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NUCLEAR REACTOR FACILITY

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March 30, 2000

Director, Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Document Control Desk
11555 Rockville Pike
Mail Stop P1-137
Rockville, MD 20852

Re: Docket No. 50-62
Docket No. 50-396

Dear Sir:

We hereby submit, as required by section 6.7.2 of the Technical Specifications, our annual report of the operations of the University of Virginia Reactor (UVAR), License No. R-66, Docket No. 50-62 and the CAVALIER Reactor, License No. R-123, Docket No. 50-396 during the period January 1, 1999 through December 31, 1999.

Sincerely,

Paul E. Benneche

Paul E. Benneche, Reactor Supervisor
UVA Reactor Facility

cc: USNRC, Mr. Alexander Adams
USNRC Region II, Mr. Craig Bassett
American Nuclear Insurers

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UNIVERSITY OF VIRGINIA

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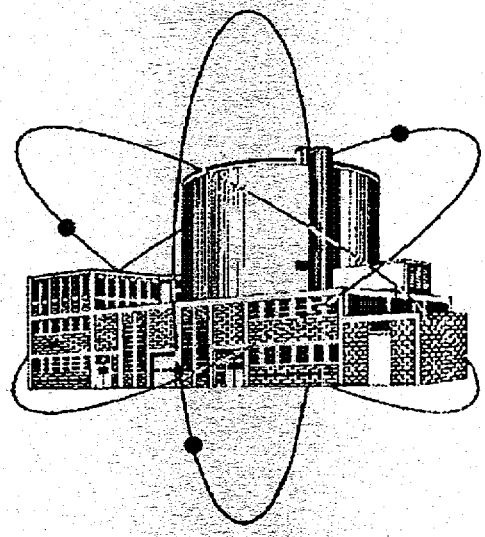

1999 ANNUAL REPORT

UNIVERSITY
OF
VIRGINIA

REACTOR FACILITY

1999
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 Safety Committee on March 29, 2000

1999 ANNUAL REPORT
UNIVERSITY OF VIRGINIA REACTOR FACILITY

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1999 ANNUAL REPORT
University of Virginia Reactor Facility

I. INTRODUCTION

A. Reactor Facility Reporting Requirements

1. Reporting Period

This report on Reactor Facility activities during 1999 covers the period January 1, 1999 through December 31, 1999.

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 germanium detectors and computerized data acquisition-analysis systems.

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 currently stored at the Reactor should be shipped in 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 1999 Reactor Utilization

a. UVAR

The UVAR has been permanently de-fueled and was not operated in 1999.

5. Special Facilities

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

Two neutron beam ports, of eight-inch diameter entrance, stepped to 10 inches 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 sample 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 fume hoods, 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 1999 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
D.A. Moody . . . Radiation Safety Technician

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 was composed of the following individuals (as of the end of 1999):

