UNIVERSITY OF CALIFORNIA, IRVINE

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Monday, September 25, 2017

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

SUBJECT: University of California – Irvine, Docket Number 50-326, License Number R-116, Annual Report Submittal in Accordance with Technical Specification 6.7.1

Dear Sir or Madam:

By way of this letter, the University of California, Irvine is submitting the annual operating report as required by Technical Specification 6.7.1 of license number R-116, covering the period of July 1st, 2016 through June 30th, 2017.

Electronic copies are being provided as indicated below.

If you have any questions regarding this matter, please contact me at (949) 824-6082.

Sincerely,

Dr. Athan James Shaka
Reactor Director

Enclosure: As stated

CC with Enclosure:

- Ken Janda, Dean of School of Physical Sciences, University of California, Irvine
- Ossy Font, Inspector, U. S. Nuclear Regulatory Commission
- Linh Tran, Project Manager, U. S. Nuclear Regulatory Commission
- George Miller, Chemistry Department, Reactor Supervisor, University of California, Irvine
- Reactor Operations Committee Members, University of California, Irvine
- American Nuclear Insurance, 95 Glastonbury Blvd., Glastonbury CT 06033, Policy NF-176

U. C. IRVINE

Nuclear Reactor Facility

Annual Report

for

July 1st, 2016 to June 30th, 2017

Facility License R-116

Docket 50-326

Prepared in Accordance with Part 6.7.1

of the Facility Technical Specifications

July, 2017

by

Jonathan Wallick, Associate Reactor Supervisor

Section 1

Operations Summary

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 2016 laboratory course in Radioisotope Techniques using the facility was 33 students with 2 graduate teaching assistants, who also learned these techniques.

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).

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 increased substantially as student use and interest has risen. Criticality was achieved for 313.50 hours, on par with the previous year, and the total energy generated was equivalent to 191.76 hours at full steady state power, down slightly from last year due to students combining experiments during the same irradiations. 178 separate experiments were performed, on par with last year as well, and 5483 samples were irradiated, up 37% (sometimes multiple samples are included in a single capsule and are not always separately logged). Two moderate level mixed isotope shipments were made, all Yellow II category, totaling 1.29 GBq of activity. Fourteen pulses were performed this year, all without incident and within expected resulting parameters. Four 10 CFR 50.59 changes have been initiated and completed during the course of the last year. A few unusual maintenance/surveillance results/activities were noted/conducted during this period: a leaking fixture in the purification system, REG control rod UP button replacement, disabled use of a position in the rotary specimen rack, CAM pump failure, failure of the air operated solenoid valve for the FTR, and a second leak of the purification system. No new experiments have been approved this year, though one is nearing submittal for approval.

A routine NRC inspection June 6th to the 8th of 2017, resulted in no Notices of Violation or follow-up items. In 2016-2017, a Reactor Operations Committee meeting was held on December 2nd, 2016, and a partial meeting was held on June 30th, 2017, in accordance with Technical Specification requirements. The partial meeting was to discuss a possible upcoming large experiment and give the experimenter the opportunity to inform and receive feedback from the committee.

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, Irvine Police Department, and reactor operators capitalizing on lessons learned in GTRI training at the Y-12 site. The exercise was held on September 20th, 2016, to large success, involving all agencies previously named, running functional exercises 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. Our

new Radiation Safety Officer continues with the university, implementing critical programs that have been long needed and improving those already in existence.

Four new operator trainees underwent training this year with one NRC examination taking place in December of 2016, resulting in four new licenses awarded at the RO level and one previous RO upgraded to the SRO level. As of June 30th 2017, 6 SRO's and 7 RO's were licensed. Two SROs are currently inactive.

