

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

BERKELEY RESEARCH REACTOR
ANNUAL REPORT OF OPERATIONS
January 1, 1987 through December 31, 1987
(BRR Technical Specifications 6.7.2)

Tek H. Lim
Reactor Supervisor

8804130227 871231
PDR ADDCK 05000224
R DCD

A020/11
P472138513

BERKELEY RESEARCH REACTOR OPERATIONS, 1987

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. It is located on the Berkeley Campus and operated by the Department of Nuclear Engineering.

Besides being used by the Department of Nuclear Engineering, the reactor is also used by other departments and campuses within the University, the Lawrence Berkeley and Lawrence Livermore laboratories, and is available to other universities and colleges in the area.

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 1 lists the experiments which were performed at the Berkeley Research Reactor during the year 1987. A total of 22 different experiments were performed. Two new experiments were approved between January 1 and December 31, 1987. The last column in Table 1 illustrates the number of times each experiment was performed.

Table 1. Experiments Performed at the Berkeley Research Reactor in 1987

Experiment #	Class	Title Objective	Facility	Experimenter in Charge	Dept./ Company	No. of Runs
13	A	Staff operation of reactor, calibrations, demonstrations, etc.	Any, rll	Lim	NE	76
188	B	Determination of fission yield of Br	Central Thimble	Prussin, Hoffman	NE/Chemistry	1
196	A	A short term activation analysis study on archaeological artifacts and geologic materials	Central Thimble	Asaro, Michel	DOE	52
210	C	Neutron Radiography facility development	Beamport S-2	Lim	NE	29
221	A	Determination of nickel impurity in Fe ₂ O ₃ by activation analysis	Central Thimble	Prussin, Cann	NE	3
273	A	Origin of pottery and geologic materials analysis	Central Thimble	Asaro, Michel	DOE	6
275	B	Electronic components test	Exposure Room	Lim	LMSC	26
280	A	Production of ^{60m} Co and ⁶⁰ Co	F1 Rabbit	Prussin	NE/Chemistry	2
281	A	Production of ¹⁹⁸ Au	F1 Rabbit	Prussin, Lim	NE/Chemistry	1
282	A	Production of ³² p	Lazy Susan and Central Thimble	Prussin, Lim	NE/Chemistry	2
283	A	Irradiation of household aluminum foil	Lazy Susan	Prussin, Cann	NE	2
284	A	Reactor power calibration and Xenon buildup	Pool	Lim	NE	1
304	A	Reactor checkout, approach to critical and pulsing	Pool	Lim	NE	12
305	A	Reactivity worth of control rods	All	Lim	NE	13
315	A	Activation analysis of geological materials	Lazy Susan	Lim	NE/Sonoma State	9
352	A	Deuterium-tritium micro balloons	Central Thimble	Lim, Lane	DOE	7

Table 1. Experiments Performed at the Berkeley Research Reactor in 1987

Experiment #	Class	Title Objective	Facility	Experimenter in Charge	Dept./ Company	No. of Runs
353	A	Doping of Germanium	Central Thimble	Lim, Hansen	DOE	6
361	B	Irradiation of natural or depleted uranium	Lazy Susan	Prussin	NE	5
369	A	Activation analysis of geological materials	Central Thimble	Denton, Lim	NE/Plant Pathology	10
372	B	Radiation Effect on electronic components	Exposure Room	Lim	TRW Ford ROLM	111
379	A	Neutron irradiation of terrestrial rocks	Lazy Susan	Lim, Erwin	NE/Physics	7
381	A	Radiation of amorphous silicon	Exposure Room	Lim, Kaplan	NE	4
382	A	Irradiation of Iridium Wire	Central Thimble	Lim, Goosman	NE/DOE	5
383	B	Irradiation of UO ₂ in the Exposure Room	Exposure Room	Lim, Prussin	NE	1

Chemistry: Department of Chemistry, University of California, Berkeley.
 DOE: Department of Energy (Lawrence Berkeley and Lawrence Livermore Laboratories).
 LMSC: Lockheed Missiles & Space Company, Inc.
 NE: Department of Nuclear Engineering, University of California, Berkeley.
 TRW: TRW, Inc.
 Ford: Ford Aerospace & Communications, Inc.
 ROLM: ROLM
 Sonoma State: Department of Physics, Sonoma State University.
 Physics: Department of Physics, University of California, Berkeley.
 Plant Pathology: Department of Plant Pathology, University of California, Berkeley.

Reactor Maintenance

Routine maintenance, minor repair and modification, testing and inspection as required by the Tech Specs were performed during 1987. No major maintenance was conducted.

10CFR 50.59 Changes

There were no changes in 1987 that required review under paragraph 10CFR 50.59.

Routine Tests and Calibrations

Thermal power calibrations were performed in August, and the constant Air Monitor was calibrated in December 1987.

The Reactor Pool Water Radiation Monitor was calibrated in April, and the Stack Gas Argon-41 Monitor was calibrated in October 1987.

Operating Schedule

The Berkeley Research Reactor normally operates on a single 8-hour shift, between 8:00 a.m. and 5:00 p.m., Monday through Friday. One day every two weeks is set aside for routine checks and maintenance. Extended reactor runs and overtime operation are allowed if required by the experimental program.

Fuel Addition and Fuel Inventory

The annual fuel inventory was performed in June. There were no fuel additions in 1987.

