U.C.IRVINE

Nuclear Reactor Facility

Annual Report

for

July 1st, 1984 to June 30th, 1985

Facility License: R-116

Docket: 50-326

Prepared in Accordance with Part 6.7f

of the Facility Technical Specifications

by

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Section 1.

Operations

Operation of this facility is in support of the Department of Chemistry program in research and education in the use and application of radiochemical techniques and radioisotope utilization 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 archeological studies, chemical synthesis, industrial quality control, enzyme studies, trace element pollution studies, etc. The reactor was also used in class work by undergraduates learning tracer and activation analysis techniques using small quantities of short-lived activated materials.

17 research students and 2 postdoctoral associates have used the facility regularly under the direction of three UCI faculty. These include two visiting students from West Germany. In addition, 5 students and post-doctoral associates from three other campuses of the University of California and several from other colleges and universities in Southern California have been served by the facility. A list of users and their affiliations is given in Appendix A.

No major changes have been made in this period to the facility. A few items of minor equipment were replaced due to age and maintenance problems. The annual inspection indicated that all fuel elements, control rods and other core components were in good condition.

Operations have continued at the higher level shown last year as a result of both internal and external uses. Data on the operations is shown in Section 2. The reactor was shut down for a brief period when a rope which had been used as part of a sample removal became jammed in the rotary specimen rack. This rope was eventually removed after persistent working.

Unusual items of maintenance carried out during this year included replacement of the water purification system pump, the conductivity bridge, and the blower motor on the Continuous Air Monitor. One recorder motor on the control console was repaired.

Section 2.

Data Tabulations for the Period July 1st, 1984 to June 30th, 1985

TABLE I.

Experiment Approvals on file	8
Experiments performed(including repeats)	232
Samples irradiated	3965
Energy generated this period (Megawatt hours)	57.1
Total, 69 element core = 127.0	
>74 element core = 869.9	
Total energy generated since initial criticality	996.9 Mwh
Pulse operation this period	12
Total pulses to 6/30/85	706
Hours critical this period	283
Total hours critical to date	5292
Operator training and requalification, hours	59
Inadvertent scrams or unplanned shutdowns	12
Visitors to reactor - admitted	1187
Maximum dosimeter recorded for visitors	0 mrem
Visiting researchers (dosimeter issues)	114
Maximum dose recorded	10 mrem
Visiting researchers (badged)	3

TABLE II

Reactor Status 6/30/85

Fuel elements in core (including 2 fuel followers)		80
Fuel elements in storage (reactor tank - used)		28
Fuel elements unused (instrumented element)		1
Graphite reflector elements in core		34
Graphite reflector elements in reactor tank storage		1
Water filled fuel element positions		7
Experimental facilities in core positions		4
Non-fuel control rods		2
Total core positions accounted	127	

Core excess, cold, no xenon		$2.73
Control rod worths (1/ 8/85)		
REG	$2.82	
SHIM	$3.72	
ATR	$1.96	
FTR	$0.66	
Total:	$9.16	

Maximum possible pulse insertion	$2.62
Maximum peak power recorded (3/21/85)($2.62 ins)	1080 Mw
Maximum peak temperature recorded (B-ring)	223 °C

Section 3.

Inadvertent Scrams and Unplanned Shutdowns

TABLE III.

Date	Time	Power	Type and Cause
1984			
7/18	08:45	<1.5 w	Seismic scram. Incorrect reset after start-up tests. No seismic activity observed
12/8	09:40	240 kw	Linear power scram on switching into auto.
1985			
1/14	12:40	250 kw	Shutdown on high sample activity on return in pneumatic transfer system. Sample placed in shielding for decay.
1/18	11:11	250 kw	%Power scram. Gamma build up from samples causing chamber reading increase. Linear at 238 kw only.
1/25	09:13	250 kw	%P scram as above. Linear 240 kw only.
2/5	10:07	250 kw	%P scram as above. Linear 240 kw only.
3/12	09:45	250 kw	%P scram as above. Linear 240 kw only.
3/17	14:01	250 kw	%P scram - uneven sample load. Linear at 225 kw reading only.
5/3	11:56	250 kw	External scram. No seismic activity. Improper reset - too sensitive.
5/9	08:55	<1.5w	Unable to raise FTR during start-up. Stuck magnetic switch.
6/12	14:15	1.5 w	External scram. No seismic activity. Improper reset after start-up tests.
6/21		250 kw	%P scram on gamma build up from samples. Linear at 220 kw only.