Section 2

Data Tabulations for the Period July 1st, 2016 to June 30th, 2017

TABLE I

Experiment Approvals on file	5
Experiments performed (including repeats)	178
Samples irradiated	5483
Energy generated this period (Megawatt hours)	47.94
Total, 69 element core = 127.00	
>74 element core = 1619.01	
Total energy generated since initial criticality	1746.01 Mwh
Pulse operation this period	14
Total reactor pulses to 6/30/2017	1024
Hours critical this period	313.50
Total hours critical to date	10229.61
Inadvertent scrams or unplanned shutdowns or events at power	2
Visitors to reactor - as individuals or in tour groups –	977
Maximum dosimeter recorded for visitors - all less than	0.2 mrem
Visiting researchers (Temporary Self Indicating Dosimeters)	32
Maximum exposure recorded at one visit	8.4 mrem
Visiting researchers (Thermoluminescent Dosimeters)	50
Students and teaching assistants in class, badged	33
Exposures reported for class (range: 0-3 mrem) average	0.17 mrem
Isotope Shipments this Period (Mixed Activation Products = 0.04 Ci total)	2

TABLE II

Reactor Core Status 6/30/17 (core configuration changed as of 11/06/12)

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 6/30/2017)			$2.80
Control Rod Worths (Calibrated 02/01/2017)	REG	$2.85	
	SHIM	$3.58	
	ATR	$1.75	
	FTR	$0.68	
	Total:	$8.86	
Maximum possible pulse insertion (calculated)			$2.43
Maximum peak power recorded			250 MW
Maximum peak temperature recorded in pulse (B-ring)			196.0 °C

Section 3

Inadvertent Scrams, Unplanned Shutdowns, Events at Power

TABLE III

Date	Time	Power	Type and Cause
2016			
08/02	13:18	1.5 W	Linear scram. The linear power monitor initiated a scram while establishing a positive period to achieve 60% of the 2.5 W range. At approximately 106% of the 750 mW range, the linear power monitor initiated a scram. All control rods dropped and the reactor was put into a safe condition. Troubleshooting was performed and root cause of the failure was determined to be a stuck button, the REG UP button, and operator error in the individual not responding quickly enough to correct the condition. The event was not found to be reproducible, though the operator was cautioned to be more aware of such events and immediately depress the DOWN buttons for both SHIM and REG in such an event. Restart was authorized by the SRO.
08/24	09:37	250 kW	Linear scram. The linear power monitor initiated a scram while stabilizing power at 100% of the 250 kW range. At approximately 106% of the 250 kW range, the linear power monitor initiated a scram. All control rods dropped and the reactor was put into a safe condition. Troubleshooting was performed and root cause of the failure was determined to be a stuck button, the REG UP button, and operator error in the individual not responding quickly enough to correct the condition. The event was not found to be reproducible, though the operator was cautioned to be more aware of such events and immediately depress the DOWN buttons for both SHIM and REG in such an event. Restart was authorized by the SRO. Later, on August 31st, 2016, the REG UP button was replaced in order to prevent the sticking behavior from recurring. The maintenance has been successful to date.

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.

2016

08/07 At 1820 on August 7th, 2016, a low water alarm was received by the local police department. An SRO was called in immediately and made entry to the facility after ensuring it was radiologically safe to do so. Water level was verified to be above the required minimum of the technical specifications of 24.00 feet and detection of the source of water loss was identified to be a leaking fitting in the purification system. The system was then secured and the resulting water was collected, checked for contamination, and deposited back into the pool. Swipe testing also certified the area free of loose contamination after cleaning the spill. As a result of this leak, reactor operation was suspended until the purification system could be restored to normal operability. The following day, a replacement fitting was ordered and rushed to the site. On August 9th, 2016, at 0935, the offending fixture was replaced and checked for leaks, of which none were found, and the system was readjusted to minimize the amount of unnecessary stress on the fittings. Reactor operation was once again permitted and the purification system brought back online.

08/31 On August 31st, 2016, the REG UP button on the control console was replaced in order to prevent a recurring behavior of sticking that has been occurring intermittently for some time. The plastic cover of the button and the plunger mechanism were replaced, as they are the traditional culprits of this behavior. The maintenance was performed successfully and no further issues with the functional operability of this button have been experienced since.

