U.C.IRVINE

Nuclear Reactor Facility

Annual Report .

for

June 26th, 1983 to June 30th, 1984

Facility License: R-116

Docket: 50-326

Prepared in Accordance with Part 6.7f

of the Facility Technical Specifications

by

Dr G.E.Miller

Reactor Supervisor

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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, 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.

10 research students and 2 post-doctoral associate have used the facility under the guidance of three faculty in Chemistry. These include visiting students from Brazil, and West Germany. Currently the facility has 2 licensed senior operators.

No major changes have been made in this period to the facility. The annual inspection of core components indicated that all fuel elements and control rods were in good condition.

Operations in general have been higher than last year, partly because the facility has seen additional use by UCLA researchers following shutdown of the UCLA reactor. Data on the operations is presented in Section 2.

Difficulties were experienced on June 30th/July 1st with the adjustable transient rod (ATR). This was reported as an abnormal occurrence to the NRC and a copy of the written report is attached as Appendix A. Subsequent to that time, further and more complete cleaning of the air supply system and buffer tanks was necessary, as solenoid valve operation irregularities recurred. During the year some difficulties were experienced with the SHIM and REG rod drive mechanisms. Complete overhaul was finally carried out at the end of the summer of 1984 to cure these problems. Unusually humid and warm weather for two successive summers seems to have been to blame for this need.

While unloading samples on October 10th, 1983, the operator "fished up" a small metal bracket that must have been wedged in the rotating sample rack for some time. This was highly radioactive (above 20 R/hr), but was eventually removed and handled with minimal personnel exposure. The bracket formed part of a sample handling device broken over a year earlier.

NRC inspections for security and for radiological safety have been carried out during this period. As a result of the second inspection, a citation was issued regarding the lack of meetings of the Reactor Operations Committee. No other items of non-compliance were identified.

Section 2.

Data Tabulations for the Period June 26th,1983 to July 1st, 1984

TABLE I.

Experiment approvals on file		8
Experiments performed (including repeats)		304
Samples irradiated		2951
Energy generated this period (Megawatt hours):		45.6 Mwh
Total, 69 element core	127.0	
>74 element cores	819.8	
Total energy generated since initial criticality:		939.8 Mwh
Pulse operation this period:		13
of which greater than $2.00 insertion:		13
Total pulses to 6/30/84		688
Hours critical this period:		289
Total hours critical to date:		5009
Operator training and requalification, hours:		7
Inadvertent scrams or unplanned shutdowns:		14
Visitors to reactor - admitted:		978
Maximum dosimeter recorded for visitors:		0 mrem
Visiting researchers (dosimeter issues):		112
Maximum dose recorded:		1 mrem
Visiting researchers (badged):		4

TABLE II.

Reactor Status 6/30/84

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:	0
Experimental facilities in fuel element positions:	4
Water filled fuel element positions:	7

Core excess, cold, no xenon:	$2.83
Control rod worths (1/18/84):	
REG	$2.85
SHIM	$3.68
ATR	$1.79
FTR	$0.67
Total:	$ 8.99

Maximum possible pulse insertion:	$2.46
Maximum peak power attained (5/29/84) ($2.46 insertion)	1040 Mwatts
Maximum peak temperature observed (B-ring)	228 ^{o}C

Section 3.

Inadvertent Scrams and Unplanned Shutdowns

TABLE III.

Date	Time	Power	Type and Cause
1983			
6/28	15:56	250 kw	Shim rod drop. Operator touched CONT/ON button.
6/28	16:12	250 kw	Shim rod drop again - this time lamp burned out.
7/1		1.5 w	ATR rod raised inadvertently by cylinder. See report.
8/17	11:33	250 kw	Manual scram. Incorrect samples placed in core.
8/25	11:38	3 w	Period scram - operator inattention during start-up.
9/7	13:46	3 kw	Linear scram - operator range switch error.
10/12	11:27	250 kw	HV and power scram - power problems at supply. Experiment terminated for day as noise continued.
1984			
1/18	10:59	1.5 w	Linear power scram. Operator range switching error.
1/19	11:59	250 kw	Manual scram. Sample terminus alarm sounded on sample return. Sample moved to lead shield.
2/16	10:06	<1.5 w	Seismic scram. Incorrect reset after start-up tests.No observable seismic activity.
4/5	10:46	250 kw	%Power scram. Meter at 102%, sample loading irregularity caused chamber fluctuations.
4/10	11:56	250 kw	Manual scram. Experimenter using delayed neutron system reported sample had not returned. Sample retrieved by continued operation of transfer system.
5/26	12:55	1.5 kw	HV scram. Momentary building power failure.
5/29	19:28	100 w	Linear scram. Trainee error in range switching.
5/29	20:15	300 w	Linear scram. Trainee error in range switching.