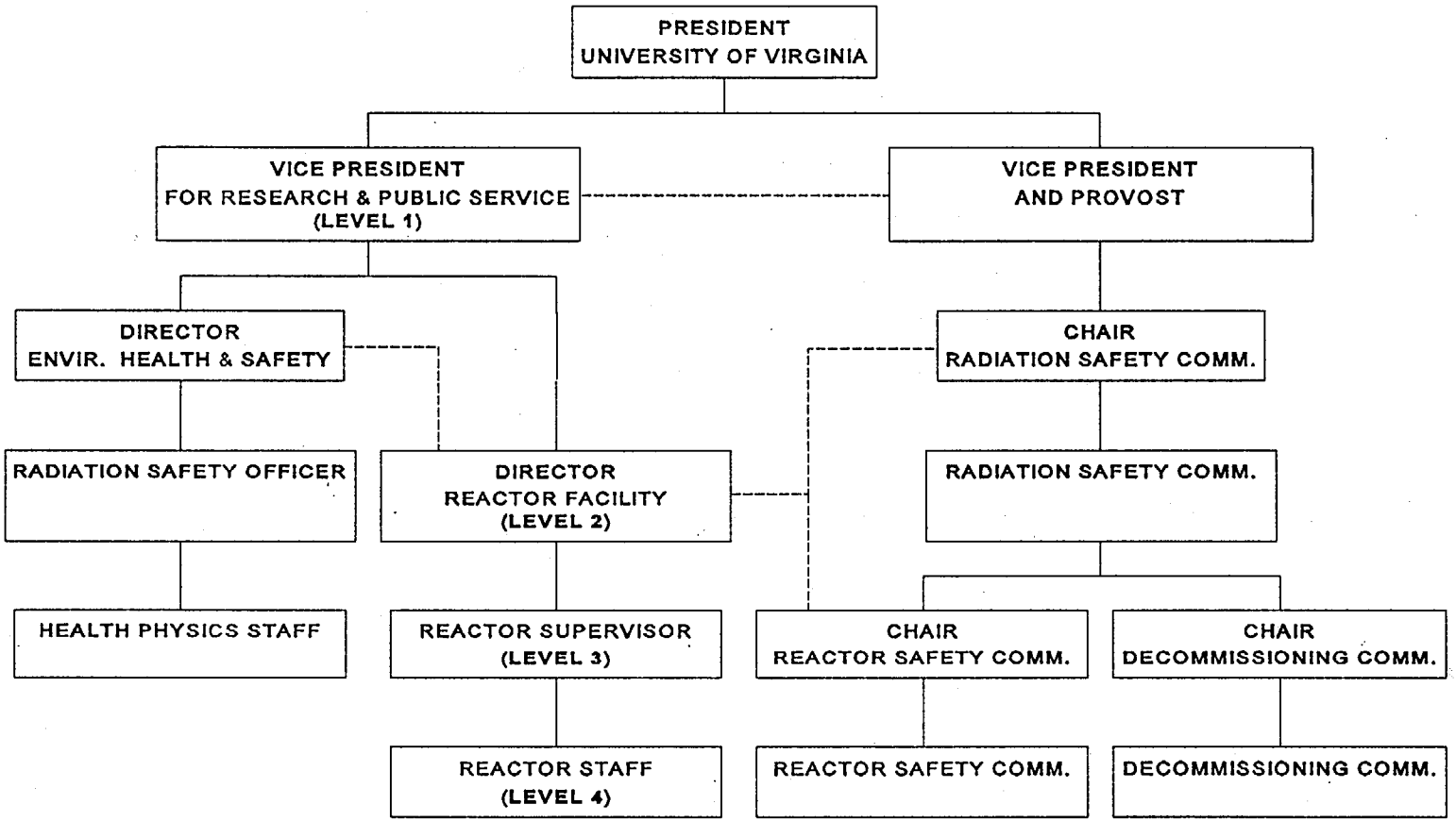
W.R. Johnson . . Professor Emeritus, Nuclear Engineering (Chair)
R.A. Rydin . . . Associate Professor, Nuclear Engineering
R.U. Mulder . . . Reactor Director & Assoc. Professor, Nuclear Engineering
R.G. Piccolo . . . University Radiation Safety Officer
D.P. Steva . . . . Radiation Safety Specialist,
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 1999):

R.O. Allen . . . . Director of UVA Office of Environmental Health and Safety & Professor, 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 . Reactor Supervisor
D.P. Steva . . . . Radiation Safety Specialist,
UVA Office of Environmental Health and Safety



——— reporting lines

---- communication lines

FIGURE 6.1 "A"
ORGANIZATIONAL CHART
UNIV. OF VIRGINIA NUCLEAR REACTOR FACILITY
(PRIOR TO SHIPMENT OF ALL FUEL ELEMENTS OFF-SITE)

Figure 1, Organizational Structure

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 are of the Materials Test Reactor (MTR) flat-plate type utilizing U_3Si_2. The fuel is approximately 19.7% enriched in the U-235 isotope. The fully loaded elements have 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 have 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 1999 a number of changes were made to the UVAR standard operating procedures. SOP 7.13B, Cleaning of the Cooling Tower was deleted. There were also several changes made to Chapter 10, Radiation Protection Procedures. The Reactor Safety Committee reviewed and approved these changes.

