SCHOOL OF
ENGINEERING
& APPLIED SCIENCE

NUCLEAR REACTOR FACILITY
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UVAR and CAVALIER Reactor Annual Report

March 26, 2001

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington D.C.
20555-0001

SUBJECT: Combined year 2000 Annual Report for the University of Virginia Reactor (UVAR), Docket No. 50-62, License R-66; and the CAVALIER Reactor, Docket No. 50-396, License R-123.

Gentlemen:

Please find in attachment the combined year 2000 annual report on reactor operations for the UVAR and CAVALIER reactors at the University of Virginia Reactor Facility. As required by UVAR and CAVALIER Technical Specification 6.7.2, the period January 1, 1999 through December 31, 1999 is covered.

Sincerely,

Robert U. Mulder, Director
University of Virginia Nuclear Reactor Facility

City/County of Albemarle
Commonwealth of Virginia
I hereby certify that the attached document is a true and exact copy of a letter (type of document), presented before me this 26th day of March, 19 2001, by Robert Mulder (name of person seeking acknowledgement).

Notary Public

My commission expires 02/28, 19 2002

Encl: University of Virginia Reactor Facility year 2000 Annual Report

Cc: Mr. Craig Bassett, Inspector, U.S. Nuclear Regulatory Commission, Region II, 61 Forsyth St. S.W., Suite 23T85, Atlanta, Ga. 30303

Mr. Alexander Adams, Project Manager, U.S. Nuclear Regulatory Commission, Mail Stop 012-D3, Washington D.C., 20555-0001

Mr. Gary Uricchio, American Nuclear Insurers

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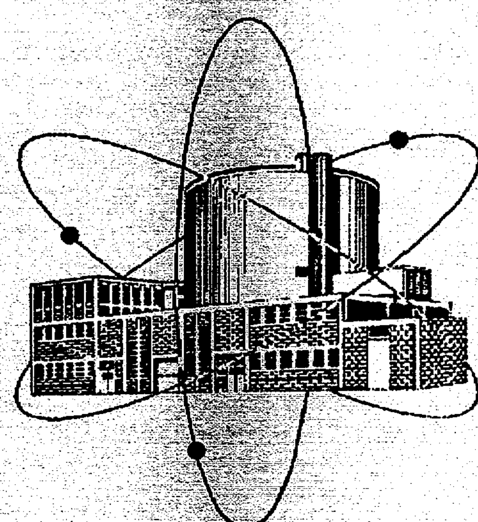

2000
ANNUAL REPORT

UNIVERSITY
OF
VIRGINIA

REACTOR FACILITY

2000
ANNUAL REPORT

This report was compiled by the following personnel:

Section IV, Health Physics	-	Deborah Steva, Reactor Health Physicist
All other sections	-	Paul Benneche, Reactor Supervisor

and reviewed and approved by the Reactor Decommissioning Committee on March 19, 2000

2000 ANNUAL REPORT
UNIVERSITY OF VIRGINIA REACTOR FACILITY

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2000 ANNUAL REPORT
University of Virginia Reactor Facility

I. INTRODUCTION

A. Reactor Facility Reporting Requirements

1. Reporting Period

This report on Reactor Facility activities during 2000 covers the period January 1, 2000 through December 31, 2000.

2. Basis for Reporting

An annual report of reactor operations is required by the UVAR Technical Specifications, Section 6.7.2.

B. Reactor Facility Description

The University of Virginia Research Reactor (UVAR) was operated from June 1960 through June 1998. The Administration of the University of Virginia School of Engineering and Applied Science, with the approval of the University's Board of Visitors, decided in early 1998 to permanently cease reactor operations as of July 1, 1998 and to begin the process of decommissioning the Reactor Facility.

The Reactor Facility is located on the grounds of the University of Virginia (UVA) at Charlottesville, Virginia and is administratively a part of the Office of the Vice President for Research and Public Service. The Facility houses the two megawatt UVAR and the Cooperatively Assembled Virginia Low Intensity Educational Reactor (CAVALIER), a 100 watt training reactor, which was shut down in 1988 and is also awaiting decommissioning. The Facility also has a hot cell facility, several laboratories with fume hoods and a counting room with gamma spectroscopy analysis systems and low background alpha-beta counters.

1. 2 MW UVAR

The UVAR is a light-water cooled, moderated and shielded type reactor that first went into operation at a licensed power level of one megawatt in June 1960, under license No. R-66. In 1971, the authorized power level was increased to two megawatts. In September 1982 the operating license for the UVAR was extended for 20 years. The UVAR was converted to low enriched uranium (LEU) fuel during 1994. The UVAR was last operated on June 30, 1998. The fuel elements used in the reactor were moved from the reactor gridplate to storage locations on the bottom of the reactor pool on September 3, 1998. The four control rod elements used in the reactor were shipped to the Savannah River Laboratory (SRL) in late 1998 and the remaining used fuel elements were shipped to SRL in two shipments in 1999. Unused low enriched uranium fuel elements were shipped in June 2000 to the manufacturer, Babcock and Wilcox.

