# ANNUAL REPORT

# 1982

## NUCLEAR ENERGY LABORATORY

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

UNIVERSITY OF CALIFORNIA, LOS ANGELES

NOMENCLATURE

| | |
|---|---|
| Ar-41 | A radioactive isotope of Argon gas with a half life of 110 minutes |
| CFH | Cubic feet per hour |
| Ci | Curie, the unit of activity equivalent to $3.7 \times 10^{10}$ d/s |
| μCi | $10^{-6}$ Ci |
| CIC | Compensated ion chamber |
| GM | Geiger-Muller ionizing radiation detector |
| HEPA Filter | A high efficiency particulate filter |
| kWh | Kilowatt hour(s) |
| kWt | Kilowatt(s) thermal |
| Log N | An instrument that measures the logarithm of the reactor power |
| NEL | Nuclear Energy Laboratory |
| Port Hours | The number of irradiation ports used times the number of hours utilized |
| PRN-4 | Type of neutron detector that reads out in rem |
| Scram | A reactor shut-down |

CONTENTS



TABLES

## Section 1

## REACTOR OPERATING EXPERIENCE

Reactor operations in 1982 provided 297 hours of services in 103 reactor runs. The operational intensity can also be summarized as 185 equivalent full (100 kWh) power hours or 18.5 megawatt hours, a decline of about 23% from 1981.

Table I illustrates the reactor usage over the last five years in four broad categories.

The bulk of the research work category derives from users external to the UCLA School of Engineering and Applied Science. As the research is dominated by service irradiations, and because several irradiation ports can be occupied in a single reactor run, the intensity of user demand in this category is appropriately summarized by port-hours of activity. One port, used for one hour, provides one port-hour. Table II illustrates port-hours of such usage in 1982 by user category.

# TABLE I

## Reactor Usage (Operating Hours)

| CATEGORY | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| CLASSROOM INSTRUCTION | 52 | 31 | 46 | 61 | 67 |
| DEMONSTRATIONS | 7 | 5 | 2 | 3 | 8 |
| RESEARCH | 178 | 335 | 295 | 284 | 203 |
| MAINTENANCE | 34 | 1 | 38 | 16 | 19 |
| TOTAL OPERATING HOURS | 271 | 372 | 381 | 364 | 297 |
| EQUIVALENT FULL POWER HOURS | 203 | 294 | 289 | 239 | 185 |
| MEGAWATT-HOURS | 20.3 | 29.4 | 28.9 | 23.9 | 18.5 |

CLASSROOM INSTRUCTION COMPRISES USE OF THE REACTOR IN SUPPORT OF UCLA UNDERGRADUATE AND GRADUATE LABORATORY WORK INVOLVING BASIC COUNTING, ACTIVATION ANALYSIS, REACTOR PARAMETER DETERMINATIONS, AND OPERATOR TRAINING. OPERATOR REQUALIFICATION IS INCLUDED IN THIS CATEGORY. HOURS ARE REACTOR OPERATING HOURS IN SUPPORT OF CLASS INSTRUCTION.

DEMONSTRATIONS ARE OF VARIOUS KINDS; THEY ARE PERFORMED FOR EDUCATIONAL GROUPS AND OTHER TOUR GROUPS.

RESEARCH IS A BROAD CATEGORY DOMINATED BY SERVICE IRRADIATIONS IN WHICH THE REACTOR IS USED AS A TOOL WITHOUT REFERENCE TO REACTOR THEORY OR OPERATIONAL PROPERTIES (SEE TABLE II)

MAINTENANCE REPRESENT[S] [HOU]RS FOR WHICH THE REACTOR IS OPERATED FOR CALIBRATION PURPOSES, AND DOES NOT IN[CLUDE] ALL MAINTENANCE HOURS.

## TABLE II

## Research Usage* (Port Hours)

| USER CATEGORY | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| UCLA ACADEMIC USERS | 105 | 91 | 101 | 67 | 146 |
| OTHER UNIVERSITIES & COLLEGES | 37 | 53 | 20 | 38 | 6 |
| OTHER EXTRAMURAL USERS | 95 | 264 | 360 | 211 | 100 |
| NEL STAFF | 9 | 1 | 27 | 113 | 130.5 |
| TOTAL PORT HOURS | 246 | 409 | 508 | 429 | 382.5 |

* RESEARCH USAGE OF THE REACTOR IS DOMINATED BY SAMPLE IRRADIATIONS. CERTAIN NEL STAFF RESEARCH DOES NOT INVOLVE SAMPLE IRRADIATIONS.

