

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

BERKELEY RESEARCH REACTOR  
ANNUAL REPORT OF OPERATIONS  
January 1, 1982 through December 31, 1982  
(BRR Technical Specifications 6.7.2)

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## BERKELEY RESEARCH REACTOR OPERATIONS, 1982

### 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 1982. A total of 27 different experiments were performed. Six new experiments were approved between January 1 and December 31, 1982. 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 1982

Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept. or Company <sup>1)</sup>	No. of Runs
13	A	Staff operation of reactor, calibrations, demonstrations, etc.	any, all	Lim	NE	12
188	B	Determination of fission yield	Lazy Susan	Prussin	NE	1
196	A	A short term activation analysis study on archaeological artifacts	Central Thimble	Asaro, Michel	DOE	122
199	A	Study of the Characteristics of Compensated Ion-Chamber	Pool	Lim	NE	2
221	A	Determination of nickel impurity in Fe <sub>2</sub> O <sub>3</sub> by activation analysis	Central Thimble	Prussin, Cann	NE	1
273	A	Origin of pottery	Central Thimble	Asaro, Michel	DOE	9
274	A	Irradiation of Ethylene Dibromide	Lazy Susan	Somorjai, Angeles	Chemistry	2
275	B	Electronic components test	Exposure Room	Young, et al	LMSC	94
280	A	Production of Co-60m	Lazy Susan	Prussin, Markowitz	NE	1
281	A	Production of Au-198	Lazy Susan	Prussin, Markowitz	NE	1
282	A	Production of P-32	Lazy Susan	Prussin, Markowitz	NE	1
283	A	Irradiation of household Aluminum foil	Lazy Susan	Prussin, Cann	NE	5

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Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept. or Company <sup>1)</sup>	No. of Runs
284	A	Reactor power calibration and Xenon buildup	Pool	Lim	NE	4
303	A	Magnitude and Shape of Central Thimble Flux	Central Thimble	Lim	NE	2
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
313	A	Activation Analysis of Biological Materials in the Central Thimble	Central Thimble	Lim, Cann	NE	1
315	A	Activation Analysis of Biological Materials in the Lazy Susan	Lazy Susan	Lim, Cann	NE	1
349	A	Trace Sodium Identification	Lazy Susan	Ruby	NE/DOE	2
351	B	Neutron Tracks Studies in Lexan	Hohlraum	Wollenberg, Lim	DOE	1
354	A	Irradiation of Environmental Samples	Central Thimble	Heft, Lim	DOE	11
356	A	Determination of Uranium in Mineral Samples	Lazy Susan	Price, Lim	Physics	3
358	B	Calibration of neutron detectors in the Hohlraum	Thermal Column	Lim, Morgan	DOE	4

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359	A	Activation of Ho-165	Lazy Susan	Prussin, Gregorich	NE/DOE	1
360	A	Irradiation of Evaporated Gold	Lazy Susan	Lim, Morita	NE/DOE	1
361	B	Irradiation of Natural or Depleted Uranium in Ceramic Form	Lazy Susan	Prussin, Bayen	NE	11
362	A	Production of Lutecium-177g	Lazy Susan	Seaborg, Gregorich	NE/DOE	1

1) Chem: Department of Chemistry, University of California Berkeley

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

LMSC: Lockheed Missiles & Space Co.

NE: Department of Nuclear Engineering, University of California Berkeley

Physics: Department of Physics, University of California Berkeley

### Reactor Maintenance

A new replacement of the count rate electronic unit of the Berkeley Research Reactor air particulate monitor was installed. Also routine maintenance, minor repair and modification, testing and inspection as required by the Tech Specs were performed during 1982.

### 10 CFR 50.59 Changes

There were no changes in 1982 that required review under 10 CFR 50.59.

### Routine Tests and Calibrations

Thermal power calibrations were performed in May and December 1982.

The constant Air Monitor was calibrated during the month of January and October 1982.

The Reactor Pool Water Radiation Monitor was calibrated in June 1982 and the Area Radiation Monitors were calibrated in July 1982 while the Stack Gas Argon-41 Monitor was calibrated in September 1982.

### 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 1982. The annual fuel element inventory was performed in June 1982.

### Energy Production and Fuel Burn-up

The Berkeley Research Reactor produced 118,673 kW-hours or 4.94 MW-days of energy during 1982. As there were 173 operating days in 1982 this corresponds to an average daily energy production of 686 kW-hours per operating day. In 1982 the Berkeley Research Reactor was critical approximately 205 hours and was operated at full power (1 MW) for approximately 103 hours. The total burn-up in 1982 was 5.3 grams elemental and 6.2 grams of isotope U-235.

The total cumulative energy production since initial criticality was approximately 263 MW-days.

### Nuclear Regulatory Commission Inspection

Respectively in January and May of 1982 inspections of the Berkeley Research Reactor operations and safety were performed by the Nuclear Regulatory Commission Region V office. No items of noncompliance to the Technical Specifications and Nuclear Regulatory Commission regulations were found during both inspections.

### Upgraded Emergency Response Plan

On October 26, 1982, the Berkeley Research Reactor's upgraded Emergency Response plan was sent to the Nuclear Regulatory Commission for approval.