11/02 On November 2nd, 2016, at 1340, two samples were discovered to be stuck in the rotary specimen rack, position 14. Two standard TRIGA tubes were connected via the screw top and screw bottom common to the design, with samples located within each, and the top tube of the duo was secured with a standard TRIGA tube cap. After attempting the normal retrieval methods several times, it was determined that the tubes, cap, and samples would have to be retrieved via a more aggressive method using long flexible tools designed for this purpose. This method was successful in removing the TRIGA cap, the samples, and the bottom portion of the upper TRIGA tube, but both TRIGA tube bodies remained wedged in position 14. It was suspected, and later confirmed via USB camera, that the tubes had expansively deformed during irradiation, a behavior that had not been witnessed before in such events. Efforts to remove the offending tubes was abandoned, as operability of the rotary specimen rack was unaffected, and use of the blocked position was prohibited and posted at the console, the rotary specimen rack drive, and the rotary specimen rack loading terminus. It was deduced that the tubes should embrittle further with additional irradiation, and retrieval efforts would recommence after one week. After several intermittent attempts over months of time, on February 7th, 2017, the position indication of the rotary specimen rack was adjusted such that position 14 became position 40 in order to prevent confusion and facilitate ease of use by experimenters.

All postings regarding the position were updated and operators and experimenters informed. Additionally, on March 23rd, 2017, a negligent experimenter placed the sample retrieval tool into position 40, where it became stuck among the other contents of the position. After removal efforts were performed, some of the additional contents were removed, and visual inspection via USB camera showed the contents to be clear of the height necessary for the rotary specimen rack to rotate freely. The position remains blocked at the time of this report's generation, but the rotary specimen rack is operational despite the problems that have developed.

12/18 On December 18th, 2016, a Continuous Air Monitor (CAM) failure alarm was received at 0449 and an SRO immediately responded. The CAM pump was identified to have failed, later to be determined from the fracture of one of the carbon vanes due to the vane holder slipping from the press fit on the shaft rotor, and was replaced with a backup pump at 0956. The CAM was determined to be operable and was returned to normal service. No reactor operation or experiments were performed during the time of inoperability.

2017

01/17 On January 17th, 2017, the water purification filters were replaced to correct an excessive differential pressure across the component due to particulate accumulation. Initial differential pressure was 12.06 psid, and after replacement it was observed to be 0.20 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.

02/01 On February 1st, 2017, the SHIM, REG, ATR, and FTR rod calibrations were performed. A new preliminary excess of $2.77 was found. Final results for rod worth were: SHIM $3.58 REG $2.85, ATR $1.75, FTR $0.68 for a total of $8.86. Final core excess was reported to be $2.79. The same day, power calibrations were also performed. 77.50% 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.

05/11 On May 11th, 2017, an abnormal noise was observed while applying air to the ATR, as a result of which, the startup checklist in progress was terminated and the reactor supervisor was notified. Troubleshooting revealed that there was a problem with the solenoid operated air valve which applies air to the ATR cylinder. Upon removal and disassembly of the valve, it was discovered that there was an insufficient amount of lubricant on the bottom O-ring of the valve actuation mechanism. The O-ring was replaced with a new one and lubricated, and the valve was reassembled and installed. Air was cycled to the ATR to verify operability five times, all successfully, and rod drop tests of the ATR were performed, also satisfactorily. Reactor operation was then permitted to continue on May 12th, 2017 at 1047.

05/31 On May 31st, 2017, a small leak was identified at 0730 in the purification system at the inlet valve to ion exchange resin tank #2; the union to the piping had split. The system was secured until the fix was affected and reactor operation was suspended.

At 1100 the same day, ion exchange resin tank #2 was isolated from the system and the purification system was restored to service at the proper flow rates, permitting reactor operation while parts were on order. On June 14th, 2017, at 0730, the offending parts were replaced and ion exchange resin tank #2 was restored to service.

Section 5

Facility Changes and Special Experiments Approved

Four 10 CFR 50.59 changes have been initiated and completed during the course of the last year.

The first change came as a result of the impending renewal of the operating license for the facility. Changes to the technical specifications required that the set point of the high fuel temperature scram be set from the previous setting of 425°C to 415°C, as the new Limiting Safety System Setting is 425°C, down from 800°C. This also required that the startup checklist be amended to reflect the change.

The second change was implemented to accommodate the installation of two additional radiation monitors: one in the newly built laboratory adjacent to the reactor facility to monitor personnel in that lab, and the second to monitor the fast transfer / delayed neutron terminus in the facility.

The third screening form was completed to amend the startup and shutdown checklists to reflect the updated periodicity requirements on several maintenance items changed by the new license's technical specifications. Updates were also made to include a new senior reactor operator on the checklist as well as organizational changes and the addition of the two radiation monitors in the last change noted.

