

NUCLEAR ENGINEERING REACTOR LABORATORY  
TRIGA MARK III FACILITY  
UNIVERSITY OF CALIFORNIA  
BERKELEY, CALIFORNIA

BERKELEY RESEARCH REACTOR  
ANNUAL REPORT OF OPERATIONS  
January 1, 1984 through December 31, 1984  
(BRR Technical Specifications 6.7.2)

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## BERKELEY RESEARCH REACTOR OPERATIONS, 1984

### Reactor Use

The Berkeley Research Reactor (BRR) is a TRIGA Mark III facility capable of producing 1 MW steady state and of pulsing to 1300 MW peak power. The Berkeley Research Reactor is a research and educational tool of the University of California, is located on the Berkeley Campus and is operated by the Department of Nuclear Engineering.

Besides being used by the Department of Nuclear Engineering, it is used by other departments and campuses of the University, by the Lawrence Berkeley Laboratory and is available to Universities and Colleges in the area. The Lawrence Berkeley Laboratory is operated by the University of California under contract from the Department of Energy.

In addition, the Berkeley Research Reactor is used as an irradiation source for service to industry contracts and provides a stimulant to touring and interested high school and college students.

### Experiments Performed

Table I lists the experiments which were performed in the Berkeley Research Reactor during the year 1984. A total of 27 different experiments were performed. Five new experiments were approved between January 1 and December 31, 1984. The last column in Table I illustrates the number of times each experiment was performed

Table I. Experiments Performed at the Berkeley Research Reactor in 1984

Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept/ Company <sup>1</sup>	No. of Runs
13	A	Staff operation of reactor, calibrations, demonstrations, etc.	any, all	Lim	NE	69
188	B	Determination of fission yield	Lazy Susan	Prussin	NE	2
196	A	A short term activation analysis study on archaeological artifacts	Central Thimble	Asaro, Michel	DOE	115
199	A	Study of the characteristics of compensated Ion-chamber	Pool	Lim	NE	3
210	C	Neutron Radiography facility development	Lazy Susan	Kaplan, Lim	NE	25
<sup>12</sup> 221	A	Determination of nickel impurity in Fe <sub>2</sub> O <sub>3</sub> by activation analysis	Central Thimble	Prussin, Cann	NE	2
273	A	Origin of pottery	Central Thimble	Asaro, Michel	DOE	10
274	A	Irradiation of ethylene dibromide	Lazy Susan	Somorjai, Angeles	Chemistry	2
275	B	Electronic components test	Exposure Room	Young, et al	LMSC	30
283	A	Irradiation of household aluminum foil	Lazy Susan	Prussin, Cann	NE	9
284	A	Reactor power calibration and Xenon buildup	Pool	Lim	NE	10
293	A	Production of $\beta^+$ source	Lazy Susan	Kaplan, Lim	NE	7
303	A	Magnitude and shape of Central Thimble flux	Central Thimble	Lim	NE	5
304	A	Reactor checkout, approach to critical and pulsing	Pool	Ruby, Lim	NE	9

Table I. Experiments Performed at the Berkeley Research Reactor in 1984

Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept/ Company <sup>1</sup>	No. of Runs
305	A	Reactivity worth of control rods	All	Lim	NE	2
306	B	Graphite prism and thermal column experiment	Thermal Column	Ruby, Lim	NE	2
327	A	Determination of Calcium in biological matter	Rabbit	Cann	NASA/AMES	1
352	A	Deuterium-tritium micro balloons irradiation	Central Thimble	Lane, Lim	DOE	2
353	A	Doping of Germanium	Central Thimble	Hansen	DOE	4
354	A	Irradiation of environmental samples	Central Thimble	Heft, Lim	DOE	10
361	B	Irradiation of Natural or depleted uranium in ceramic form	Lazy Susan	Prussin	NE	4
365	B	Irradiation of Copper containing phantom	All	Lim, Derenzo	NE/DOE	3
367	A	Irradiation of Tungsten foil	Lazy Susan	Lim	NE	2
368	A	Analysis of glass and quartz	Lazy Susan	Prussin	NE	7
369	A	Activation analysis of geologic materials	Central Thimble	Denton/Lim	NE	5
370	A	Production of $^{24}\text{Na}$	Central Thimble	Lim	Chevron	2
371	A	Production of activity tracers $^{169}\text{Er}$ , $^{170}\text{Tm}$ , $^{169,175}\text{Yb}$	Central Thimble	Lim, Seaborg	NE/DOE	1

<sup>1</sup> Chemistry: Department of Chemistry, University of California, Berkeley

Chevron: Chevron Research Company

DOE: Department of Energy, U. S. A.

