UNIVERSITY OF CALIFORNIA, IRVINE

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DEPARTMENT OF CHEMISTRY
NUCLEAR REACTOR FACILITY
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U.S. Nuclear Regulatory Commission
Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

July 30th 1992

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

Ladies/Gentlemen:

Please find enclosed three(3) copies of the annual report for the UCI Nuclear Reactor Facility, covering the period July 1st 1991 through June 30th 1992. This report is submitted in accord with license regulations and Technical Specifications as referenced above.

Sincerely,

George E. Miller.

George E. Miller
Reactor Supervisor

GEM/mm

cc: Region V, NRC, 1450 Maria Lane, Suite 210, Walnut Creek CA 94596
American Nuclear Insurance, The Exchange, 270 Farmington Ave, Farmington, CT 06032, Policy NF-176
Reactor Operations Committee members and alternates
W.J. Evans, Vice Chair, Chemistry

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Nuclear Reactor Facility

Annual Report

for

July 1st 1991 to June 30th 1992

Facility License R-116

Docket 50-326

Prepared in Accordance with Part 6.7f

of the Facility Technical Specifications

by

Dr G.E. Milier
Reactor Supervisor

Section 1.

Operations

Operation of this facility is in support of the Department of Chemistry program of research and education in the use and application of radiochemical techniques and radioisotopes in chemical studies.

Reactor utilization, apart from operator training and maintenance, is thus entirely for sample irradiation. Samples come from diverse origins related to forensic science, fossil fuels, geochemistry, art, and archaeological studies, 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.

Some use is made of the facility by other educational institutions supported by the Reactor Sharing Program of DOE since September 1st 1987. This program has involved tours, class demonstrations, and analyses of samples submitted by faculty.

A number of items have needed maintenance during this period (see Section 4), but most inspections have found the facility to be in good condition. During the annual inspection, no abnormalities were found for the fuel or control rod systems.

An emergency drill was held on June 25th 1992. Practice was gained in handling a spill/contamination incident. Tested were coordination of response with all EH&S personnel and their response team and equipment and the operations at the Student Health Center in terms of handling a slightly injured, contaminated victim. Methods for personnel and laboratory decontamination were a focus. This was used as a full training exercise for personnel.

Seismic shocks were felt in this area on several occasions during this year. None caused any detectable damage at the facility. Most were centered over 60 miles away. Standing shelving and cabinets have been fastened to walls to minimize damage from falling objects.

Section 2.

Data Tabulations for the Period July 1st, 1991 to June 30th,1992

TABLE I.

Experiment Approvals on file	8
Experiments performed (including repeats)	328
Samples irradiated	818
Energy generated this period (Megawatt hours)	11.7
Total, 69 element core = 127.0	
>74 element core = 1086.5	
Total energy generated since initial criticality	1213.5 Mwh
Pulse operation this period	14
Total pulses to 6/30/92	955
Hours critical this period	137
Total hours critical to date	6666
Inadvertent scrams or unplanned shutdowns	6
Visitors to reactor - admitted	691
Maximum dosimeter recorded for visitors	0 mrem
Visiting researchers (dosimeter issues)	13
Maximum dose recorded	6 mrem
Visiting researchers (badged)	2

TABLE II

Reactor Status 6/30/92

Fuel elements in core (including 2 fuel followers)	82
Fuel elements in storage (reactor tank - used)	25
Fuel elements unused (4 instrumented elements + 1 element + 1 FFCR)	6
Graphite reflector elements in core	33
Graphite reflector elements in reactor tank storage	1
Water filled fuel element positions	6
Experimental facilities in core positions	4
Non-fuel control rods	2
Total core positions accounted for	127
Core excess, cold, no xenon	$2.88
Control rod worths (1/27/92)	

REG	$2.88
SHIM	$3.72
ATR	$1.82
ETR	$0.75
Total:	$9.17

Maximum possible pulse insertion	$2.57
Maximum peak power recorded (5/29/92) (no pulses made this report period)	940. Mw
Maximum peak temperature recorded (B-ring)	260.^{o}C

Section 3.