### Operating Procedures

The following new and revised operating and safety procedures were introduced in 1982:

Appendix #7 to NERL 27	Jan., 1982	Stackgas Monitor Source Test
Appendix #8 to NERL 27	Feb., 1982	Low Pool Water Level Alarm Testing Procedure
Appendix #9 to NERL 27	Feb., 1982	Bulk Water Temperature Alarm Testing Procedure
NERL 16	Feb., 1982	Procedure for Fuel Loading, Unloading, Measurement and Control Rod Removal and Replacement (Revised)

In addition NERL-7, 8, 9, 15, 16, 21, 23, 24, 26, 27, 28, 29, 33 and the Berkeley Research Reactor Security Plan were reviewed by the reactor staff in August of 1982.

#### Emergency Shutdowns and Inadvertent Scrams

<u>Date</u>	<u>Scram Circuit</u>	<u>Reason</u>
7-13-82	Period Scram	Operator Error (Operator training)
8-4-82	Period Scram	Operator Error (Operator training)
8-31-82	Linear Power Scram	Operator Error (Operator training)
8-31-82	Linear Power Scram	Operator Error (Operator training)

#### Operators Training

In October 1982 two reactor operators passed the Nuclear Regulatory Commission Reactor Operators examination.

#### Requalification Training Program

In accordance with regulations a successful requalification written examination was given to licensed operators and senior operators in November 1982.

#### Exercise

Routine security and emergency evacuation exercises were performed during the months of June and December 1982. Both the reactor staff and campus police participated in the drills. In addition a special training tour for the Berkeley Fire Department and the Campus Fire Marshal, including his staff, was given in July of 1982.



## Radioactive Effluent Released or Shipped

### Liquid Waste

All liquid waste from the facility was picked up by Campus Environmental Health & Safety personnel for disposal in accordance with their regulations. All waste was in one gallon glass jugs.

Material shipped included:

6-9-82      1 gal.      1.0 gram U-nat

No liquid waste was discharged to the sewer, storm drain or other location in the environment from this facility in 1982.

### 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 2.98 Ci as Ar-41.

Average concentration at stack mouth was  $3.3 \times 10^{-9}$   $\mu\text{Ci/ml}$ .

This concentration is 0.0011 of allowable maximum concentration for this facility of  $3.12 \times 10^{-6}$   $\mu\text{Ci/ml}$  or maximum permitted release of 2,785 Ci.

Maximum concentration noted was  $3.6 \times 10^{-7}$   $\mu\text{Ci/ml}$  which is 0.12 of the permitted average concentration at the release point.

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:

6-9-82      10 ft<sup>3</sup>      14.2kg U-nat + 0.2 mCi miscellaneous activation products

No solid waste was released to the environment.

### Personnel Radiation Exposures

Recorded radiation exposures to personnel included:

- a. Facility personnel (routine users of dosimeters)

Maximum total exposure to an individual - 255 mrem

Minimum total exposure to an individual - 0 mrem

Note: Forty individuals were assigned dosimeters; only one individual incurred any recorded exposure.

- b. Visitors (non-routine dosimeter users)

Maximum total exposure to any individual - 45 mrem (90 entries)

Minimum total exposure to any individual - 0 mrem

Average total exposure to any individual - 0.12 mrem

Note: Approximately 885 entries were made by 640 individuals.

74 positive results were recorded for 14 individuals.

Two individuals incurred total recorded exposures exceeding 25 mrem/year each; no other exceeded 10 mrem/year.

Maximum exposure for any entry was 4 mrem.

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

There were three persons for whom dosimeters were required by provisions of 10 CFR 20 (entry into high radiation area).

### Radiation and Contamination Levels

- a. Routine monthly meter surveys generated 384 individual radiation readings.

Maximum reading observed was 120 mrem/hr.

Minimum reading observed was 0 mrem/hr.

Average of readings is meaningless due to abnormal influence of one high dose rate area out of 26 locations routinely surveyed.

- b. Routine area quarterly film dosimeters at 27 locations generated 108 readings, routine area monthly dosimeters at 3 locations generated 36 readings.

Maximum readings observed - 960 mrem (monthly location)

700 mrem (quarterly " )

Minimum readings observed - 0 mrem (monthly location)

0 mrem (quarterly " )

Maximum annual accumulated - 4950 mrem (monthly location)  
2180 mrem (quarterly " )

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

- c. Routine quarterly area TLD dosimeter readings totalled 16.

Maximum total dose at any location for the period was 7 mrem.

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

Average total dose at any location for the period was 1.8 mrem.

Period reported for film and TLD is 2-1-82 through 1-31-83.

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

Maximum swipe activities recorded was 1500 cts/min from normally  
contaminated surfaces, 316 cts/min from not-normally-contaminated  
surfaces.

Minimum activities for both categories was zero.

Averages were not determined.

#### Environmental Surveys

Environmental TLD measurements at eleven locations outside the facility  
generated 44 radiation readings.

Maximum total recorded exposure at any location for the period was  
311 mrem.

Minimum total recorded exposure at any location was 0 mrem.

Average recorded exposure for the eleven locations was 57 mrem.

Note that the period reported was 2-1-82 through 1-31-83.