3. Surveillance Requirements

The following surveillance items were completed during 1999 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 1999.

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) Monthly

Operational checks of the ventilation duct, personnel door, truck door and emergency exit cover were performed as required.

2) Semi-Annually

A visual inspection of gaskets on the UVAR confinement personnel door, ventilation duct and truck door was completed.

Calibration checks of source range channel, linear power channel, core gamma monitor, bridge radiation monitor, reactor face monitor (see maintenance section), duct argon monitor, constant air monitor, pool level monitors, pool temperature monitor and core differential temperature monitor were done.

3) Annually

The emergency cooling system test was discontinued in 1999 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).

4) Daily Checklist

Daily checklists were not completed in 1999 because the reactor had been permanently unloaded and was not operated during the year.

5) Reactor Pool Water Quality

The Technical Specifications require that the pH and conductivity of the pool water be measured at least once every two weeks. Actually, these measurements were being made on a daily basis when the reactor was operating and otherwise at least once each week. These measurements indicate that the water quality continues to be maintained well within the Technical Specification limits of pH between 5.0 and 7.5 and with conductivity < 5 micromhos/cm.

6) Core Configuration Changes

The UVAR core configuration was not modified during 1999 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 Fire Department were checked on a weekly basis throughout the year. These checks confirmed the availability of systems and communication equipment.

4. Maintenance

The maintenance performed on the UVAR systems during the calendar year 1999 is shown in Table 3. No significant trends were noted in the maintenance.

TABLE 3

Reactor System Maintenance Performed in 1999

Date	System	Problem	Corrective Action
03-16-99	Bridge monitor	alarming continuously	replaced bad capacitors in power supply circuits
05-19-99	Reactor polar crane	dead spots in rotation motion	contactor was somewhat corroded, so it was cleaned, and the spring in the contactor was weak so it was tightened
06-27-99	Fire alarm system	alarm condition at monitor at police station after a lightning hit	replaced bad electronics board
07-14-99	Fire alarm system	constant trouble alarm indicated at police station	had to eliminate middle level monitoring in order to get the system to work at all
08-11-99	Wind sock	wind sock was torn and detached from its mast	replaced with new sock
09-17-99	Secondary side of heat exchanger	need to remove pipe section, sample inside for characterization study, and replace	pipe removed, sampling done, pipe replaced
09-17-99	Demineralizer system	sampling resin and flow meter repairs	resin sampled and flow meter repaired
09-30-99	UVAR Source Range	need to permanently remove the fission chamber from the Reactor pool	removed fission chamber from instrument well
11-09-99	Face monitor	would not pass semi-annual calibration	tried to repair with no success, left out-of-service since it is not a required instrument when reactor is not operating

5. Unplanned Shutdowns

The UVAR was not operated in 1999 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 169 gallons for a total of 61,530 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, nor shipped from the facility, during 1999.

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 1999 the reactor staff consisted of a total of three individuals. Only one of these individuals is licenced. The Reactor Supervisor possesses a senior reactor operator (SRO) license. The other two employees were the Reactor Director, a faculty member who serves as Director on a half-time basis, and the department secretary. One other University employee, previously employed at the Reactor, maintained an SRO license and assisted with the fuel shipments. Following the shipments this individual had his license canceled for lack of further need.

Licensed operators participated in the Facility's operator requalification program carried out during the year. By necessity, the program was conducted at minimum requirements level because only a single licensed individual was employed for most of the year.

b. Summer Course for School Teachers

During June 1999, 16 high school and middle school teachers from within the state of Virginia attended a one-week special course at the Reactor Facility entitled: "Science of Nuclear Energy and Radiation". The course consisted of formal lectures, laboratory experiments, basic radiation counting and gamma-ray analysis. During the week the teachers also visited the North Anna Nuclear Power Station.

9. Reactor Tours

During the calendar year 1999, the staff guided four tour groups along with a small number of individual tours of the Facility.