Section 4.
Maintenance and Surveillance.

All critical systems (fuel elements, control rods, safety systems) continue to be found in good condition during routine inspections. There are a few new and recurring items given special attention this year:

(a) A new G-M tube was installed in one area monitor channel.

(b) Trash containers were replaced with "Cease Fire" type.

(c) A new conductivity meter was installed. The previous unit had become very difficult to read, although still giving good readings. Values obtained with the new unit were indistinguishable from those previously obtained. The cells were not replaced.

(d) A new water system purification pump and motor was installed. The new pump is of the close coupled, sealed bearing type, eliminating problems with leaking seals on the old unit.

(e) The motor on the blower unit of the Continuous Air Monitor failed and was replaced with a new motor of the same type.

(f) The high voltage circuit of the CAM experienced a sudden drop in output causing a false CAM high alarm. Cleaning contacts and adjusting potentiometers cured the problem and the unit was placed back in service.

(g) The LOG recorder in the control console became extremely sluggish, especially in one direction. Efforts to increase response time by increasing amplifier gain were not successful. The problem was eventually traced to a worn bearing plate in the pen motor. Since new pen motors were expensive, a repair was made to the bearing plate. The repaired motor functions well and the unit was placed back in service.

(h) During an attempt to remove a sample tube from the rotating specimen rack by means of a "standard" tool consisting of a heavy tube with a stopper attached to a thin rope, the rope became somehow jammed in the mechanism. Efforts over several days were made to free the jam. Finally a hooked tool was used to break off the rope at the site of the jam so that the rack could be rotated. After proper location, all the pieces of the tool and the remaining samples and tubes were successfully removed. It is not felt that any damage to the rack occurred. The unit is now back in service with no subsequent problem.

(i) The security/safety systems computer developed a problem when a failure of building electric power occurred. This was apparently due to failure of the battery back-up to sustain the unit for a sufficient length of time. A new battery was installed, and, after some necessary readjustments to the automatic charging circuit, the unit now functions normally.

Section 5.

Facility Changes and Special Experiments Approved.

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

Section 6.

Radioactive Effluent Releases.

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

Releases are estimated based on original estimates at point of origin within the facility and taking only dilution into account. Since the greater release is from operation of the pneumatic sample transfer system, this is a conservative estimate in that the assumption is made that all use of this facility is at full reactor power (250 kilowatts) when, in fact, some of the time the facility is used with the reactor at a lower power level. An integrated dose estimate is provided by an environmental dosimeter (calcium sulfate-dysprosium) hanging directly in the exhaust at the point of stack discharge. This is changed and read quarterly. The results substantiate the projection that an individual standing continuously directly in the stack discharge flow for one year would receive a submersion dose less than the reliability limit of the four combined dosimeters, or less than 20 mrem per year. In fact, because of the distance of this dosimeter (location 5 in Section 7, Table IV) from adjacent structures, the exposure at this point has consistently been lower than that at most "control" remote locations where the dosimeter is closer to concrete or other building structures.

The quarterly data are presented, along with all other environmental dosimeter readings, in Table IV, Section 7.

Release estimates based on operational parameters are as follows:

(1) Operation of pneumatic transfer system (7/1/84 - 6/30/85):

Total time of operation:	1149 minutes
Release rate assumed	6×10^{-8} microcuries/ml
Flow rate of exhausted air	2×10^{6} ml/sec
Total release computed	0.8×10^{4} microcuries

(2) Release from pool surface (7/1/84 - 6/30/85):

Total hours of operation at power (Mwh x 4)	228 hours
Release rate assumed	$<1 \times 10^{-8}$ microcuries/ml
Flow rate of exhaust air	2×10^{6} ml/sec
Total release computed	$<1.6 \times 10^{4}$ microcuries

Total of (1) and (2) = 2.4×10^{4} microcuries

Concentration averaged over 12 months = $<4 \times 10^{-10}$ microcuries/ml

This remains similar to values reported in earlier years and remains lower than MPC 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 tp the custody of the Campus Environmental Health and Safety Office for final packaging and shipping according to applicable State and Federal ragulations. Spent filters from the pool water purification system are also disposed in this way. Spectrometric measurements indicate that these are contamineted with long, medium and short-lived isotopes in low quantities that would be expected from activation of reactor components of stainless steel and aluminum alloy. No ion exchange resin from this system has been discarded during this period.