Inadvertent Scrams and Unplanned Shutdowns

TABLE III.

Date	Time	Power	Type and Cause
1991			
7/3	16:02	30 w	Unusually fast period during control rod calibration insertion because of low current path on circuit board. Reported as abnormal occurrence to NRC. (See Section 4)
7/9	14:46	300 w	Period scram on dropping SHIM rod, operator may have knocked another switch, or switching transient happened.
10/25	09:46	<1.5 w	External scram during start-up. No seismic activity. Seismic switch not set well after test.
10/31	15:46	125 kw	Period scram on switching from automatic to steady state mode. Switching transient.
11/06	13:28	1.5 w	% power scram while switching into PULSE mode. Switching transient.
11/06	13:35	1.5 w	Repeat of earlier event.
1992			
4/09	11:05	1 kw	Period scram after erratic behavior of period channel. No other indication of fast period. Contact problem in channel circuit boards cured by cleaning and replugging boards.

Section 4

Maintenance and Surveillance

The following non-routine maintenance activities were carried out during this period:

7/02/91 - The CAM recorder drove steady trace for a period of time instead of the normal fluctuating one.. This was traced to a poor contact in the TEST/OPERATE switch. The switch was cleaned by successive operation which cured the problem. All other contacts and switches in the CAM were cleaned and checked.

7/05/91 - 7/08/91 Work on malfunctioning REG rod drive circuit at reactor bridge reported as Abnormal Occurrence. Circuit for REG rod drive rebuilt to avoid burned circuit board which allowed a low resistance path current leakage between two previously insulated pads on the board. Resistor R903 replaced with higher wattage to discourage further occurrence of problem, and resistor wired high off board to allow more air cooling.

7/09/91 -Two pool lights were dismantled, serviced and reassembled with new gaskets and lamps.

7/16/91 - LOG channel failed during calibration activities. It was repaired the following day by replacement of a failed transistor in the demodulator board.

7/17/91 - Operations were curtailed (according to Tech Specs), because the ventilation system was found to be malfunctioning due to remodelling work on higher floors of the building interfering with the exhaust duct from the facility. This was corrected by the following day and the system returned to normal flows.

8/13/91 - the SHIM ON lamp was replaced in the magnet current circuit. It had failed during a shutdown period.

8/15/91 - The control room and outer office were repainted as part of building remodelling.

9/3/91 - New smoke detectors were installed in the facility as part of building remodelling upgrades. The old units were verified to be uncontaminated and removed from the facility for disposal.

9/12/91 - The police dispatch desk completed installation of a new alarm upgrade readout and computer based indicator system to include the reactor security and trouble alarm reports.

Date unspecified - new plastic retaining tanks were installed in the sink drain line in the laboratory area. This provides about 10 gallons of hold-up volume to trap potential radioactive material washed in error into the sink. (Regulations at UCI call for no activity to be disposed down sink drains.)

11/6/91 - During set-up for a pulse demonstration, a core excess of $3.01 was recorded. Since an uncertainty of +$0.03 exists, this was determined not to be in violation of the $3.00 limit. In addition, the "normal" excess was well under $3.00. The pulse tests were not successful as the MODE switch contacts prevented staying critical in PULSE configuration. Thus no pulses were fired. The wafers of this switch were eventually replaced as part of annual maintenance activities during January 1992.

1/6/92 - A serious flood of water occurred in the early morning on the opposite side of the building. The water had seeped under walls into the facility by the time of arrival of the Reactor Supervisor, but did not reach or enter the pool. Water vacuumed up inside the facility was checked for contamination before disposal to regular drains, but showed none. water did fall in to two fuel storage pits where small radioisotope sources were stored. These were dried and cleaned out by 1/27/92. The sources were well sealed, and unaffected. This water was also checked carefully for contamination before disposal.