2. 100 W CAVALIER

The CAVALIER first went into operation in October 1974, under license R-123, at a licensed maximum power of 100 watts. The reactor was built to accommodate reactor operator training and performance of experiments for undergraduate laboratory courses. The operating license was renewed in May 1985, for a period of 20 years. A dismantlement plan was submitted in November, 1987 to the U.S. Nuclear Regulatory Commission (NRC). The NRC requested a decommissioning plan, and this was submitted early in 1990. An order to decommission was issued by the NRC on February 3, 1992. The CAVALIER is now scheduled to be decommissioned concurrently with the UVAR.

3. Past Operating History

a. UVAR

The UVAR operating history is shown in Table 1.

TABLE 1		
Operating History of University of Virginia Reactor		
Year(s)	Megawatt-hours	Hours Operated
1960-1970	3,960	4,500
1971-1975	1,654	1,800
1976-1978	1,769	1,480
1979-1980	9,036	5,627
1981	4,988	3,568
1982	5,507	3,024
1983	6,079	3,556
1984	5,687	3,166
1985	927	718
1986	1,330	891
1987	1,220	801
1988	910	621
1989	1,378	869
1990	1,837	1,087
1991	2,360	1,365
1992	2,428	1,450
1993	2,663	1,533
1994	1,594	1,016
1995	1,703	1,079
1996	1,741	1,083
1997	1,954	1,230
1998 (to 7/1)	686	437
7/1/98 to present	shutdown	shutdown
Lifetime Totals	**61,411**	**40,901**

From 1960 until 1994 the UVAR operated using HEU fuel. The first full power operation with LEU fuel was on May 12, 1994.

b. CAVALIER

The CAVALIER operating history is shown in Table 2.

TABLE 2		
Operating History of CAVALIER		
Year(s)	Watt-hours	Hours Operated
1974-1980	2,128	758
1981-1985	1,278	388
1986	147	37
1987	28	29
1988-present	shutdown	shutdown
Lifetime Totals	**3,581**	**1,212**

For about 13 years the CAVALIER was used primarily for reactor operator training and undergraduate lab experiments. The last date of operation was August 4, 1987. The CAVALIER fuel and start-up source were unloaded on March 3, 1988. A decommissioning plan was submitted to the NRC in January, 1990. An order to decommission was issued by the NRC on February 3, 1992. Decommissioning will be conducted at the same time as the UVAR.

4. Summary of 2000 Reactor Utilization

The UVAR and CAVALIER have been permanently de-fueled and were not operated in 2000.

5. Special Facilities

The following facilities were operated in connection with the UVAR while it was in operation:

Two neutron beam ports, eight-inch diameter entrance, 10 inch at the exit.

Two access ports (6 ft x 4 ft). One port is currently configured for a high energy photon beam, and the other port for a neutron beam.

Hydraulic rabbit, for activation analysis, permitting samples with less than 0.69 inch diameter and 6 inch length.

Two pneumatic rabbit facilities, for activation analysis and source production, permitting sample diameters of one inch and length not exceeding 2.3 inches. One facility is for irradiation with thermal neutrons and the other is cadmium-lined for the use of epithermal neutrons.

Solid gel irradiator for electrophoresis.

Epithermal neutron Mineral Irradiation Facility (MIF).

Small Animal Irradiation Neutron Tube (SAINT), for irradiating mice in conjunction with Boron Neutron Capture Therapy experiments.

A rotating irradiation facility (RIF) used to equalize neutron fluence during irradiation of a large number of specimens.

Epithermal neutron irradiation facilities with heaters for temperature control.

Cobalt-60 gamma irradiation facility with 1,800 curies. Currently stored in a lead shipping / storage container in the Facility's hot cell.

Depleted uranium subcritical facility. Shipped to Oak Ridge National Laboratory in March 2000.

Small hot cell, (10 ft x 6 ft x 12.5 ft high) with remote manipulators, currently housing 1,800 Ci of Co-60 in a lead storage / shipping cask.

Machine and electronic shops.

Several radiochemistry labs, with counters and standard lab equipment.

Low-background counting room with shielded, solid state germanium and silicon detectors and computerized data acquisition/analysis system.

C. Reactor Staff Organization

1. Operations Staff

A NRC approved Reactor Facility organization chart is shown in Figure 1. Personnel on the reactor staff as of the end of 2000 were:

RU. Mulder . . Reactor Director
P.E. Benneche . Reactor Supervisor (SRO)
V.S. Thomas . . Reactor Facility Secretary

2. Health Physics Staff at the Facility

D.P. Steva . . . . Reactor Health Physicist

Other personnel from the Office of Environmental Health and Safety assisted with work at the Reactor on an as needed basis.