## Section 2

## UNSCHEDULED SHUTDOWNS & REPORTABLE (ABNORMAL) OCCURRENCES

### Unscheduled Shutdowns

The four unscheduled shutdowns experienced in 1982 are briefly described in the following paragraphs.

A high flux scram occurred at approximately 200 watts when the reactor was being taken to power to test the newly installed Dual Linear Amplifier that replaced the original Safety Amplifier. The reactor shutdown as it should have when the Dual Linear Amplifier output reached 125%. The reactor was restarted and the chambers adjusted in stages until the reactor power and the Dual Linear Amplifier both agreed at 100 kW.

A newly installed HEPA filter in the reactor core vent line was placed too close to a high radiation detector. The detector, sensing radiation emitted from the argon-41 in the filter, initiated a ventilation system shutdown and scram. The problem was corrected by reducing the concentration of argon-41 in the core vent line. The reduction was accomplished by displacing much of the core air with dry nitrogen.

A momentary disruption of building power caused the reactor to shutdown during a student orientation run. The reactor was returned to power for the completion of the run.

A loss of power to the primary pump caused the reactor to shut down on a drop rods scram. The reactor was shut down until the defective pump relay could be isolated and replaced.

Reportable Incidents/Abnormal Occurrences

On June 30 during an initial approach to critical, the reactor operator was unable to take the reactor critical due to the constant engagement of the auto controller. The problem was traced to a failed diode in the inhibit surveillance circuit which is normally engaged by the auto control switch (see Section 3, Inhibit Surveillance Circuit).

## Section 3

## PREVENTIVE AND CORRECTIVE MAINTENANCE

The annual calibration and tests were completed by February first. The semi-annual calibrations of the radiation monitoring equipment were performed in January and July.

The maintenance performed on various reactor subsystems or components is summarized in the following paragraphs.

### Area Radiation Monitors

A remote indicating meter was incorporated into the calibration track which utilizes the south area monitor cable to facilitate the calibration process. Also a new high voltage modular power supply replaced the original power supply which had failed earlier and was being powered by an external power supply.

### Argon-41 Monitor

The Keithley model 640 vibrating reed electrometer failed, and had to be sent to an authorized Keithley repair center for repairs. The process took 5 months. A Keithley model 417 picoammeter was substituted for the model 640 in the interim. With the substitution of the Keithley 417 picoammeter for the Keithley 630 vibrating reed electrometer, an offset correction graph had to be constructed. Using the correction graph during the mid-year calibration of the system, agreement between the original calibration and the mid-year calibration was within 3%.

### Auxiliary Air Compressor

The reactor auxiliary air compressor's unloader and check valve were replaced with a Load Genie after the unit failed, which prevented

the unit from starting under load.

Secondary Effluent Monitor

The secondary effluent monitor required frequent adjustment primarily because it is very temperature sensitive. Control room air conditioning failure in the summer coupled with heater failure in the winter caused severe drifting of the zero setting. The frequency of handling the unit compounded the maintenance problem in the form of broken cables, and readjustments of the high voltage and the single channel amplifier.

Flow Meter Indicator

The primary and secondary flow meter indicator was disabled when a wire connected to the unit's function switch broke. The unit was repaired and returned to service after a thorough check.

High Radiation Monitor

What appeared to be a failure of the high radiation monitor turned out to be an actual reading of 25 mr/hr (see Section 2). The alarms were changed from the self resetting to the latched mode so that there would be no doubt as to what caused the ventilation shutdown. A second failure occurred as a result of a burned out fuse.

Inhibit Surveillance Circuit

During a prestart check, what appeared to be a failure of the Auto/Manual Circuit was traced to the failure of a coupling diode in the Inhibit Surveillance Circuit. The Radiation Use Committee recommended that the type of transient suppression previously incorporated into the rod drive circuits be provided in this circuit.

Log and Linear Chart Recorders

New chart drum and clutch assemblies were installed in both the linear and log chart recorders.

Primary Pump

Two unrelated failures of the primary pump system occured in consecutive order. The first involved the failure of the relay contacts that power the pump. Replacing the relay solved the problem. The second failure occurred when the coupling between the primary pump and the pump motor loosened resulting in a loss of primary flow. Reinstallation of the coupling corrected the problem.