Some of the materials generated in experiments in this facility are transferred to other users operating under State of California license and final disposal of such materials is not under the control of this facility.

Direct disposals by the facility were as follows: (activities are estimated as of time of trnasfer to E,H and S control)

Dry wastes:	9 cubic feet -	70 microcuries mixed activation products.
Liquids:	6 gallons -	8 microcuries mixed activation products.

TOTAL 78 microcuries

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 off-campus in a wood frame house (second story) in Irvine as a control. In fact, the average of the remotely (to the reactor) located "concrete environment" packs on campus is used as the "background" for comparison purposes for evaluation of the data for those packs located closer to the facility.

Table of Locations.

1. Window of reactor room (inside the facility).
2. In hallway between reactor laboratories and radiochemical laboratory.
3. Loading dock, adjacent to west wall of reactor room.
4. Classroom 152, directly over reactor room.
5. In roof exhaust air flow from reactor room.
6. Steinhaus Hall (Biological Sciences building), 4th floor.
7. Main library building across campus, 5th floor office.
8. Computer Science Building, 4th floor office.
9. Fume hood exhaust, roof level, from reactor laboratory.
10. 15 Spicewood Way, Irvine, private residence about 2.5 miles from facility.

Table IV shows the data as received from RDC for the period. All levels are as expected. Those above background reflect the neutron generator operating schedule (nitrogen-16 formation) and are essentially similar to those reported in previous years. As noted before, areas (1) and (2) are partly controlled so that maximum possible annual exposure to an individual in a true "off-site" location would be estimated to be much less than 40 mrem (above background) from operations at this facility. The main and fume hood exhaust records continue to show no detectable exposure above background in the exhaust stacks from the facility.

<u>TABLE IV.</u>

<u>Environmental Dosimetry Report Data.</u>

<u>1984-1985.</u>

<u>Average Exposures in mr.</u>

Location.	Quarter				Total.	Total less Background (42+-28)
	2	3	4	1		
1	20	10	36	22	88	46
2	11	6	9	9	35	0
3	12	7	17	13	49	7
4	2	3	6	8	49	7
5	6	6	13	9	34	0
6	13	6	15	11	45	(3)
7	16	14	26	13	69	(27)
8	2	3	2	6	13	(0)
9	10	10	14	9	43	1
10	6	3	11	6	26	0

Average of 6,7, and 8 used for background.

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 these exposures are acquired in the course of isotope handling experiments, and in some instances have been accumulated in areas outside the facility, licensed by the State of California. Some exposure is experienced as a result of handling calibration sources during calibration of radiation monitoring equipment.

Twenty-five (25) persons were monitored on a continual basis using film badges; of these all were also issued 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 thirty-four (34) students were issued badges during the Fall quarter during a laboratory course in Radioisotope Techniques. These students entered the facility for some of their experiments but not for all. Their exposure records have been included in this listing.

Certain individuals and visitors are issued with pocket dosimeters during their period in the facility. The recorded data for these have been summarized in Table I, Section 2.

Contamination surveys consisting of wipe tests and G-M surveys have shown significant removable contamination in areas coming in direct contact with samples removed from the reactor, and on sample handling tools. No other contamination areas have been found.

TABLE V.

Personnel Exposure Summary for 7/1/84 to 6/30/85 (in mrem)

Individuals	Whole Body		Finger Ring
	Deep	Shallow	
1	0	0	780
1	0	0	500
1	0	0	380
1	0	0	240
1	0	0	130
1	0	0	30
19	0	0	0

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U.S.Nuclear Regulatory Commission,
Division of Reactor Licensing,
Washington, D.C. 20555

August 16th, 1985

Att'n: Document Management Branch

Gentlemen:

Docket 50-326

Re: Facility Annual Report

Please find enclosed five copies of the annual report for the UCI Nuclear Reactor Facility, covering the period July 1st, 1984 - June 30th, 1985. Please let me know if additional copies are required.

Sincerely,

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