3. Reactor Safety Committee

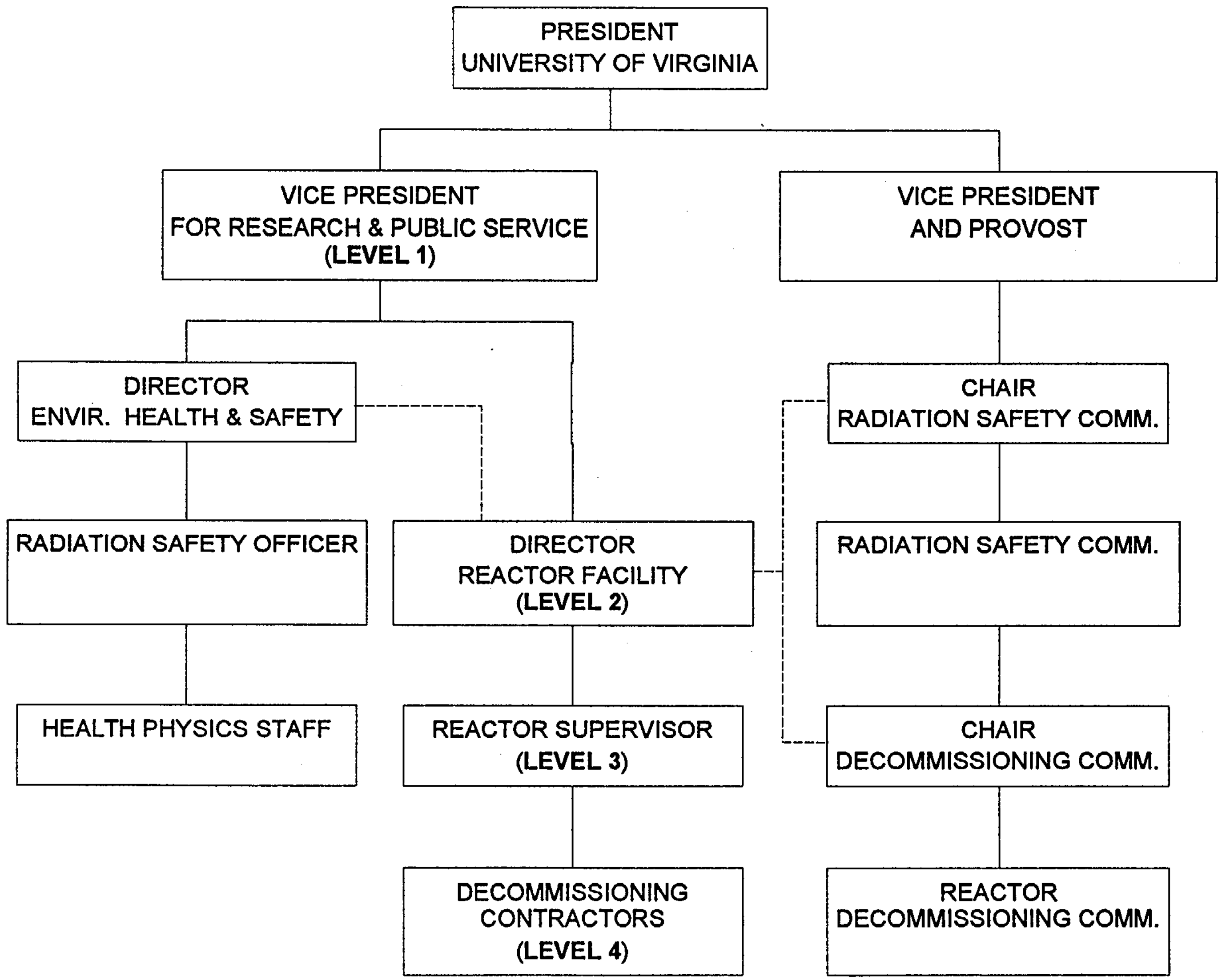
The Reactor Safety Committee (ReSC) was composed of the following individuals. The final meeting of this committee was October 27, 2000. Many of the responsibilities of the ReSC were at this time assumed by the Reactor Decommissioning Committee.

W.R. Johnson . .	Professor Emeritus, Nuclear Engineering (Chair)
R.A. Rydin . . .	Associate Professor, Nuclear Engineering
R.U. Mulder . . .	Reactor Director & Assoc. Professor, Nuclear Engineering
R.G. Piccolo . . .	University Radiation Safety Officer
D.P. Steva	Radiation Safety Specialist, UVA Office of Environmental Health & Safety

4. Reactor Decommissioning Committee

The Reactor Decommissioning Committee was composed of the following individuals (as of the end of 2000):

R.O. Allen	Director of UVA Office of Environmental Health and Safety & Professor of Chemistry (Chair)
R.U. Mulder . . .	Reactor Director & Assoc. Professor, Nuclear Engineering
R.G. Piccolo . . .	University Radiation Safety Officer
H.N. Wadley . .	Associate Dean for Research, School of Engineering and Applied Science & Professor, Materials Science
Ex-Officio	
P.E. Benneche .	UVA Reactor Supervisor
D.P. Steva	Radiation Safety Specialist, UVA Office of Environmental Health and Safety



—— reporting lines
- - - communications lines

FIGURE 1
ORGANIZATIONAL CHART
UNIV. OF VIRGINIA NUCLEAR REACTOR FACILITY
(AFTER SHIPMENT OF ALL FUEL ELEMENTS OFF-SITE)

II. REACTOR OPERATIONS

A. UVAR

1. Core Configurations

The reactor employed three boron-stainless steel safety rods and one stainless steel regulating rod for fine power control. The fuel elements were of the Materials Test Reactor (MTR) flat-plate type utilizing U_3Si_2. The fuel was approximately 19.7% enriched in the U-235 isotope. The fully loaded elements had 22 fuel plates per element, with an initial loading of approximately 275 grams of U-235 per element. The control rod elements and partial fuel elements had 11 fueled plates with an initial loading of approximately 137 grams U-235 per element.