LMSC: Lockheed Missiles & Space Company, Inc.

NE: Department of Nuclear Engineering, University of California, Berkeley

### Reactor Maintenance

Routine maintenance, minor repair and modification, testing and inspection as required by the Tech Specs were performed during 1984.

### 10 CFR 50.59 Changes

Lines 28, 29, and 31 of page 60a of the Emergency Plan, rewritten July 25, 1977 and revised August 15, 1977, were changed on April 25, 1984. The changes were reviewed by the Reactor Hazards Committee, EH&S, Reactor Supervisor, Reactor Administrator, and the Reactor Staff.

### Administrative Changes

In April 1984, Gordon Little, Reactor Health Physicist, resigned to take a position at Oregon State University. He was replaced in August of 1984 by Peter Vernig.

### Routine Tests and Calibrations

Thermal power calibrations were performed in April 1984. The constant Air Monitor was calibrated during the month of November 1984.

The Reactor Pool Water Radiation Monitor was calibrated in April 1984, and the Stack Gas Argon-41 Monitor was calibrated in September 1984.

### Operating Schedule

The Berkeley Research Reactor normally operates on a single 8 hour shift between 8 AM and 5 PM, Monday through Friday. One day every two weeks is set aside for routine monthly checks and maintenance. Extended reactor runs and overtime operation are allowed if required by the experimental program.

### Fuel Addition and Fuel Inventory

There were no fuel additions in 1984. The annual fuel element inventory was performed in June 1984.

### Energy Production and Fuel Burn-up

The Berkeley Research Reactor produced 138,521 kW-hours or 5.77 MW-days of energy during 1984. As there were 161 operating days in 1984, this corresponds to an average daily energy production of 860 kW-hours per operating day. In 1984, the Berkeley Research Reactor was critical approximately 205 hours and was operated at full power (1 MW) for approximately 126 hours.

The total burn-up in 1984 was 6.2 grams elemental and 7.2 grams of isotope U-235.

The total cumulative energy production since initial criticality is approximately 272.1 MW-days.

### Nuclear Regulatory Commission Inspection

Inspections of the Berkeley Research Reactor operations and safety were performed by the Nuclear Regulatory Commission Region V office in December of 1984. No items of noncompliance to the Technical Specifications and Nuclear Regulatory Commission regulations were found during the inspections.

### Emergency Plan

The revised upgraded Berkeley Research Reactor Emergency Response Plan was approved by the NRC on November 17, 1984.

### Emergency Shutdowns and Inadvertent Scrams

<u>Date</u>	<u>Scram Circuit</u>	<u>Reason</u>
5-14-84	Period Scram	Operator Error
9-16-84	Linear Power Scram	Operator Error

### Operator's Training

In August 1984, one senior operator passed the Nuclear Regulatory Commission Reactor Operator's Examination.



## Requalification Training Program

In accordance with regulations, a successful requalification written examination was given to licensed operators and senior operators in September and November 1984.

## Exercise

Routine security and emergency evacuation exercises were performed during the months of June and December 1984. Both the reactor staff and campus police participated in the drills.

## Radioactive Effluent Released or Shipped

### Liquid Waste

No liquid waste from the reactor facility was picked up by Campus Environmental Health and Safety personnel.

No liquid waste was discharged to the sewer, storm drain or other location in the environment from this facility in 1984.

### Gaseous Waste

All gaseous waste discharged was calculated as Ar-41, since studies in the past have shown no other significant radionuclides.