Rod Position Indicators

Rod 4 position indicator stuck at 80% although the rod could continue driving up until the up limit light came on. Once the indicator was cleared, the unit worked properly. However, as a precaution, the entire circuit was checked out and a rod withdrawal and drop test was conducted before the system was declared operational. A ground wire failure on the Rod Position Indicator adjustment circuit which is mounted on a hinged door prevented the zeroing of all rod position indicators. Replacing the ground corrected the problem.

Start-up Channel

The lack of carry pulse from the unit's decade to the ten's decade was corrected by tube replacement in the Start-up Channel.

Temperature Recorder

Replacing a power tube in the servo amplifier of the temperature recorder caused the sluggish unit to function in a normal manner.

## Section 4

## FACILITY AND PROCEDURE CHANGES

The following changes were made for the year 1982.

Equipment:

1. The original Safety Amplifier was replaced by a Dual Linear Amplifier manufactured by General Atomic.

2. A running time meter connected to the magnet power circuit was installed in the console.

3. A closures scram point test circuit was installed in the log recorder to allow the operator to test the circuit without having to force the recorder above the 1 watt mark.

4. A HEPA filter was installed in the reactor core air extract line.

5. Pending the repair of the Keithley model 630 vibrating reed electrometer, a Keithley model 417 picoammeter was substituted for the model 630. A spare model 417 and the model 417 used as the reference channel were substituted as the system was refined to reduce the noise level. Five months later, with the repair of the model 630 completed by the Keithley authorized repair center, the argon-41 system was restored to its original configuration.

6. The Inhibit Surveillance and the Auto/Manual circuits were modified for transient protection as recommended by the Radiation Use Committee.

Procedures

1. The Radiation Use Committee approved the Calibration of the Argon-41 Monitor Procedure during its meeting of June 15.

## Section 5

## RADIOACTIVE MATERIAL RELEASES TO THE ENVIRONMENT

### Total Releases

The total releases of radioactive material to the environment for 1982 were as follows:

A. Gaseous: Ar-41, 27 Ci

B. Liquid: None

C. Solid: None

### Gaseous Effluents

The principal radioactive gaseous effluent as monitored in the building exhaust stack is argon-41. The actual concentration is determined by a 4.3 liter ion chamber which is calibrated in microcuries per milliliter versus ion current. This data is recorded on a strip chart recorder whenever the reactor is running. The data are periodically integrated using a compensating polar planimeter to obtain the total release.

The lower total release of radioactive gaseous emissions to the environment is attributed to two factors. The first being the decline by 23% of the total energy generated as compared with 1981. The second factor, the use of nitrogen gas as a sweep over the core to displace the air and hence the argon present in the atmosphere further reduced the emissions by another 20%.

Airborne radioactive particulate releases are monitored by a system that samples both the supply and exhaust air from the reactor room at the reactor room level (third floor, Boelter Hall). The system over-collects particulates relative to isokinetic sampling

(ANSI N13.1 - 1969, Table C1). The particulate filters are counted rountinely on a batch basis.

Equipment difficulties were experienced during the year, and actual fluctuations from week-to-week were appreciably larger than can be accounted for by counting statistics alone. This was true for both supply air and exhaust air. Of course some part of the fluctuations can be real and reflect seasonal changes, short period atmospheric variations, and earth moving construction effects that influence the amount of natural radioactivity collected by this kind of sampling.

A statistical analysis of the weekly data for 1982 yielded the following estimates of annual average concentrations:

$$C \text{ (exhaust)} = (5.3 \pm 2.0) \times 10^{-13} \ \mu Ci/cm^3$$

$$C \text{ (supply)} = (3.9 \pm 1.2) \times 10^{-13} \ \mu Ci/cm^3$$

$$\Delta C = (1.4 \pm 2.1) \times 10^{-13} \ \mu Ci/cm^3$$

## Section 6

## ENVIRONMENTAL SURVEYS

The reactor room is almost completely surrounded by a controlled buffer zone of limited access. The unrestricted public area is exterior to the laboratory boundary. Although environmental measurements (wipe tests and radiation surveys) are made within the reactor room, environmental surveying generally pertains to the buffer zone and the further regions beyond the laboratory boundary.

### Area Wipe Tests for Contamination

Weekly routine surveys for removable radioactive material from selected areas both inside and outside the controlled regions in areas having the greatest potential for contamination were performed. Results indicated that no discernible radioactive material cross-contamination was identified outside of the controlled areas.