Section 4.

Maintenance and Surveillance.

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

The following special items were noted this year:

(a) Rod drive mechanisms (see also Appendix A.) .

A number of problems were noted with "sticking" rod drives, both SHIM and REG. Usually the system would respond to cleaning and spraying with silicone lubricant - but only for a while. This problem was particularly noticeable during hot humid weather, especially when air conditioning systems were down, or not coping. Eventually a drive was dismantled and taken to the reactor manufacturer for inspection. The diagnosis was that the "plastic" seals through which the draw tubes slide had swollen with moisture absorption, thus causing insufficient clearance. The seals were lapped down on inner and outer surfaces, and the rod drives now behave as required.

The ATR and FTR drive air systems needed extensive cleaning. The first attempt failed to note that metal turnings, from tank port threading, were still residing in the b ttom of one of the buffer supply tanks. Since the tanks were removed from under the bridge and carefully scoured, no further problems have occurred.

(b) In order to facilitate adjustment of ion chamber heights during power calibration activities, slight modifications were made in how the ion chamber supports are fastened to the side of the reactor tank.

(c) The pneumatic tube sample system blower was serviced on 4/27/84. New bearings were needed to replace "seized" ones. The system now functions well.

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. 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 the submersion dose to an individual standing continuously in the stack discharge for one year would be less than the combined reliability limit of the four dosimeters, or less than 20 mrem per year.

The exact quarterly dose readings obtained are given in Section 7 of this report. The location is location 5 in Table IV.

Release estimates are as follows:

(1) Operation of pneumatic transfer system (6/26/83 - 6/30/84):

Total time of operation (assumed to be at 250 kw):	2649 minutes.
Release rate assumed	6×10^{-8} microcuries/ml
Flow rate of exhaust air	2×10^{6} ml/sec
Total release computed	1.9×10^{4} microcuries

(2) Release from pool surface (6/26/83 - 6/30/84)

Total hours of operation at power (Mwh x 4)	182 hours
Release rate assumed	$<1 \times 10^{-8}$ microcuries/ml
Flow rate of exhaust air	2×10^{6} ml/sec
Total release computed	$<1.3 \times 10^{4}$ microcuries

Total of (1) + (2) = 3.2×10^{4} microcuries

Concentration averaged over 12 months = $<5 \times 10^{-10}$ microcuries/ml

This is higher than the level reported last year because of increased operations and remains lower than MPC even assuming no additional plume dilution 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 for final packaging and shipping. Wastes from filters in the pool water cooling system are also disposed in this way. Spectrometric measurements indicate that these are contaminated with medium and short-lived by-product isotopes in low quantities.

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.

Disposals by the facility were as follows: (activities are estimated as of time of transfer to E, H and S control).

Dry wastes:	4 cubic feet	3 microcuries mixed activation products.
Liquids:	7 gallons	74 microcuries mixed activation products.
Total:		77 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 U.C.I. campus. One pack is kept off-campus in a wood frame house (second story) as a control. The average of the remotely located packs on campus is in fact used as a "concrete environment" background for comparison purposes for evaluation of packs placed closer to the facility.

Table of Locations.

1. Window of reactor room (inside the facility).
2. Between reactor laboratories and radiochemical laboratory, in hallway.
3. Loading dock, adjacent to west wall of reactor facility.
4. Classroom 152, over reactor facility.
5. In roof exhaust air flow from reactor room.
6. Steinhaus Hall (Biological Sciences building), 4th floor.
7. Library building across Campus, 5th floor office.
8. Computer Science building, 4th floor.
9. Fume Hood exhaust, roof level, from reactor laboratory.
10. 17941 Spicewood Way, Irvine. (Control location about 2.5 miles from Campus)

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 formed in the cooling water) and are essentially similar to those reported in prior years. As noted before, areas 1 and 2 are partly controlled so that the maximum possible annual dose to an individual in a true 'off-site' location would be estimated to be less than 40 mrem (above background) from operations at this facility, using this data. The main and fume hood exhaust dosimeters continue to show no detectable dose, above background, in the exhaust stacks from the facility.

TABLE IV.

Environmental Dosimetry Report Data.

1983-84.

Average Exposures in mr.

Location.	Quarter.				Total.	Total less Background (71 ± 18)
	2	3	4	1		
1	54	122	31	15	222	151
2	46	40	31	14	131	60
3	26	21	16	11	74	3
4	32	22	(missing)	4	(58)	0
5	25	18	8	7	58	0
6	42	15	18	15	90	(19)
7	34	19	11	13	77	(6)
8	26	12	4	4	46	(0)
9	29	(missing)	22	13	(64)	0
10	49	7	6	5	67	0

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

Section 8.

