U.C.IRVINE

Nuclear Reactor Facility

Annual Report

for

July 1st, 1981 to June 30th, 1982

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, 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.

12 graduate students and 4 post-doctoral associates have used the facility under the guidance of three faculty in Chemistry. These include visiting students from Taiwan, Thailand, Brazil, Ireland and the Peoples Republic of China.

Currently the facility has 3 licensed senior operators including the Reactor Supervisor.

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.

The rotating specimen rack is still under repair. It was removed from the reactor structure on June 24th, 1982 and is stored at the free end of the reactor pool for decay before repair is attempted. This procedure has received full approval by the Reactor Operations Committee.

Operations in general have been slightly reduced from last year. Data on the operations is presented in Section 2.

An operations inspection was conducted by an NRC inspector in March, 1982. As a result of this inspection a Notice of Violation was issued with regard to an operation with higher than permitted core excess in June, 1981. As a result of this incident, several revisions were made in the Standard Operating Procedures to clarify procedures for core reactivity excess adjustment.

An incident report was filed in April regarding a sticking adjustable transient rod drive mechanism. This is more fully described in the maintenance section of this report. In late June, an accidental release occured of a few hundred gallons of deionized water, much of which flowed into the reactor pool. This was also the subject of an incident report to NRC.

Section 2.

Data Tabulations for the Period July 1st,1981 to June 30th, 1982

TABLE I.

Experiment approvals on file		7
Experiments performed (including repeats)		301
Samples irradiated		2446
Energy generated this period (Megawatt hours):		40.5
Total, 69 element core	127.0	
>74 element cores	738.8	
Total energy generated since initial criticality:		865.8 Mwh
Pulse operation this period:		16
of which greater than $2.00 insertion:		10
Total pulses to 6/30/82		665
Hours critical this period:		232
Total hours critical to date:		4516
Operator training and requalification, hours:		11
Inadvertant scrams:		27
Visitors to reactor - admitted:		238
Maximum dosimeter recorded for visitors:		0 mrem
Visiting researchers (dosimeter issues):		134
Maximum dose recorded:		3 mrem
Visiting researchers (badged):		6

TABLE II.

Reactor Status 6/30/82
(Rotating Specimen Rack Removed)

Fuel elements in core (including 2 fuel followers):	78
Fuel elements in storage (reactor tank) - used:	30
Fuel elements unused (instrumented element):	1
Graphite reflector elements in core:	29
Graphite reflector elements in reactor tank storage:	5
Experimental facilities in fuel element positions:	2
Water filled fuel element positions:	16

Core excess, cold, no xenon: $2.71

Control rod worths (6/28/82):

REG	$3.82
SHIM	$3.54
ATR	$1.86
FTR	$0.49
Total:	$9.71

Maximum possible pulse insertion:	$2.35
Maximum peak power attained (6/11/82 - $2.84 insertion):	860 Mwatts
Maximum peak temperature observed (B-ring):	245 ^{o}C

Section 3.

Inadvertent Scrams and Unplanned Shutdowns

TABLE III.

Date	Time	Power	Type and Cause
1981			
7/17	10:08	250 kw	Linear Power Scram. Electronic noise on switching mode switch.
7/27	14:11	10 kw	Same as 7/17
8/17	10:51	250 kw	Same as 7/17
8/21	10:04	250 kw	Same as 7/17
8/21	10:09	250 kw	Same as 7/17
9/10	10:15	10 kw	Same as 7/17
9/30	09:08	300 w	Period scram. Operator error during power increase.
10/2	13:42	10 kw	Same as 7/17
10/22	09:48	10 kw	Same as 7/17
11/4	15:25	250 kw	Same as 7/17
11/5	13:02	10 kw	Same as 7/17
11/12	12:07	<1 watt	Period scram. Trainee operator error during approach to criticality.
11/16	10:09	10 kw	Same as 7/17
11/19	13:08	<1 watt	Period scram. Operator error during approach to criticality.
12/18	10:07	10 kw	Same as 7/17
1982			
2/4	08:38	250 kw	Same as 7/17/81
2/10	09:51	10 kw	Same as 7/17/81
3/16	14:49	100 w	Same as 7/17/81
3/16	15:03	100 kw	Same as 7/17/81
3/31	10:53	0.3 w	Period Scram. Trainee operator error during approach to critical.
4/15	17:21	<10 w	Period Scram. Electronic noise glitch during rod calibration. reactor actually on negative period when scram occurred.
5/18	10:27	10 kw	Same as 7/17/81
5/18	12:50	250 kw	Same as 7/17/81
6/2	10:44	3 watts	Same as 7/17/81
6/8	10:45	10 kw	Same as 7/17/81
6/8	11:08	10 kw	Same as 7/17/81
6/8	11:11	10 kw	Linear Power Scram. Operator Range switching error.

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. Improved surveillance has been noted for some radiological safety items because of additional staff personnel assignment. New Standard Operating Procedures have been introduced for surveillance on area radiation monitors and personnel dosimeters.

The following special items were noted this year:

(a) Console Mode Switch. This switch continues to be a source of undesired reactor scrams when switched between steady-state and automatic mode. The switch is used many times during an operating day and occasions a few scrams each month. Attempts to clean the wafers have resulted in some improvement, but the problem has not been completely eliminated.