The fourth and final change for the year was to increase the margin between the pool water alarm level setting and the new technical specification requirement. Additionally, all maintenance procedures and operational checklists were updated to reflect the change as well.

All of the changes performed this year were to make the operation of the facility more conservative with respect to the technical specifications of the new license and to improve the safety and monitoring systems of personnel and radiation.

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 (07/01/2016-06/30/2017):

a. Minutes of operation: 1034.5 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) = 7.45×10^{1} microcuries

(2) Release from pool surface (07/01/2016-06/30/2017):

a. Total hours of operation at full power (EFPH) = 191.76 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) = 1.38×10^{2} microcuries

e. Total of (1) and (2) emission in 1 year = 2.13×10^{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) = ~< 3.37×10^{-10} microcuries/mL
Since 2×10^{-9} microcuries/mL provides an annual exposure for constant immersion of 10 mrem, this corresponds to < 2.0 mrem potential additional radiation exposure to an individual standing in and breathing in the effluent stack for the entire year.

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, granting even greater dilution).

(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:

Six transfers of 2 cubic foot containers of dry waste were disposed during this period (07/01/2016 through 06/30/2017), estimated at a total quantity in 12 cu ft of 32.36 microcuries of mixed activation products (measured as ^{60}Co equivalent at time of transfer).

LIQUIDS:

No transfers of liquid constituent were made this year.

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 of 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.
2016-2017
Average Total Exposures in mrem (including "control background")

Location.	Quarter				Annual	Prior year	Excess(16-17) over control
	2/16	3/16	4/16	1/17	Total 2016/17	Totals 2015/16	mr ANNUAL
1. S. Facility perimeter	47	39	35	31	152	112	+40
2. W. Facility perimeter	36	36	29	28	129	131	+17
3. N Facility perimeter	30	24	28	32	114	125	+2
4. Facility main air exhaust	27	22	23	22	94	93	-18
5. Hallway over facility	29	24	23	23	99	101	-13
6. McGaugh Hall top floor	30	25	26	24	105	106	-7
7. Langson Library top floor	36	31	31	29	127	129	+15
8. Reines Hall top floor	31	26	28	25	110	110	-2
9. Facility emer. exhaust	27	23	23	21	94	91	-18
10. On-campus housing	28	23	24	22	97	98	-15
11 Facility fume hood exh.	27	22	24	21	94	91	-18
12 Engineering Tower 521	28	23	26	22	99	97	-13
Background control -Mirion	33	26	27	26	112	112	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, with this year varying slightly in that locations 1, 2, and 7 were the only ones notably above the control group. 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 2 is on the other side of a location in the reactor facility temporarily used for source storage.
- Location 1 near the facility's gamma irradiator, which has been in greater use this reporting period, as well as a lead cave which is storing a higher activity load now.

Exposure estimated to a single individual in an uncontrolled area at this facility is minimal. With the exception of two locations near the facility, all dosimetry associated with exposures from the facility indicates lower than control levels. 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, 2016. 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. 50 persons were issued TLD badges on a continual basis; 50 were also issued with finger TLDs. 33 students and 2 teaching assistants in a Radioisotope Techniques class were TLD badged. Reported exposures for the Radioisotopes Techniques class returned to normal values this period, likely due to proper storage of dosimetry, contrary to last year, averaging 0.17 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: 04/01/2016 to 03/30/2017 (in millirem)

Individuals	Whole Body			Finger Ring
	DEEP	EYE	SHALLOW	(Shallow)
15[1]	146	154	207	1366
0[2]	0	0	0	0
35[3]	0	0	0	0
Totals	115	115	115	0
35[4]	Range 0-3 (mean 0.17)	Range 0-3 (mean 0.17)	Range 0-3 (mean 0.17)	not issued
class total	6	6	6	-
Totals	267 (85 individuals)	275 (85 individuals)	328 (85 individuals)	1366 (50 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)
32[1]	5 each on average	23.7
110 other visitors logged	1 each on average	2.2
867 in tour groups[5]	1 each	0.0 to 0.2 each monitor
Total 1009 persons	Total 1140	Total 26.5 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 2016. 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.