1/26/92 - A new plastic skimmer hose was installed to replace the older rubber/metal unit which had begun to corrode where the steel support was exposed.

3/04/92 - The first pulse was tried after many months of non-pulsing. The timing adjustment synchronizing the two rods had been moved inadvertently in the meantime, so a much lower pulse power (540 Mw) than anticipated (1000 Mw) was observed. The timing circuit was reset to its original setting and subsequent pulses have been in-line with much earlier data. The new, more sensitive, lazy susan unload port radiation monitor is able to "see" the 16N produced in a pulse quite effectively, so shows a burst of radiation over a few seconds up to 40 mr/hr, dropping in about a minute to < 1 mr/hr reading.

Section 4 Maintenance and Surveillance (continued)

4/21/92 - Erratic behavior was observed for the LS unload channel of the Radiation Area Monitor, turning in spurious alarms at infrequent intervals. This was traced to a failing Geiger tube on 4/30/92. A new tube had to be ordered and was installed some weeks later. Meanwhile a detector from the lab was traded into the LS location, as the latter is more crucial to current operations than having two lab detector channels. This could be done easily as all channels of the new system were deliberately made identical in sensitivity and range.

4/22/92 - Seismic activity felt quite strongly at 21:55 in the facility. Insufficient to trip seismic trip or cause any apparent damage. Pool water observed to sway several inches, but none splashed out of the pool. (EQ was 6.1 Richter;100 miles E of Los Angeles). Security alarms (motion sensors) were tripped

6/27/92 - Substantial seismic event at Landers, CA tripped security alarms at facility at 04:57. Reactor Supervisor inspected the facility at about 05:30 and found no sign of damage or water sloshing from pool. Substantial aftershocks noted at about 08:05. Alarms again tripped, but no signs of damage were found. Seismic trip was not actuated in either event. (MM V not reached). Initial shock now rated at 7.4 Richter scale. Smaller aftershocks continue into August. Larger ones can just be felt at the facility location.

It should be noted that during this entire period, the final stages of main building (Physical Sciences 1) renovation was completed. This caused numerous small problems with power and utility full or partial interruptions. The staff has had to be especially vigilant to affirm functionality of all systems before reactor operation, and to maintain emergency access and egress routes at the facility.

Section 5
Facility Changes and Special Experiments Approved

No significant changes or special experiments were approved during this period.

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 estimates 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 kwatts) when, in fact, some 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 location 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 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 (7/1/91-6/30/92):

a. Minutes of operation:	371.5 minutes
b. Release rate assumed:	$6. \times 10^{-8}$ microcuries/ml
c. Flow rate of exhaust air:	1.2×10^{8} ml/min
Total release computed: (a x b x c) =	2.7×10^{3} microcuries

(2) Release from pool surface (7/1/91-6/30/92):

a. Total hours of operation at power (Mwh x 4) =	47 hours
b. Release rate assumed:	$<1. \times 10^{-8}$ microcuries/ml
c. Flow rate of exhaust air:	1.2×10^{8} ml/min
Total release computed: (a x 60 x b x c)	$= 3.4 \times 10^{3}$ microcuries
Total of (1) and (2) emission in 1 year	**$= 6.1 \times 10^{3}$ microcuries**

Concentration averaged over 12 months	**$= < 1.0 \times 10^{-10}$ microcuries/ml**

This remains similar to values reported in previous years and remains lower than MPC even assuming no dilution of the plume at the stack.

(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 the Campus Environmental Health and Safety Office (E,H&S). Direct disposals from this facility are given below. It is important to note that activity values are estimated at the time of transfer to E,H&S control. In all instances considerable time elapses before final shipment from campus, so that substantial decay may occur for medium-lived radionuclides.

DRY WASTES: 4 cubic feet - less than 10 microcuries mixed activation products.

LIQUIDS: 2 gallons - estimated less than 1 microcurie. Most of this was from student laboratory work with materials produced with the reactor.

