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NUCLEAR ENGINEERING REACTOR LABORATORY
TRIGA MARK III Facility
University of California
Berkeley, California

BERKELEY RESEARCH REACTOR
ANNUAL REPORT OF OPERATIONS
January 1, 1979 through December 31, 1979
(BRR Technical Specifications 6.7.2)

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BERKELEY RESEARCH REACTOR OPERATIONS, 1979

Reactor Use

The Berkeley Research Reactor (BRR) is a TRIGA Mark III facility capable of producing 1 MW steady state and of pulsing to 1200 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 1979. A total of 23 different experiments were performed. Five new experiments were approved between January 1 and December 31, 1979. The last column in Table 1 illustrates the number of times each experiment was performed.

Table I. Experiments Performed at the Berkeley Research Reactor in 1979

Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept. or Company*	No. of Runs
13	A	Staff operating of reactor, calibrations, demonstrations etc.	any, all	Staff	NE	60
37	B	Br-83 & Br-84 determination of fission yields	Lazy Susan	Prussin, Zendel	NE	1
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	LBL	63
247	B	Production of Au-198	Hohlraum	Kaplan	NE	6
272	A	Activation of inorganic iodide	Rabbit	Prussin	NE	25
273	A	Origin of pottery	Central Thimble	Asaro, McCracken	LBL	11
274	A	Irradiation of Ethylene Dibromide	Lazy Susan	Somorjai, Angeles	Chem.	11
275	B	Electronic components test	Exposure Room	Young, et al	LMSC	94
280	A	Production of Co-60m	Lazy Susan	Prussin, Markowitz	NE	2

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Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept. or Company*	No. of Runs
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 Aluminium foil	Lazy Susan	Prussin, Cann	NE	4
286	B	Characteristics of Short-Lived Fission Products	Rabbit	Prussin, Zendel	NE	6
306	B	Graphite Prism and Thermal Column Experiment	Thermal Column	Ruby, Lim	NE	1
313	A	Activation analysis of biological materials	Central Thimble	Prussin, Lim, Cann	NE	6
314	A	Activation Analysis of biological materials	Flex Rabbit	Prussin, Cann	NE	22
319	A	Production of Flourine 18	Central Thimble	Cann	UCSF	2
345	B	Identification of Pu-244	Central Thimble	Asaro, McCracken	LBL	4
346	A	Irradiation of Meteorites	Central Thimble	Michel, McCracken	LBL	1

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Experiment #	Class	Title Objective	Facility	Principal Investigator, Experimenter	Dept. or Company*	No. of Runs
347	B	Calibration of Fission Chamber in the Hohlraum	Hohlraum	Kaplan	NE	21
349	A	Trace Sodium Identification	Lazy Susan	Ruby	NE/LBL	9
350	A	Bone Irradiation and Analysis	Rabbit	Cann	UCSF	1

* Chem.: Department of Chemistry, University of California Berkeley

LBL: Lawrence Berkeley Laboratory

LMSC: Lockheed Missile & Space Co.

NE: Department of Nuclear Engineering, University of California Berkeley

UCSF: University of California San Francisco, Department of Radiology

Reactor Maintenance

Other than routine maintenance, no other work was performed at the Berkeley Research Reactor facility during 1979.

License Renewal and Revision of the Berkeley Research Reactor Technical Specifications

License No. R-101 of the Berkeley Research Reactor was renewed on September 28, 1979 and will expire on February 3, 2005. A new revised Technical Specification was approved concomitant with the license renewal.
A previously requested change #6 in the Berkeley Research Reactor Technical Specifications was incorporated in the new revised specification.

10 CFR 50.59 Changes

A statement was added to the second paragraph of section 5.4.1 and on page 52 starting on line 18 of the Berkeley Research Reactor Emergency Plan. This change was made by the Reactor Supervisor, and reviewed by the Reactor Administrator and the Chairman and Secretary of the Reactor Hazards Committee. The addition does not constitute an unreviewed safety question. On the contrary the addition will assure proper notification to the Nuclear Regulatory Commission in case immediate reporting of an accident is required. The revised pages were sent to the Nuclear Regulatory Commission, Washington, D. C. in April, 1979.

Routine Tests and Calibrations

The limit of transverse bend and longitudinal elongation of each reactor fuel element was measured during September, 1979 and was found to be within limits specified by the operating license. Thermal power calibrations were performed in May and October 1979.

The Constant Air Monitor was calibrated during the month of January 1979.

The Reactor Pool Water Radiation Monitor and the Area Radiation Monitors were calibrated in August, 1979 while the Stack Gas Argon-41 Monitor was calibrated in September 1979.

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

There were no fuel additions in 1979.

Energy Production and Fuel Burn-up

The Berkeley Research Reactor produced 110,595 kW-hours or 4.61 MW-days of energy during 1979. As there were 185 operating days in 1979 this corresponds to an average daily energy production of 598 kW-hours per operating day. In 1979 the Berkeley Research Reactor was critical approximately 216.0 hours and was operated at full power (1 MW) for approximately 102.0 hours. The total burnup in 1979 was 5.0 grams elemental and 6.0 grams of the isotope U-235.

The total cumulative energy production since initial criticality was 246 MW-days.

Nuclear Regulatory Commission Inspection

Respectively in April, May and August of 1979 inspections of the Berkeley Research Reactor operations, security and safety were performed by the Nuclear Regulatory Commission Walnut Creek office. No items of non-compliance to the Technical Specifications

and Nuclear Regulatory Commission regulations were found during the operations and security inspections. However, during the radiation safety inspection a deficiency was found for not reporting personnel dosimetry under 10 CFR 20.407 for the year 1978.