Total curies released was 4.04 Ci as Ar-41 of a maximum permitted release of 2,785 Ci or 0.14% of the allowable release. Maximum concentration at stack discharge was  $1.56 \times 10^{-6}$   $\mu\text{Ci/ml}$ . This concentration is 50% of the allowable maximum concentration for this facility of  $3.12 \times 10^{-6}$   $\mu\text{Ci/ml}$ . That maximum concentration is believed due to erroneous data. The actual maximum concentration is believed to have been  $1.31 \times 10^{-6}$   $\mu\text{Ci/ml}$  or 42% of allowable maximum concentration. No average concentration was calculated due to frequent periods of time where the reactor was idle more than 50% of normal operational time (8 hours per day, 5 days per week excluding legal and university holidays).

Filter paper air samples showed no particulate radioactivity was released via exhaust stream. No particulate radioactivity concentrations above naturally occurring values were detected.

#### Solid (Dry) Waste

All solid (dry) waste was picked up by Campus Environmental Health and Safety personnel for disposal in accordance with their regulations. Material shipped included:

July 1984 - 16 cubic feet and .15 mCi miscellaneous activation products. No solid waste was released to the environment.

#### Personnel Radiation Exposure

Recorded radiation exposures to personnel included:

- a. Facility personnel (routine users of dosimeters) -

Maximum total exposure to an individual - 125 mrem

Minimum total exposure to an individual - 0 mrem

Note: at year end 38 individuals were assigned dosimeters and only one showed an exposure.

- b. Visitors (non-routine dosimeter users) -

Approximately one-thousand eighty entries were made by visitors.

Less than five percent had any reading. None were significant, the highest being 3 mrem. No average exposure was calculated.

- c. There were no exposures in excess of 10 CFR 20 limits.

#### Radiation and Contamination Levels:

- a. Routine monthly meter surveys generated individual radiation readings.

Maximum reading observed was 110 mrem/hr (gamma).

Minimum reading observed was 0 mrem/hr.

Average of readings is not meaningful due to abnormal influence of a few high dose rate areas out of 26 locations routinely surveyed.



- b. Routine area quarterly film dosimeters at 24 locations generated 96 readings, routine area monthly dosimeters at 3 locations generated 36 readings.

Maximum readings observed:

Monthly location - 450 mrem (120γ + 330 neutron)

Quarterly location - 900 mrem

Minimum readings observed:

Monthly location - 0 mrem

Quarterly location - 0 mrem

Maximum annual accumulated:

Monthly location - 1150 mrem (all gamma exposure)

Quarterly location - 2770 mrem

Average dose is meaningless due to excessive influence of a few positions.

- c. Routine quarterly area TLD dosimeter readings totalled 14.

Maximum total dose at any location for the year was 442 mrem.

Minimum total dose at any location for the year was 0 mrem.

Note that the period reported for film and TLD is 2-1-84 through 1-31-85.

- d. Routine weekly swipe program generated 2040 swipes, of which 24 showed contamination above normally expected level.

Maximum swipe activities recorded was  $5.5 \times 10^{-2}$   $\mu\text{Ci}/100 \text{ cm}^2$  from normally contaminated surfaces,  $1.4 \times 10^{-1}$   $\mu\text{Ci}/100 \text{ cm}^2$  from not-normally contaminated surfaces. This was due to tritium not associated with reactor operations.

Minimum activities for both categories was zero.

Averages were not determined due to excessive influence of a few swipes.

Environmental surveys

Environmental TLD measurements at 7 locations outside the facility generated 28 radiation readings.

Maximum total recorded exposure at any location for the year was 442 mrem.

Minimum total recorded exposure at any location for the year was 0 mrem.

Averages were not determined because the majority of locations had very low or no exposure and only a few locations had significant readings.

Note that the period reported was 2-1-84 through 1-31-85.

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COLLEGE OF ENGINEERING  
DEPARTMENT OF NUCLEAR ENGINEERING

BERKELEY, CALIFORNIA 94720

March 14, 1985

Docket No. 50-224

License No. R-101

Mr. Cecil O. Thomas, Chief  
Standardization and Special Project Branch  
Division of Licensing  
U. S. Nuclear Regulatory Commission  
Washington, District of Columbia 20555

Dear Mr. Thomas:

Enclosed is a copy of the Berkeley Research Reactor Annual Report  
for the calendar year 1984.

The Report is prepared for the Nuclear Regulatory Commission as  
required by our Technical Specifications.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Thomas H. Pigford'.

Thomas H. Pigford  
Reactor Administrator

THP:sf

Enc.

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