(b) False Security Alarms. A number of false alarms were received. The cause of many was finally traced to the presence of certain liquid nitrogen storage tannks within the facility. One or two of these tanks appear to have presuure relief valves that release with abnormal noise - enough to trip the facility ultrasonic motion sensors.

(c) Count-Rate Channel. Abnormal noise in this channel circuit was discovered during routine checks on 7/6/81. Cleaning all BNC connectors in the signal path cured this problem.

(d) Fuel Element Location Record. An error in fuel element location record was discovered during annual core surveillance. The locations of a graphite dummy element and a fuel element had been interchanged in the F-ring of the core (between F6 and F7). As a final check on this mistake, the serial number on the element was read by placing it in a temporary rack about 2 feet under water and using a small mirror.

(e) Pneumatic Transfer System Blower Motor. New brushes were installed in this motor after erratic behaviour was noticed.

(f) ATR Rod Drive. This rod drive was dismantled and all "O" ring and piston seals replaced after a problem occurred in which raising the cylinder caused the rod to be raised as well, even with no air applied. Since this event produced an unexpected insertion of reactivity, an incident report, dated April 5th, 1982, was filed with NRC. The rod was placed back in full

service on April 15th, 1982.

(g) Rotary Specimen Rack. As noted in a previous report, a bearing failed inside this unit some time ago. On 6/24/82 the entire rack was removed from the core structure following approved procedures. The unit, which is highly radioactive, is stored at the side of the reactor tank for decay before a repair of the bearing problem is attempted. No special problems were encountered during removal. Following removal, the core was carefully reloaded and the reactor restarted. During an attempt to perform a power calibration of the reactor, on July 3rd, 1982, the reactor was operated at a power level in excess of 300 kilowatts for a short period. This happened because the absence of the rack resulted in a reduction of neutron flux reaching the detector systems that was much larger than anticipated. This incident was reported to NRC in accordance with Tech. Specs. 6.7.c (1), by telephone on July 4th and by letter dated July 6th.

(h) Deionized Water Release. On June 29th a few hundred gallons of pure, deionized, water was accidentally released onto the reactor room floor. This occurred as a fitting on a shut-off valve came loose as an operator was performing a "back-flush" operation on the facility deionizer resin tanks. Much of this water flowed into the reactor pool, but the release was stopped before the pool. The level of the pool was reduced to normal three days later by pumping out the excess water after radiochemical assay assured only a low level of contamination. No other safety problem was encountered. This incident was reported to NRC in a letter dated July 8th, 1982.

Section 5.

Facility Changes and Special Experiments Approved.

Additional improvements were made to the security system as completion of the new program was accomplished. Final approval of a new plan was received in June, 1982. Additional modifications were made, however, around the date of receipt of approval in response to an incident occurring during April-May, 1982. A separate report on these additions will be sent to NRC under 10 CFR 2.790 (d) provisions.

As noted under maintenance, the rotating specimen rack was removed from the core structure at the end of June. This system is not essential to reactor operation and is classified as an experimental facility. The unit will be allowed to remain for radioactive decay before repair work is attempted. This was the only unusual change authorized 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 (7/1/81 - 6/30/82):

Total time of operation (assumed to be at 250 kw):	6068 minutes.
Release rate assumed	6×10^{-8} microcuries/ml
Flow rate of exhaust air	2×10^{6} ml/sec
Total release computed	4.8×10^{4} microcuries

(2) Release from pool surface (7/1/81 - 6/30/82)

Total hours of operation at power (Mwh x 4)	162 hours
Release rate assumed	$<1 \times 10^{-8}$ microcuries/ml
Flow rate of exhaust air	2×10^{6} ml/sec
Total release computed	$<1.2 \times 10^{4}$ microcuries

Total of (1) + (2) = 6×10^{4} microcuries

Concentration averaged over 12 months = $<1 \times 10^{-9}$ microcuries/ml

This is comparable to the level reported last year 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-prodct 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 also 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:	6 cubic feet	43 microcuries mixed activation products.
Liquids:	2 gallons	30 microcuries mixed activation products.
Total:		73 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.

1981-82.

Average Exposures in mr.

Location.	Quarter.				Total.	Total less Background (32 ± 15)
	2	3	4	1		
1	21	13	240	53	327	295
2	27	23	40	43	133	101
3	8	9	12	9	38	6
4	5	3	4	4	16	0
5	3	2	2	6	13	0
6	12	8	8	9	37	(5)
7	13	10	11	13	47	(15)
8	2	4	2	3	11	(0)
9	1	4	4	(missing)	(5)	0
10	0	3	4	4	11	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.

Thirty (30) persons were monitored on a continual basis using film badges, of these twenty-four (24) 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 eighteen (18) 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. For one of these students a report of thirty (30) mrem finger-ring exposure for the nine week period was made. For all others, the report was zero (0). There was no obvious reason why this student should have been exposed more than others.

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 5/1/81 to 5/31/82 (in mrem)

Individuals	Whole Body		Finger-Ring
	Pen	Non-pen	
1	15	130	230
1	0	0	640
1	0	0	330
1	0	0	210
1	0	0	180
1	0	0	80
3	0	0	30
33	0	0	0
6	0	0	not issued