The spend reactor fuel was permanently unloaded from the reactor gridplate and placed in storage racks at the bottom of the pool in September of 1998. This fuel was shipped to the SRL Plant in 1998 and early 1999.

2. Standard Operating Procedures (SOP)

During 2000, several changes were made to Chapter 10, Radiation Protection, of the UVAR standard operating procedures. The Reactor Safety Committee reviewed and approved these changes.

3. Surveillance Requirements

The following surveillance items were completed during 2000 as required by Section 4.0 of the Technical Specifications:

a. Rod Drop Tests and Visual Inspection

The control rod drive mechanisms and the control rods were removed from the control rod elements at the same time that the core was permanently unloaded in September of 1998. The UVAR Technical Specifications were modified with NRC approval to remove the requirement for rod drop testing. Consequently, rod drop times were not measured in 2000.

In the past rods had been visually inspected annually for physical integrity. This stopped being a requirement in the Technical Specifications when all fuel in the reactor pool had been shipped off-site.

b. Tests and Calibrations

Data on these tests and calibrations are on file at the Facility.

1) <u>Monthly</u>

Monthly operational checks of the ventilation duct, personnel door, truck door and emergency exit cover are no longer required.

Health Physics surveys of the Reactor Building are completed monthly.

2) <u>Quarterly</u>

There should be quarterly checks of the contents of the emergency equipment lockers and other emergency equipment. These checks were not completed in 2000 as noted in NRC Inspection Report No. 50-62/2001-201 and Notice of Violation, dated January 25, 2001. These checks will be completed as required, as noted in UVA's Reply to Notice of Violation, dated February 23, 2001.

3) <u>Semi-Annually</u>

Visual inspection of gaskets on the UVAR confinement personnel door, ventilation duct and truck door are no longer required.

The calibration checks of the fixed instrumentation which was used in conjunction with reactor operation are no longer required now that all reactor fuel has been shipped off-site.

Criticality monitoring instrumentation outside the fuel storage room continues to be used and calibrated.

3) <u>Annually</u>

The emergency cooling system test was discontinued in 2000 because no fuel remained stored in the UVAR pool. UVA received approval from the NRC) for the deletion of this TS requirement prior to the test due date (15 months from the previous test).

Instrumentation used in conjunction with health physics measurements are calibrated annually. This includes portable instrumentation, hand and foot monitor, alpha-beta low background counters and portable air samplers.

4) <u>Daily Checklist</u>

Daily checklists were not completed in 2000 because the reactor had been permanently unloaded and was not operated during the year.

5) <u>Reactor Pool Water Quality</u>

The Technical Specifications requiring a certain level of pool water quality were deleted when all reactor fuel was removed from the pool

and shipped off-site. The pool water quality is still being maintained at a high degree of purity but there are no specific quality standards or measurement requirements.

6) Core Configuration Changes

The UVAR core configuration was not modified during 2000 since the core had been permanently unloaded on September 3, 1998.

7) Communication Checks

The security system and emergency communications with the University Police and Charlottesville-Albemarle Fire Department were checked on a weekly basis throughout the year. These checks confirmed the availability of systems and communication equipment.

4. Maintenance

No corrective maintenance or repairs of any significant consequence was performed on any UVAR system during the calendar year 2000.

5. Unplanned Shutdowns

The UVAR was not operated in 2000 and therefore there were no unplanned reactor shutdowns.

6. Pool Water Make-up

During the year, the daily makeup of water to the reactor pool averaged 265 gallons for a total of 96,700 gallons during the year. The makeup replaced water evaporated at the pool surface and leaked from the pool. Since the reactor ceased operations the estimated leak rate has increased. However, the activity of the pool water is greatly reduced. The only isotope above MDA is tritium, and its concentration is a couple of orders of magnitude below the release limit.

7. Fuel Shipments

a. Fresh Fuel

No fresh fuel was received at the facility in the year 2000. The total on-hand inventory of 13 new LEU fuel elements at the facility was shipped to BWXT in Lynchburg, Virginia on June 6, 2000.

b. Spent Fuel

In November 1998, the four control elements used in the UVAR were shipped to the Savannah River Laboratory in South Carolina. An amendment to the Certificate of Compliance for the shipping cask was necessary to permit

shipment of regular LEU fuel, and once accomplished, the remaining 16 regular elements were shipped in two shipments in early 1999.

8. Personnel Training and Instruction

a. Reactor Facility Staff

At the end of 2000 the reactor staff consisted of a total of three individuals. Only one of these individuals was a licensed reactor operator. The Reactor Supervisor possessed a senior reactor operator (SRO) license, which was terminated at his request in November 2000. Since the reactor is no longer operated, and there is no reactor fuel at the facility, there is no longer a need for the facility to have any licensed individuals. The other two employees were the Reactor Director, a faculty member who serves as Director on a half-time basis, and the department secretary.

No licensed activities were conducted, nor could be conducted, during the year since the reactor was permanently shutdown and all used reactor fuel had been shipped off-site. Consequently, no requalification training specifically required for licensed individuals was conducted. Required training and re-training was conducted in the subject areas of health physics, emergency procedures and security procedures.