Operating Procedures

The following new and revised operating and safety procedures were introduced in 1979:

NERL 30 1-15-79 Reporting Defects and Noncompliance of Components Which are Currently Used Within, or Will be Used at the BRR Facility.

NERL 31 10-23-79 Additional BRR Procedures

1) Note on stackgas printout paper tape in 1110-A Etcheverry Hall when test is performed;
2) Emergency evacuation and security exercises in June and December;
3) Annual Personnel Monitoring Report to NRC.

Emergency Shutdowns and Inadvertent Scrams

Date	Scram Circuit	Reasons
2-21-79	Linear Power	Operators error
9-10-79	Linear Power	Operators error
11-30-79	Period Scram	Operators error

Operators Training

In December of 1979, one reactor 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 November 1979.

Exercise

Security and emergency evacuation exercises were performed during the months of August and December 1979. Both the reactor staff and campus police participated in the drills.

In addition a special training tour for the Campus police was given in April 1979.

Also, an emergency exercise, including the Berkeley Research Reactor staff, Environmental Health and Safety, Campus police, Herrick Hospital, and the Berkeley Fire Department, was performed in October 1979.

Tours

Tours of the reactor laboratory are held on the afternoon of Fridays once every four to six weeks for students and the general public. In addition, tours are held as requested for classes from the University and nearby high schools and colleges.

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 except for the 1/2 gallon of MAP (miscellaneous activation product) picked up on 5-7-79, which was a large number of capped glass vials.

Material shipped included:

1-5-79	5 gal.	1.67×10^{-6} Ci U-nat (5 gms)
	2 gal.	2×10^{-5} Ci MAP
5-7-79	3 gal.	1×10^{-5} Ci U-depl. (30 gms)
	1/2 gal.	1×10^{-5} Ci MAP
7-30-79	2 gal.	$6\text{-}7 \times 10^{-8}$ Ci U-nat (0.2 gm)
11-14-79	4 gal.	1.3×10^{-7} Ci U-nat (0.4 gm)
Total	16-1/2 gal	3×10^{-5} Ci MAP plus 1.17×10^{-5} Ci U-238

No liquid waste was discharged to the sewer from this facility in 1979.

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 2.311 Ci as Ar-41.

Average concentration at stack mouth was 2.6×10^{-9} μCi/ml.

This concentration is 0.0008 of allowable maximum concentration for this facility of 3.12×10^{-6} μCi/ml.

Samples showed no particulate radioactivity was released.

No other significant radionuclides were released in gaseous waste discharges.

Solid (Dry) Waste

All solid (dry) waste was picked up by Campus Enviornmental Health and Safety personnel for disposal in accordance with their regulations.

Material shipped included:

1-5-79	16 ft^3	1×10^{-3} Ci MAP
5-7-79	8 ft^3	4×10^{-5} Ci MAP
7-30-79	8 ft^3	1×10^{-4} Ci MAP plus 1×10^{-7} Ci U-238
11-14-79	8 ft^3	4×10^{-5} Ci MAP
Total	40 ft^3	1.2×10^{-3} Ci MAP plus 1×10^{-7} Ci U-238

Personnel Radiation Exposures

Recorded radiation exposures to personnel included:

a. Facility personnel (routine users of dosimeters)
   Maximum total exposure to an individual - 310 mrem
   Minimum total exposure to an individual - 0
   Average total exposure to an individual - 8.2 mrem
   Note: Thirty-eight individuals were assigned dosimeters; only one individual incurred any recorded exposure.

b. Visitors (non-routine dosimeter users)
   Maximum total exposure to any individual - 98 mrem
   Minimum total exposure to any individual - 0
   Average total exposure to any individual - 0.45 mrem
   Note: 1070 entrees were made by 775 individuals. 100 positive results were recorded for 53 individuals. Eight individuals incurred total annual exposures exceeding 6 mrem each; two of these incurred total annual exposures exceeding 25 mrem each.

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

Radiation and Contamination Levels

a. Routine monthly meter surveys generated 322 individual radiation level readings.
   Maximum reading observed was 15.5 mrem/hr.
   Minimum reading observed was 0.
   Average of readings observed was 1.15 mrem/hr.

b. Routine monthly and quarterly area film dosimeter readings totalled 168.
   Maximum total dose at any location for the period was 9,120 mrem.
   Minimum total dose at any location for the period was 0.
   Average dose for the thirty locations was 581 mrem.

c. Routine quarterly area TLD dosimeter readings totaled 20.
   Maximum total dose at any location for the period was 29 mrem.
   Minimum total dose at any location for the period was 3 mrem.
   Average total dose at any location for the period was 11 mrem.
   Note: Periods for quarterly dosimeters were changed in early 1979 to begin in February, May, August, and November. Hence periods reported for film and TLD is the thirteen-month period 1-1-79 through 1-31-80.

d. Routine weekly swipe program generated 2140 swipes, of which 35 showed contamination above normally expected level.

Maximum swipe activities recorded was 2.3×10^3 cts/min from normally contaminated surfaces, 8.3×10^2 cts/min from not-normally-contaminated surfaces.
Minimum activities for both categories is 0.
Averages were not determined.

Environmental Surveys

Environmental TLD measurements at eleven locations outside the facility generated 55 radiation readings.

Maximum total recorded dose at any location for the period was 333 mrem.
Minimum total recorded dose at any location was 5 mrem.
Average recorded dose for the eleven locations was 71.8 mrem.
Note that the period reported was 1-1-79 through 1-31-80. See note in previous section.