### REACTOR SHIELD SURVEY

A complete area radiation survey (beta, gamma, and neutron) was conducted during a steady-state, full power operation on June 29th. This survey was taken with the normal biological radiation shielding in place. The biological shields have not been altered since the previous annual area survey. The survey was conducted by the campus Radiation Safety Officer assisted by the Reactor Supervisor. All results during full power operation were completely negligible. On top of the reactor, measurable gamma-ray levels were found that justified the continued use of radiation area signs. The only neutron signal was observed next to the thermal column. No significant radiation levels were found.

The survey report was subsequently misplaced or misfiled and is

now assumed to be lost. The preceding recollections are excerpted in part from correspondence to the NRC regarding the loss.

Area Film Badge

An environmental area film badge program is currently conducted in and around the NEL. In Calendar Year 1982 this program consisted of 27 film badges divided into one month and three month integrating periods and are located at strategic locations (see Table III) inside and outside of Boelter Hall, the Math Science Addition, and the NEL. There are two badges (which may be described as source badges) located inside the exhaust stack: one at the exhaust fan; and the other at the center of the exhaust exit. The location and issue schedule of the badges are described in Table III.

The films are Kodak Type 2 double emulsion, personal monitor film in filtered standard metal holders which are the same as those used in personnel beta-gamma monitoring.

The threshold detection levels for these films are:

| | | |
|---|---|---|
| X-ray | (<150 kev) | 10 mR |
| gamma | (>150 kev) | 20 mR |
| beta | | 20 mrad |

The film exposure is cumulative and a three month integration time will detect lower exposure rates (factor of three) than a one month integration time. The films are processed and read by UCLA's Radiation Safety Office.

Five of the badges were placed in offices or rooms of the MSA at the request of their occupants. Those badges are not part of any

## TABLE III

## LOCATION AND IDENTIFICATION OF BETA GAMMA AREA FILM BADGES

| FILM BADGE NUMBER | FILM BADGE LOCATION | AREA FILM BADGE LOCATIONS | ISSUE PERIOD |
|---|---|---|---|
| A. MATH SCIENCE ADDITION | | | |
| 2372 | MSA RM 8331 | INSIDE AIRSHAFT S-11 | 3 MO. |
| 2357 | MSA RM 7331 | INSIDE AIRSHAFT S-10 | 3 MO. |
| 2367 | MSA RM 6331 | INSIDE AIRSHAFT S-9 | 3 MO. |
| 2349 | MSA RM 5329 | INSIDE AIRSHAFT S-8 | 3 MO. |
| 3202 | MSA RM 5907 | MR. W. KEHL'S OFFICE (INNER) | 3 MO. |
| 2312 | MSA RM 5308 | MR. W. DRAIN'S OFFICE (OUTER) | 3 MO. |
| 2298 | MSA RM 4302B | MR. M. STEPHEN'S OFFICE (INNER) | 3 MO. |
| 2287 | MSA RM 4328C | COMPUTER AIR SUPPLY SHAFT | 3 MO. |
| 2374 | MSA RM 4328D | INSIDE AIRSHAFT S-6 | 3 MO. |
| 2395 | MSA RM 3940 | INSIDE AIRSHIPT S-4 | 3 MO. |
| 2268 | MSA RM 3901 | MR. ARCHER'S OFFICE | 3 MO. |
| 2378 | MSA RM 2334 | KEYPUNCH ROOM WINDOW | 3 MO. |
| 0834 | MSA RM 2334 | KEYPUNCH ROOM VENT INTAKE | 3 MO. |
| B. NUCLEAR ENERGY LABORATORY INCLUDING TOKAMAK RESEARCH AREA | | | |
| 0218 | BH RM 2001 | REACTOR CONTROL ROOM EAST WINDOW | 3 MO. |
| 0219 | BH RM 1005 | SAMPLE REFINING AND CONC. LAB | 3 MO. |
| 0220 | BH RM 2567 | NEL BUSINESS OFFICE BADGE RACK | 3 MO. |
| 0230 | BH RM 1561 | SHOP SOUTH OF R.H.B. | 3 MO. |
| 1581 | MSA RM 2000A | HEALTH PHYSICIST'S OFFICE | 1 MO. |
| 1914 | MSA RM 2000 | NEL CLASSROOM | 3 MO. |
| 1944 | BH RM 1000A | EAST WALL TAKAMAK LAB** | 1 MO. |
| 1951 | BH RM 1000A | WEST WALL TOKAMAK LAB** | 1 MO. |
| 1965 | MSA RM 1000B | EAST END HEAT TRANSFER LAB** | 3 MO. |
| 2048 | MSA RM 1000B | CENTER OF HEAT TRANSFER LAB | 3 MO. |
| 0203 | BH RM 8000 | INSIDE EXHAUST DOGHOUSE | 1 MO. |
| 0265 | BH RM 8000 | EXHAUST STACK EXIT GRILLE | 1 MO. |
| 0302 | BH RM 9000 | MATH SCIENCE INTAKE DUCT | 1 MO. |
| C920 | BH RM 8000 | SOUTH OF REGION 1 TOWARD 8500 BH | 1 MO. |