9. Reactor Tours

During the calendar year 2000, the staff guided two tour groups along with a small number of individual tours of the Facility (see Health Physics section).

B. CAVALIER Reactor

1. Reactor Shutdown

The reactor was permanently unloaded of fuel during the first week of March, 1988. A decommissioning order was issued by the NRC on February 3, 1992. The decommissioning should be at least started, and likely will be completed, in the year 2001, along with the UVAR decommissioning.

III. REGULATORY COMPLIANCE

A. Reactor Safety Committee

1. Meetings

During 2000, the Reactor Safety Committee met two times, on the following dates:

April 27, 2000 October 27, 2000

The Technical Specifications require the committee to meet at least twice each year. As dictated by recently approved changes to the Technical Specifications, the Reactor Safety Committee was dissolved following the October 27 meeting. With all reactor fuel elements having been shipped off-site, the Reactor Decommissioning Committee will now be the oversight organization for activities at the Reactor.

2. Audits

During the year a sub-committee of the Reactor Safety Committee performed one audit of the Facility records. An audit of Operations Related Programs (QA/QC Program, Experimental Procedures and Methods and Reactor Operator Requalification Program) for the period November 1997 through October 1999 was completed by Messrs. Johnson and Mulder on January 31, 2000. A response to this audit was written by Mr. Benneche, dated April 26, 2000.

3. Approvals

During 2000, the Reactor Safety Committee approved changes to standard operating procedures as well as reviewing other documents:

February 2000:	UVAR Decommissioning Plan approved for submission to the NRC.
March 2000:	Change to UVAR SOP 10.4.B.2,
March 2000:	Approved 1999 Facility Annual Report for submission to NRC.
May 2000:	Approved procedures to ship unused fuel elements to BWXT in Lynchburg, VA.

4. 10 CFR 50.59 Reviews

During 2000 there were no 10CFR50.59 analyses.

B. Reactor Decommissioning Committee

1. Meetings

During 2000, the Reactor Decommissioning Committee met approximately monthly.

C. Inspections

1. During 2000 there were no NRC compliance inspections of the Facility.

D. Licensing Action

1. A possession-only amendment to the UVAR license (#25) was issued by the NRC in February 2000.

2. The Decommissioning Plan for the UVAR was submitted for approval to the NRC in February 2000. As of March 2001 this plan is still being reviewed by the NRC.

E. Emergency Preparedness

1. On December 7, 2000, the annual emergency drill for the calender year 2000 was initiated at the facility. The drill involved a simulated injured and possibly radioactively contaminated member of the Reactor Staff.

IV. HEALTH PHYSICS

A. Personnel Dosimetry

1. Visitor Exposure Data For 2000

During 2000, there were 51 visitors who toured at the Reactor Facility. Of these visitors, 32 were visitors in tour groups. Additionally, there were 438 other "sign-ins" of unbadged individuals at the Reactor for either work or meetings. The highest dose received in any single visit was one mrem.

2. Reactor Facility Personnel Dosimetry Data For 2000

a. Monthly Whole Body Badge Data

Radiation doses received by Reactor Facility personnel were measured using Landauer film badge dosimeters. These dosimeters measured exposure from beta, X, gamma and thermal neutron radiation. Following the final spent fuel shipment and removal of the Co-60 pins from the pool, the number of people requiring dosimetry was reduced. In addition, only individuals authorized to use the neutron emitting sealed sources present at the facility were issued neutron dosimeters. The neutron dosimeters used were Landauer Neutrak ER badges that allowed detection of an extended range of neutron energies. All dosimeters were changed out on a monthly basis.

The dose distribution for personnel badged at the Reactor Facility during the period January 1, 2000 through December 31, 2000 is shown in Table 3.

TABLE 3

2000 Personnel Radiation Doses Received at Reactor Facility

Measured Accumulated Deep Dose Equivalent* (mrem)	Number of Individuals in Dose Range
Less than 10 (M)	15
10 - 20	3
21 - 30	1
31 - 40	0
41 - 50	0
51 - 100	0
101 - 500	0
Greater than 500	0

Number of badged personnel: 19 persons

Collective dose for this group: 0.060 rem

* Deep dose equivalent (DDE) as measured by "whole body" film badge dosimeters. These dosimeters have a detection minimum of 10 mrem for gamma, X-rays and thermal neutrons and 40 mrem for energetic beta particles.

During 2000, no doses exceeded the UVA ALARA Investigational Level 1 of 125 mrem per quarter.

b. Neutron Exposures

Four (4) Facility personnel were issued Neutrak ER neutron badges in 2000. The neutron dose distribution for this group is shown in Table 4.

TABLE 4	
2000 Personnel Neutron Doses at the Reactor Facility	
Measured Accumulated Deep Dose Equivalent (mrem)	Number of Individuals in Dose Range
Less than 20 (M)	3
20 - 30	1
Greater than 30	0
NOTE: These dosimeters have a minimum reporting dose of 20 mrem.	

c. Extremity Exposures

During 2000, four (4) Facility personnel were issued TLD ring badges in addition to their whole body badges. The following is a summary of the extremity doses received by Reactor Facility personnel who wore ring badges during the period January 1, 2000 through December 31, 2000.