Energy Production and Fuel Burn-Up

The Berkeley Research Reactor produced 143,000 kW-hours or 5.95 MW-days of energy during 1987. As there were 171 operating days in 1987, this corresponds to an average daily energy production of 836 kW-hours per operating day. In 1987 the Berkeley Research Reactor was critical approximately 233 hours and operated at full power (1 MW) for approximately 132 hours.

The total burn-up was 6.5 grams elemental and 7.5 grams of the isotope U-235.

The total cumulative energy production since initial criticality is approximately 290 MW-days.

Nuclear Regulatory Commission Inspection

The Berkeley Research Reactor was inspected on July 13-16, 1987. Two items of non-compliance to the Berkeley Research Reactor Technical Specifications were identified:

1. Failure of the Reactor Hazards Committee to perform audits on a quarterly basis.
2. Failure of the Reactor staff to report to the NRC that such audit was not performed on time.

Corrective measures to avoid repeat of such violation was undertaken.

Emergency Shutdowns and Inadvertent Scrams

<u>Date</u>	<u>Scram Circuit</u>	<u>Reason</u>
9-23-87	Linear Power Scram	Operator Error

Requalification Training Program

In accordance with regulations, a requalification written examination was given to licensed operators and senior operators in July and December 1987.

Exercise

A routine emergency and security evacuation exercise involving the Reactor staff, and the Campus Police Department was conducted in January and July 1987.

Termination of Reactor Operations

On December 20, 1986 the Chancellor of the University of California at Berkeley announced his decision to decommission the 20 year old Berkeley Research Reactor, citing a history of declining use and the need to erect a new computer science building over the reactor site as the main reason.

The Reactor was permanently shutdown on December 23, 1987.

Radioactive Effluent Released or Shipped

Liquid Waste:

No liquid radioactive waste generated by the reactor facility was picked up by Campus Environmental Health and Safety Personnel in 1987.

No liquid radioactive waste was discharged to the sewer, storm drain or other location in the environment from this facility in 1987.

Gaseous Waste:

All gaseous radioactive waste discharged was calculated as Ar-41, since studies in the past have shown no other significant radionuclides occur from normal operations. The total released was 3.48 Ci as Ar-41, which was 0.12% of the maximum annual allowable release of 2,785 Ci. Maximum concentration

at one particular period at stack discharge was 2.02×10^{-6} $\mu\text{Ci/ml}$. This concentration is 65% of the allowable continuous concentration for this facility of 3.12×10^{-6} $\mu\text{Ci/ml}$. No average concentration was calculated due to intermittent periods when the reactor was not operating.

Filter paper air samples showed that no particulate radioactivity above naturally occurring levels could be detected in the exhaust stream.

Solid (Dry) Waste:

Twelve cubic feet of dry radioactive waste was released for disposal with an estimated 1 millicurie of activity.

Personnel Radiation Exposure

Recorded radiation exposure for the year to personnel included:

a. Facility personnel (routine users of dosimeters):

- maximum total whole body exposure to an individual - 30 mrem
- maximum total extremity exposure to an individual - 230 mrem
- minimum total whole body exposure to an individual - 0 mrem
- minimum total extremity exposure to an individual - 0 mrem

Note: At year end, 48 individuals were assigned whole body dosimeters, and six were assigned extremity dosimeters. Four individuals showed no exposure. Exposures were both whole body and extremity.

b. Visitors (non-routine dosimeter users):

Approximately seven hundred and sixty-nine entries were made by visitors. Less than 2% had any reading. None was significant. The highest was 5 mrem. No average exposure was calculated.

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

Radiation and Contamination Levels

a. Routine monthly meter surveys generated 296 individual radiation readings.

- maximum reading observed - 250 mrem/hr (gamma)
- minimum reading observed - 0 mrem/hr

Average of readings was 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 22 locations generated 88 readings; routine monthly dosimeters at 5 locations generated 60 readings.

Maximum readings observed:

- monthly location - 460 mrem (gamma)
- quarterly location - 650 mrem (gamma)

Minimum readings observed - (0)

Maximum annual accumulated:

- monthly location - 1270 mrem (gamma)
- quarterly location - 1840 mrem (gamma)

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

c. Routine quarterly area TLD dosimeter readings totalled 52 at 13 locations.

- maximum total dose at any location for the year - 400 mrem
- minimum total dose at any location for the year - 0 mrem

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

Note that the period reported for quarterly film and TLD is 2/1/85 through 1/31/87.

d. Routine weekly swipe program generated 1780 swipes of which 43 showed contamination above normally expected level.

- maximum swipe activities recorded was $3.8 \times 10^{-4} \mu\text{Ci}/100 \text{ cm}^2$ from normally contaminated surfaces. This was due to uranium 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 9 locations outside the facility generated 36 radiation readings. Two dosimeters were not recovered due to apparent theft.

- maximum total recorded exposure at any outside location for the year was 400 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 2/1/85 through 1/31/87.

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

COLLEGE OF ENGINEERING
DEPARTMENT OF NUCLEAR ENGINEERING

BERKELEY, CALIFORNIA 94720

March 21, 1988

Docket No. 50-224
License No. R-101

Mr. Cecil O. Thomas, Chief
Standardization and Special Projects Branch
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Thomas:

For your information, enclosed is a copy of the Berkeley Research Reactor's Annual Report for the year 1987.

The report is prepared for the Nuclear Regulatory Commission, as required by Technical Specifications.

Sincerely,

Thomas H. Pigford
Reactor Administrator

THP/jmh

Enclosure

A020
11

P472138513