official program; they are at locations requested by the occupants. All badges so placed showed no measurable radiation. These results are consistent with those from prior years.

The results of the 1982 area film badge program are shown in Table IV. Area badges in the MSA were placed in airshafts or intake ducts in locations generally inaccessible to the public, but chosen to monitor the air supply. Badges so placed in years past have shown no detectable radiation.

## Section 7

## Personnel Dosimetry

The personnel dosimetry program is administered by the UCLA Radiation Safety Office. Film badges for beta-gamma exposure and thermoluminescent dosimeters, for fast neutrons as appropriate, were issued to personnel who were occupationally exposed to ionizing radiation. Nineteen faculty and staff members in the NEL and ten students enrolled in ENG 135A were included in the personnel dosimetry program. A review of the supporting records for the dosimetry program indicated that whole body occupational exposures were in conformance with the applicable limits of Title 10, Code of Federal Regulations, Part 20.

TABLE IV

QUARTERLY AREA FILM BADGE EXPOSURES - 1982

| Film Badge Number | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|
| 2372 | 0 | 0 | 0 | 0 |
| 2357 | 0 | 0 | 0 | 0 |
| 2367 | 0 | 0 | 0 | 0 |
| 2349 | 0 | 0 | 0 | 0 |
| 3202 | 0 | 0 | 0 | 0 |
| 2312 | 0 | 0 | 0 | 0 |
| 2298 | 0 | 0 | 0 | 0 |
| 2287 | 0 | 0 | 0 | 0 |
| 2374 | 0 | 0 | 0 | 0 |
| 2395 | 0 | 0 | 0 | 0 |
| 2268 | 0 | 0 | 0 | 0 |
| 2378 | 0 | 0 | 0 | 0 |
| 0834 | 0 | 0 | 0 | 0 |
| 0218 | 0 | 0 | 0 | 0 |
| 0219 | 0 | 0 | 0 | 0 |
| 0220 | 0 | 0 | 0 | 0 |
| 0230 | 0 | 0 | 0 | 0 |
| 1581 | 0 | 0 | 0 | 0 |
| 1914 | 0 | 0 | 0 | 0 |
| 1944 | 85* | 20* | 70* | 35* |
| 1951 | 55* | 95* | 460* | 95* |
| 1965 | 0 | 0 | 80* | 0 |
| 2048 | 0 | 0 | 80* | 0 |
| 0203** | 0 | 0 | 0 | 0 |
| 0265** | 408 | 0 | 0 | 0 |
| 0302 | 0 | 0 | 0 | 0 |
| 0820 | 0 | 0 | 0 | 0 |

* These films reflect Tokamak operation

** These films showed no gamma radiation responses as they are located in the reactor exhaust stack main airstream before dispersion. These values are beta responses.

UNIVERSITY OF CALIFORNIA, LOS ANGELES

UCLA

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

SANTA BARBARA · SANTA CRUZ

COMMUNITY SAFETY DEPARTMENT
OFFICE OF RESEARCH & OCCUPATIONAL SAFETY
LOS ANGELES, CALIFORNIA 90024

22 June 1983

Mr. Hal Bernard, Acting Chief
Standardization and Special Projects Branch
Division of Licensing
USNRC
Washington, D.C. 20555

Docket 50-142
License R-71

Dear Mr. Bernard:

Enclosed are two copies of the UCLA Nuclear Energy Laboratory Annual Report for 1982, covering the period from January 1, 1982 through December 31, 1982. Two copies have also been sent to the Director of Region V.

Sincerely,

Neill C. Ostrander for

Walter F. Wegst, Director
Office of Research & Occupational Safety

WFW/jb

enc.

A020
1/1