TABLE 5	
2000 Personnel Extremity Doses at the Reactor Facility	
Measured Accumulated Extremity Dose (mrem)	Number of Individuals in Dose Range
Less than 30	3
30 - 40	1
41-1250	0
1251 - 5,000	0
Greater than 5,000	0
NOTE: These dosimeters have a minimum reporting dose of 30 mrem for X and gamma-rays and 40 mrem for energetic beta particles.	

During 2000, there were no individuals who received doses (extremity) that exceeded the UVA ALARA Investigational Level 1 of 1250 mrem/qtr.

d. Direct-reading Dosimeter Exposures

Direct-reading dosimeters (in addition to whole body film badges) are worn by UVAR personnel when they handle irradiated material that has a calculated or measured exposure rate of greater than 100 mR per hour, measured at one foot from the source. If the exposure totals more than 5 mR in one day, the exposure is recorded in an exposure log kept in the control room. This information is helpful in assessing the amount of exposure received during specific operations. There were no exposures recorded in the log book during 2000.

B. Effluents Released During 2000

1. Airborne Effluents

The reactor was not operated in 2000 and no airborne radioactivity areas were created in the facility during this time. Consequently, there were no airborne releases from the Reactor Facility.

2. Liquid Effluents

Liquid radioactive waste generated at the UVAR is disposed of by one of two means. Liquid waste generated in the research laboratories is poured into approved containers that are collected and disposed of by the Office of Environmental Health and Safety. Liquid waste from regeneration of the UVAR demineralizer system is collected in three 2,250 gallon tanks on the ground floor of the Facility. In 2000, water from the outside fuel transfer tank was also transferred to the ground floor waste tanks for disposal to the sanitary sewer. The liquid waste collected in these tanks was released to the sanitary sewer in accordance with 10 CFR 20 requirements.

In unusual situations, (e.g. draining of the reactor pool, pool leaks, sink drain disposal), an onsite pond may receive radioactive liquid discharges from the facility. The major sources of water in the pond are surface runoff and a creek that flows into it from the west end. Water is periodically released from the pond in a controlled manner via a spillway. A small amount of pond water routinely leaks through the pond spillway to the release standpipe at an average rate of 4.0 gallons per minute. As this is considered release of pond water, the volume and activity released via this pathway was included in the 2000 liquid release totals.

During 2000 there were 13 releases of pond water and five releases to the sanitary sewer. (See Table 6) Prior to, and during all liquid releases, water samples are collected and analyzed for radioactivity content. The average concentration of radioactive material (as measured by gross beta particle activity analysis) released in effluent from the UVAR pond was 3.9 E-9 μCi/ml. The concentration was 13% of the UVAR administrative release limit and was approximately the same as the average concentration of radioactive material measured in the water upstream of the pond, 4.0 E-9 μCi/ml. The average tritium concentration in effluent released from the pond

was less than the LLD of 7E-7 µCi/ml. The total volume of liquid released off-site from the pond was 20,400,000 liters (5,401,000 gallons). The total activity (excluding tritium activity) in this volume was 106 µCi. This activity was primarily from naturally occurring radionuclides deposited in the pond by the feeder creek mentioned above.

The total volume of wastewater released to the sanitary sewer was 36,900 liters. The total tritium activity released to the sanitary sewer was 641 µCi. The total of all other radionuclides released to the sewer was 272 µCi. All radionuclides released to the sanitary sewer were in concentrations that were less than 15 % of their individual EC limits.

TABLE 6	
Liquid Effluent Releases Sampling Results	
Release No.	Pond Water *Avg. Gross Beta Particle Activity (excluding Tritium) ($x10^{-8}$ µCi/ml ± 2 s.d.)
1	0.4 ± 0.5
2	0.4 ± 0.1
3	< LLD
4	0.4 ± 0.1
5	0.3 ± 0.1
6	0.1 ± 0.03
7	0.8 ± 0.8
8	0.3 ± 0.1
9	0.3 ± 0.6
10	0.6 ± 0.2
11	0.5 ± 0.2
12	0.4 ± 0.1
13	0.3 ± 0.1
Average ± 2 s.d. =	**0.4 ± 0.2**

* Three samples are collected during the release. Number reported is the average (or mean) of the three samples and ± 2 s.d. of this mean.
A priori LLD: 0.3 x 10^{-8} µCi/ml

TABLE 7 2000 Sewer Release Data µCi/ml					
Nuclide	Release #1 (% of Release Limit*)	Release #2 (% of Release Limit)	Release #3 (% of Release Limit)	Release #4 (% of Release Limit)	Release #5 (% of Release Limit)
H-3	2.4 E-6 (0.02)	<7 E-7	2.7 E-5 (.3)	2.8 E-6 (0.3)	<7 E-7
Mn-54	5.2 E-8 (0.02)	5.3 E-8 (0.02)	6.9 E-8 (0.02)	6.7 E-8 (0.02)	4.6 E-8 (0.02)
Co-60	1.4 E-7 (0.5)	1.9 E-7 (0.6)	2.6 E-7 (0.9)	2.7 E-7 (0.9)	2.9 E-7 (1.0)
Cs-137	8.8 E-7 (8.8)	1.3 E-6 (13)	1.1 E-6 (11)	1.2 E-6 (12)	1.2 E-6 (12)
Cs-134	2.5 E-8 (0.3)	2.6 E-8 (0.3)	2.3 E-8 (0.3)	2.0 E-8 (0.2)	2.0 E-8 (0.2)
Ag-108m	ND	ND	ND	1.2 E-8 (.01)	8.6 E-9 (.01)

ND - Not detected

* Release Limit - 10CFR20 Appendix B, Table 3

3. Solid Waste Shipments

There were no shipments of low level radioactive waste from the reactor facility in 2000.