Radiation Exposure to Personnel.

The annual exposures reported as a result of finger-ring and film badge dosimetry are presnted in Table V. Essentially all of these exposures are acquired in the course of isotope handling experiments and in some instances will have been accumulated in areas outside the facility, licensed by the State of California.

Twenty-four (24) persons were monitored on a continual basis using film badges, of these nineteen (19) were also issued finger rings. These were required to be worn while handling isotopes. Film badges were generally worn at waist level by all personnel. An additional twenty-eight (22) students were issued badges and finger rings for nine weeks during a laboratory course in Radioisotope Techniques. They entered the facility for some of their experiments, but not for all. Their exposure records have not been included in this listing.

Contamination surveys consisting of wipe tests and G-M surveys have shown significant removable contamination in isotope handling areas. No other contamination areas have been found.

TABLE V.

Personnel Exposure Summary for 5/1/83 to 6/30/84 (in mrem)

Individuals	Whole Body		Finger-Ring
	Pen	Non-pen	
1	130	0	0
1	20	0	120
1	0	0	540
1	0	0	380
1	0	0	310
1	0	0	240
1	0	0	200
1	0	0	180
1	0	0	70
10	0	0	0
5	0	0	not issued

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DEPARTMENT OF CHEMISTRY IRVINE, CALIFORNIA 92717

July 8, 1983

U.S. Nuclear Regulatory Commission

Chief, Standardization and Special Projects Branch,
Division of Licensing,
Washington D.C. 20555

Re: Docket 50-326, License R-116
Incident Report for July 1, 1983
Reported under Tech . Specs: 6.7.c.3. (abnormal occurrence)

Gentlemen:

An abnormal event occurred July 1, 1983 at the UCI Nuclear Reactor Facility. During a series of step insertions to generate maximum power and temperature curves, the adjustable transient rod cylinder was withdrawn to a height corresponding to a $2.00 insertion. At the upper limit of the cylinder's travel, the control rod began to withdraw. The reactor was critical at 1.5 watts and power increased to approximately 1.6 watts with a 20 second period. The reactor was immediately shut down. This incident was reported the same day to D. Sternberg of the NRC Region V Office.

Inspection of the cylinder's interior did not indicate a problem. Light oil was applied to the inside walls.This seemed to alleviate but not entirely eliminate the sticking of the piston during cylinder travel.

Another transient rod has experienced similar problems this past month. Both transient rods are serviced by the same air system, so suspecting the problem may be due to contamination, this system was dismantled.

Fine dirt had accumulated in the air trap since it was serviced during monthly maintenance. Some dirt had passed through the trap and filter and entered the buffer tanks which supply air to the rods at 80 psi. These

tanks, valves, traps and air hoses were removed and cleaned. The permanent filter in the air trap was cleaned of accumulated debris. Each transient rod was opened, cleaned thoroughly with solvent and lubricated.

Specifications by General Atomics, manufacturer for the TRIGA Reactor, call for clean, dry air to be used in the transient rod operation. While the air trap is cleaned monthly, the permanent filter attached to the system is not scheduled for regular maintenance. It is felt that it became overloaded and was no longer able to strain debris from the system. Regular maintenance of this item will most likely be added to our schedule.

When the system was reassembled each cylinder was tested thoroughly and no problems have since occurred. All rod drop times were in the normal range consistent with values obtained during tests over the last 2 years. Repairs to the rods and air system have been inspected and approved by the Acting Reactor Supervisor.

The Facility will continue to operate on a conservative basis in the steady state mode only until Dr. George Miller, Reactor Supervisor, returns in August. All pulsing operations will be delayed until repairs to the rod systems and air delivery systems have been inspected again and approved by the Reactor Supervisor. Inspection of the air system will be made frequently during this time to avoid any further problems.

Sincerely,

Patricia J. Rogers,
Acting Reactor Supervisor

cc: NRC Region V
W.Lillyman, The Vice Chancellor
V.P. Guinn, Chair, ROC
Member, ROC
✔ G.E. Miller, Reactor Supervisor

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DEPARTMENT OF CHEMISTRY

IRVINE, CALIFORNIA 92717

December 3rd, 1984

U.S. Nuclear Regulatory Commission,
Document Management Branch,
for Division of Licensing,
Washington, D.C. 20555

Docket: 50-326

Gentlemen:

Enclosed are twelve (12) copies of an annual report for the UCI Nuclear Reactor Facility. I regret that there has been some delay in getting this ready and printed up for distribution. It should have been delivered in August.

This report is submitted in accordance with the Technical Specifications for the reactor.

Sincerely,

G. E. Miller

George E. Miller
Reactor Supervisor

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