Section 7.
Environmental Surveillance.

Calcium sulfate/Dysprosium thermoluminescent dosimeters in packs supplied by the Radiation Detection Company, Sunnyvale, California are placed at nine locations around the UCI Campus. One pack is kept on the edge of campus in a wood frame house in University Hills. In fact, the average of the more remotely located "concrete environment" packs on campus is used as the background for comparison purposes, since a more similar microenvironment is experienced by such packs.

Table of Locations.

1. Window of reactor room east wall (inside the facility).
2. In hallway on exterior of south wall of facility.
3. Loading dock, adjacent to west wall of reactor room.
4. Laboratory 152, directly over reactor facility, approximately over core center.
5. In roof exhaust air flow from reactor room, roof level (hung in center of duct at final release point).
6. Biological Sciences 2 building), 5th floor, laboratory near window*.
7. Main library building across campus, 5th floor office.
8. Computer Science building, 4th floor office, in window.
9. Fume hood exhaust, roof level, from reactor laboratory (hung in center of duct).
10. 12 Perkins Court, University Hills, private residence (wood frame house).

* The location of this dosimeter was moved on October 3 1991, following occupancy of the new BS2 building which is closer to the reactor than the older building.

Table IV shows the data as received from RDC for the period. All levels are as expected and are similar to those reported in recent years. As noted before, areas (1) and (2) are also partly controlled so that maximum possible exposure to an individual in an uncontrolled area is very minimal at this facility with current operations. The air released from the facility (measured by locations #5 and #9) continues to give no detectable exposure above background for dosimeters immersed in it. Location 7 consistently shows higher readings presumably because it is in a window above a warm, outside, cement wall. Over many years, the data at each location show remarkable consistency. An appreciable change would be easily noticeable.

TABLE IV.
Environmental Dosimetry Data,
1991-1992

Average Exposures in mr.

Location.	Quarter 2/91	3/91	4/91	1/92	Total	Total less background (36± 28)
1	7	7	8	6	28	0
2	11	8	12	11	42	6
3	10	6	10	8	34	0
4	0	0	0	0	0	0
5	6	3	8	5	22	0
6	14	10	6*	4*	34	0
7	18	12	18	17	65	29
8	2	2	2	3	9	0
9	6	4	6	6	22	0
10	0	0	2	1	3	0

Average of locations 6, 7, and 8 used for "background" (= 36)

Section 8.
Radiation Exposure to Personnel.

The annual exposures reported as a result of finger dosimeter ring and film badge dosimetry are presented in Table V. Much of this exposure is acquired in the course of isotope handling experiments, and in some instances has been accumulated in areas outside the facility, in locations licensed by the State of California. A substantial exposure is experienced by some individuals during required calibration of radiation monitoring equipment.

Ten (10) persons were monitored on a continual basis using film badges, and all of these were also issued with finger dosimeter rings. These were required to be worn while handling isotopes. Film badges were generally worn at waist level by all personnel. An additional twenty-two(22) students were issued badges during the Winter quarter, 1992 for a laboratory course in radioisotopes, during which they spent some hours in the facility. These exposure listings have been included in this table.

Certain additional monitoring is done of visiting individuals who are issued with direct-reading pocket dosimeters in addition to film badges and finger dosimeter rings.

Contamnations surveys consisting of wipe tests and G-M surveys have shown significant, removable contamination only in areas coming into direct contact with samples removed from the reactor,and on sample handling tools.

TABLE V.

Personnel Exposure Summary for 5/1/91 to 1/30/92 (in mrem)

Individuals	Whole Body		Finger Ring
	Deep	Shallow	Shallow
1	0	0	60
1	0	0	40
1	0	0	30
7	0	0	0
22 (students in class)	0	0	0
Totals 32	0	0	130

Additional aggregated data from self-reading dosimeters issued to researchers:

1	19	(6 visits)
6	0	(6 visits)