C. Environmental Surveillance

1. Water Sampling

Environmental water samples were collected on a monthly basis from the locations indicated in Table 8. Gross beta particle activity analysis was performed on all water samples collected. The results of the analyses are provided in Table 8. The average gross beta particle activity measured at each location was less than the UVAR Administrative Effluent Concentration Release Limit of 3×10^{-8} μCi/ml.

TABLE 8

Environmental Water Sampling Results

Gross Beta Particle Activity ($\times 10^{-8}$ μCi/ml $\pm$ 2 sigma)

	Upstream of on-site pond	Water filtration plant 0.26 mi. southeast	Meadow Creek near Barracks Road, 1.8 mi northeast (2 samples collected short distance apart on creek, results are averaged)
January	0.1 ± 0.2	< LLD	0.03 ± 0.1
February	0.3 ± 0.2	0.1 ± 0.1	0.3 ± 0.1
March	0.2 ± 0.2	< LLD	0.3 ± 0.2
April	0.4 ± 0.2	< LLD	0.4 ± 0.1
May	0.4 ± 0.3	<LLD	0.2 ± 0.1
June	1.4 ± 0.3	0.7 ± 0.2	0.6 ± 0.6
July	0.5 ± 0.2	< LLD	0.7 ± 0.4
August	0.3 ± 0.2	< LLD	0.3 ± 0.5
September	0.2 ± 0.2	0.1 ± 0.2	0.1 ± 0.1
October	1.3 ± 0.2	0.3 ± 0.1	0.6 ± 0.04
November	0.1 ± 0.2	< LLD	0.3 ± 0.3
December	0.3 ± 0.2	0.1 ± 0.1	0.1 ± 0.03
Avg±2 s.d.	**0.4 ± 0.6**	**0.3 ± 0.5**	**0.3 ± 0.4**

A priori LLD: 0.3×10^{-8} μCi/ml

2. Air Sampling

During 2000, there were no activities which generated airborne radioactivity. No air samples were required to be collected in the facility or the environment surrounding the facility. Air sampling equipment does, however, continue to be calibrated and maintained in operating condition for use on an as needed or emergency basis.

3. Environmental TLD Network

Thermoluminescent dosimeters (TLDs) are mounted at eight fixed field sites in the vicinity of the UVAR. All of the sites are outside the UVAR facility but within the area surrounding the facility that is bounded by the exclusion fence. The dosimeters are changed out and read on a quarterly basis. At several locations, Aluminum Oxide (Al_2O_3) dosimeters are in place alongside the TLDs. Table 9 shows the doses recorded by the dosimeters. The doses measured by the Al_2O_3 dosimeters are shown in parentheses beside the dose measured by the TLDs. In the 2nd quarter, the minimum detection limit changed from 10 mrem to 1 mrem for gamma and x-rays. In the 3rd quarter of 2000, the TLDs and aluminum oxide dosimeters were replaced with the new Luxel aluminum oxide dosimeter developed by Laundauer. These dosimeters have a minimum reporting limit of one mrem. The annual total dose measured at each location was less than the annual dose limit of 100 mrem.

TABLE 9

2000 Environmental Surveillance - Outside Area TLD Network
Deep Dose Equivalent (mrem) For Periods Shown Below

Location	1st Quarter*	2nd Quarter	3rd Quarter	4th Quarter	Annual Total	Annual Net **
280	50*(1.6)	2 (7.2)	15	17	84	44
281	60 (5.2)	4 (17.4)	14	18	96	56
282	60 (10.8)	6 (17.3)	13	13	92	56
283	50 (3.6)	M (10.5	10	15	75	35
284	60	2	15	18	95	55
285	50	M	10	7	67	27
286	59 (-8.4)	M (-0.7)	5	M	55	15
287	50	M	6	9	65	25
Control	40	M	M	M	40	Control
Control	40	M	M	M	40	Control

* No control was subtracted from any of the 1st quarter badges
M mininum detection limits: For TLD: 10 mrem for gamma and x-rays
For Luxel Al_2O_3 dosimeters: 0.02 - 0.03 mrem
** Annual Net = Annual Total = Average Control Annual Total

D. UVAR Facility Health Physics Surveys

1. Radiation and Contamination Surveys

Monthly surveys were performed throughout the Facility to monitor radiation and contamination levels. All required area radiation and contamination surveys were performed during 2000.

The levels of contamination detected in the Facility during 2000 were generally very low (typically less than 50 dpm/100 cm^2). In keeping with the ALARA policy, most areas are decontaminated if found to have greater than 50 dpm/100 cm^2. The area radiation level surveys revealed no overall increase in background or systems-related radiation levels.

