).
- Location 2 is on the other side of a location in the reactor facility temporarily used for source storage.
- Location 3 is on a heavy concrete wall.

Exposure estimated to a single individual in an uncontrolled area at this facility is minimal. Locations 1, 2, and 3 are in hallways with extremely minimal occupancy or travel, especially since security policy is to maintain permanently locked doors to the hallways on this floor level (access only with building keys). The rooms overhead (location 5) are casually occupied by very few individuals (one or two at the most) in the space above the reactor core. The air released from the facility/building (measured by locations 4, 9, and 11) continues to give no detectable exposure above background. Over many years, the data at each specific location has shown remarkable consistency. The net conclusion is that, within precision of measurement, and compared to distant control areas (numbers 7 and 10), we are operating with very minimal levels (within statistical error of zero) of potential (full 24/7 occupancy) public exposure over normal background levels.

Section 8. Radiation Exposure to Personnel.

Personnel exposure data are summarized in Table V-I.

UCI issued TLD badges to UCI students or researchers regularly utilizing radiation. Finger dosimetry (TLD) rings are also issued to personnel who might be regularly handling radioactive sources. TLDs are read quarterly by Mirion Technologies, and results are presented in Table V-I. Data are for 4 quarters of operations since April 1, 2014. Reporting categories are DEEP, EYE, and SHALLOW. Other individuals visiting or casually working in the facility were issued DOSIMAN/R for which results are shown in Table V-II. 47 persons were issued TLD badges on a continual basis; 47 were also issued with finger TLDs. 34 students and 3 teaching assistants in a Radioisotope Techniques class were TLD badged. Reported exposures for the Radioisotopes Techniques class were non-existent this year, averaging 0.0 mrem each person for the quarter.

Table V-II. also lists all visiting individuals that were issued with DOSIMAN/R monitors that record in units of 0.1 mR. In the course of a few hours, a worker can accumulate 0.2 mr. A tour visitor accumulates 0.0 or 0.1 mR during a 45 minute visit to the facility. Any reading above 0.2 is thus tabulated separately.

TABLE V-I.

Personnel Exposure Report Summary for 12 months: 4/1/14 to 3/30/15 (in millirem)

Individuals	Whole Body			Finger Ring
	DEEP	EYE	SHALLOW	(Shallow)
11[1]	201	201	201	1158
3[2]	0	0	0	0
33[3]	0	0	0	0
Totals	201	201	201	1158
37[4]	Range 0-0 (mean 0.0)	Range 0-0 (mean 0.0)	Range 0-0 (mean 0.0)	not issued
class total	0	0	0	-
Totals	201 (84 individuals)	201 (84 individuals)	201 (84 individuals)	1158 (47 persons)

TABLE V-II

Aggregated non-zero data from self-reading dosimeters issued to researchers or visitors in addition to TLD badges are:

Persons	Admissions (per person)	Total Accumulation (mrem)
17[1]	5 each on average	8.8
102 other visitors logged	1 each on average	0.9
497 in tour groups[5]	1 each	0.0 to 0.1 each monitor
Total 616 persons	Total 696	Total 9.7 mrem

1. Individuals doing extensive or casual activation analysis and radiochemical work at the facility. Most of the exposure is a result of Cl-38 or Al-28 radioactivity production.
2. Individuals receiving exposure as a result of shipping isotopes, and/or calibration activities in the facility.
3. Individuals who did enter but not carry out radiation related activities during this period, so any exposure reported is an indication of range of general background/precision where the badges are stored when not in use.
4. Reported for students and teaching assistants in Radioisotope Techniques class Sep-Dec 2014. Note badges kept 24/7 in laboratory room. All also ran samples by NAA as well as working with sealed sources.
5. Issuing 1 dosimeter each for groups up to 10 and 10 randomly for larger groups. No readings > 0.2 mrem were recorded.

Personnel exposures continue to be very low at this facility in keeping with ALARA efforts. Fewer isotope shipments have been made this year, so exposure from that activity is lower.