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 completed in the year 2001, along with the UVAR decommissioning.

III. REGULATORY COMPLIANCE

A. Reactor Safety Committee

1. Meetings

During 1999, the Reactor Safety Committee met three times, on the following dates:

January 18, 1999 March 5, 1999 October 8, 1999

The Technical Specifications require the committee to meet at least twice each year.

2. Audits

During the year sub-committees of the Reactor Safety Committee performed two audits of the Facility reactor operations. An audit of the reactor operations records is required every year and this was completed for the period April 1998 through March 1999 on June 11, 1999. The second audit of the H.P. procedures and records, security plan and emergency plan was completed on January 27, 1999. An audit in these areas is done every two years.

3. Approvals

A substantial revision of the UVAR Technical Specifications, was required in conjunction with the request for a possession-only amendment to the reactor license. The UVAR TS changers were approved by mail ballot in September 1998. Following several iterations of NRC questions and UVA responses during 1999, amendment 25 to the UVAR Technical Specifications was issued on February 9, 2000

During 1999, the Reactor Safety Committee approved several changes to various standard operating procedures and experimental procedures and methods:

Jan. 18, 1999: deleted the semi-annual calibration of the north neutron beamport neutron detector from experimental procedures and methods.

removed the requirement for the annual cleaning of the cooling tower from UVAR SOP 7.13.B.

Jun. 25, 1999: removed the requirement for monthly off-site air sampling from UVAR SOP's 10.4.C and 10.4.D.

Jul. 21, 1999 removed the requirement to issue film badges or other dosimetry to all regular occupants of the Reactor Facility from UVAR SOP 10.3 and limited this requirement to reactor staff members only.

4. 10 CFR 50.59 Reviews

During 1999 there were three 10CFR50.59 analyses. These were considered minor in nature and were approved by the Reactor Director. These were:

January 7, 1999 - Installation of UVAR reactor pool heater to keep pool temperature from dropping too much during the winter months.

September 14, 1999 - Cutting water lines in hot cell liquid waste pit to take samples for characterization study.

September 16, 1999 - Drilling to extract concrete core samples at several locations around the Reactor Facility for characterization study.

B. Reactor Decommissioning Committee

1. Meetings

During 1999, the Reactor Decommissioning Committee averaged meeting twice a month.

C. Inspections

During 1999 the Facility had one NRC compliance inspection, at the following time and in the area of:

April 14-16, 1999	#50-62/99-201	Radiation protection & transportation

This inspection resulted in no violations.

An inspection from late 1998 (November 16-19, 1998; #50-62/98-202) resulted in a Notice of Violation, Level IV, which was dated December 9,1998. This violation was in the area of the marking and paperwork of certain radioactive materials shipments. A reply to this violation was dated January 7, 1999 and the NRC acceptance of the response was dated January 25, 1999.

D. Licensing Action

1. There were no license amendments issued by the NRC in 1999. There continued to be discussion between UVA and the NRC on UVA's request for a possession-only amendment to the UVAR TS. Amendment #25 was issued in February 2000.

E. Emergency Preparedness

1. A practice evacuation of the Reactor building was conducted on July 29, 1999. All the persons present evacuated the building and gathered at the designated assembly area, as required. Necessary supplies and equipment were carried by the reactor staff to the assembly area.

2. On February 9, 1999, the annual emergency drill for the calender year 1998 was initiated at the facility. The drill for 1999 will be held in early 2000 (in the near future).

IV. HEALTH PHYSICS

A. Personnel Dosimetry

1. Visitor Exposure Data For 1999

During 1999, there were 85 visitors who toured at the Reactor Facility. Of these visitors, 55 were visitors in tour groups. Additionally, there were 1,075 other "sign-ins" of unbadged individuals at the Reactor for either work or meetings. The highest dose received in any single visit was 7.0 mrem. This dose was incurred by an individual assisting with the shipment of reactor fuel. Most visitors received no measurable dose.