E. Quality Assurance

For quality control proposes the UVAR submitted three split samples to an independent laboratory for analysis. The results obtained by the laboratory were compared to results obtained by the UVAR. There was fairly good agreement of results with the exception of activities measured for Mn-54 and Co-60. The Co-60 measured by the UVAR may be higher due to the fact that none of the UVAR analyses had background subtracted. Historically, background spectrum obtained in the UVAR counting room has contained quantities of Co-60.

TABLE 10

Results of Radioactivity Measurement Inter-Comparison Analyses

Date	Study	Isotope	UVA reported value* pCi/l	Teledyne value pCi/l
4-4-2000	Pre-Release Sample from Waste Tank	Be-7	NRP	<60
		Mn-54	65	<4
		Co-58	NRP	<4
		Fe-59	NRP	<8
		Co-60	260	25.3 ± 3.6
		Zn-65	<27	<9
		Cs-134	NRP	22 ± 3.6
		Cs-137	1300	1390 ± 140
		H-3	2800	2700 ± 200
4-12-2000	Monitoring Well Sample 1	H-3	<200	<700
9-1-2000	Monitoring Well Sample 13	H-3	7100	8300

NRP - No results reported by UVAR Facility

* UVA results not background corrected. Co-60 is normally detected in UVAR background samples.

F. Unusual Occurrences

In June of 2000, the Reactor Facility shipped the remaining unirradiated fuel elements to BWX Technologies in Lynchburg.

In September 2000 approximately 181 grams of high enriched uranium scrap (HEU) was shipped to Oak Ridge.

Both shipments were made safely and in accordance with proper shipping procedures and regulations. No measurable doses were received by personnel involved in the handling and shipment preparation of these materials.

G. Summary

During 2000, no State or Federal limits for exposure to personnel or the general public were exceeded.

V. EDUCATIONAL ACTIVITIES

A. Academic Courses and Laboratories

The academic Nuclear Engineering program at the University of Virginia was terminated in 1998. Only those five graduate students that were in the program at the time of the termination, all of which had completed all their necessary course work, were permitted to continue to pursue their degrees. Two of these students graduated in 1999.

B. Degrees Granted by U.Va. in Nuclear Engineering

The following number of degrees were awarded during 2000 by the University of Virginia in the discipline of Nuclear Engineering:

Masters of Science, Nuclear Engineering	0
Masters of Engineering, Nuclear Engineering	0
Doctor of Philosophy, Nuclear Engineering	1
TOTAL	1

The following PhD dissertations by students majoring in Nuclear Engineering were completed during 2000 in part using services or facilities provided at the UVA Reactor Facility.

New Nodal Method for Fluid Flow Equations, a PhD dissertation in Nuclear Engineering by Edward P. Michael.

VI. ACTIVITIES IN PREPARATION FOR DECOMMISSIONING

A. Site Characterization Study

The firm GTS-Duratek was employed by the University to perform a site characterization study, make a decommissioning cost estimate and write the decommissioning plan. The site characterization study was performed from July to September 1999 and a report has been prepared for use in the preparation of the decommissioning plan and its implementation.

B. Decommissioning Cost Estimate

GTS-Duratek estimated that the cost of decommissioning the UVAR will be slightly in excess of $3,000,000. Bids submitted by three companies vying for the contract to perform the decommissioning work were about this same amount.

C. The Decommissioning Plan

With the assistance of GTS-Duratek, a decommissioning plan was prepared in late 1999 and early 2000 and was submitted to the NRC for approval in February 2000. NRC approval of this plan is expected in April-May 2001.

D. Cobalt-60 Facility

In 1971 a cobalt-60 irradiation facility of approximately 70,000 curies was installed in the UVAR pool. The facility consisted of 71 pins that were approximately one inch in diameter by 11 inches long. In 1999 the activity of the cobalt had decayed to below 2,000 curies. The possession license for the cobalt was changed with the NRC from the Reactor License (R-66) to the University's Broad Radioactive Materials License (45-00026-34) to permit moving the cobalt out of the reactor pool. A commercially-manufactured lead storage and shipping container was purchased to hold all of this cobalt. On Friday August 27, 1999 the cobalt was transferred to the cask and was then moved to the hot cell in the Facility for interim storage. The cask remained there throughout the year 2000.

E. Equipment Transfers

Equipment at the Reactor Facility continues to be either transferred to other University departments, transferred to other nuclear related facilities in the U.S., disposed of via the University surplus system or is being discarded.

VII. FINANCES

A. Expenditures

Expenditures for 2000 were as follows:

State and University Support

Salaries + Fringe benefits:	$175,245
Other Than Personnel Service:	86,824
Total Expenditures:	$262,069

B. Income

There was no income from outside sources in 2000, other than the payment of a small bill by a company that formerly had work performed at the Facility.

C. State Support / Research and Service Income

The University of Virginia Reactor Facility was in the past supported by allocations from the State of Virginia, University funds and monies internally generated at the Reactor. Since the Reactor has not been operating its support has been from state and University monies alone. The balance of the Reactor generated monies that remained at the time of the reactor shutdown have been placed in an interest generating account until expended during the Reactor Facility decommissioning.