2. Reactor Facility Personnel Dosimetry Data For 1999

a. Monthly Whole Body Badge Data

Radiation doses received by Reactor Facility personnel were measured using Landauer personnel dosimeters. Film badge 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, 1999 through December 31, 1999 is shown in Table 4.

TABLE 4

1999 Personnel Radiation Doses Received at Reactor Facility

Measured Accumulated Deep Dose Equivalent* (mrem)	Number of Individuals in Dose Range
Less than 10 (M)	44
10 - 20	3
21 - 30	0
31 - 40	1
41 - 50	1
51 - 100	0
101 - 150	0
151 - 500	0
Greater than 500	0

Number of badged personnel: 49 persons

Collective dose for this group: 0.150 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 1999, no doses exceeded the UVA ALARA Investigational Level 1 of 125 mrem per quarter.

b. Neutron Exposures

Nine Facility personnel were issued Neutrak ER neutron badges in 1999. The neutron dose distribution for this group is shown in Table 5.

TABLE 5	
1999 Personnel Neutron Doses at the Reactor Facility	
Measured Accumulated Deep Dose Equivalent (mrem)	Number of Individuals in Dose Range
Less than 20 (M)	9
20 - 40	0
Greater than 40	0
NOTE: These dosimeters have a minimum reporting dose of 20 mrem.	

c. Extremity Exposures

During 1999, ten 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, 1999 through December 31, 1999.

TABLE 6	
1999 Personnel Extremity Doses at the Reactor Facility	
Measured Accumulated Extremity Dose (mrem)	Number of Individuals in Dose Range
Less than 30	7
30 - 500	3
501 - 1,250	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.	

The highest extremity dose (190 mrem) was received by an individual during the transfer of the Co-60 pins from the UVAR pool to the storage and shipping cask. During 1999 no facility personnel doses (extremity) exceeded the UVA ALARA Investigational Level 1 of 1,250 mrem per quarter.

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. Exposures were recorded for only one operation during 1999, the transfer of the Co-60 pins from the pool to a storage and shipping cask. The highest individual whole body exposure recorded by a direct-reading dosimeter during this operation was 40 mR.

B. Effluents Released During 1999

1. Airborne Effluents

The reactor was not operated in 1999. Therefore, there were no Argon-41 gaseous releases from the UVAR in 1999.

2. Liquid Effluents

Liquid radioactive waste generated at the UVAR is disposed of by one of two means. Liquid waste generated in the student laboratories is poured into approved containers that are collected and disposed of by the Environmental Health and Safety Office. Liquid waste from regeneration of the UVAR demineralizer system is collected in three 2,250 gallon tanks on the ground floor of the Facility. The liquid waste collected in these tanks is 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 1999 liquid release totals.

The Spring and Summer of 1999 were unusually dry; consequently, there were only 13 releases of pond water. There was 1 release to the sanitary sewer (see Table 7). 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 0.5×10^{-8} μCi/ml. This concentration was 17% of the UVAR administrative release limit and was less than the average concentration of radioactive material measured in the water upstream of the pond (0.6×10^{-8} μCi/ml). The average tritium concentration in effluent released from the pond was less than the lower limit of detection (7.0×10^{-7}

μCi/ml). The total volume of water released off-site, from the pond, in 1999 was 34,400,000 liters (9,090,000 gallons). The total activity (excluding tritium activity) in this volume was 130 μCi. This activity was primarily from naturally occurring radionuclides contributed to the pond from the runoff in the feeder creek mentioned above. There was no measurable tritium activity in the pond water released.

The total volume of wastewater released to the sanitary sewer was 7,570 liters. The total tritium activity released to the sanitary sewer was 318 μCi. The total of all other radionuclides released to the sewer was 9.8 μCi. All radionuclides released to the sewer were in concentrations that were less than 10 % of their individual EC limits.

3. Solid Waste Shipments

Thirty-five ft^3 of solid radioactive waste were removed from the facility in 1999. This waste was disposed of through US Ecology in July 1999.

TABLE 7

1999 Pond Release Sample Results

Release No.	*Avg. Gross Beta Activity (excluding Tritium) ($x10^{-8}$ μCi/ml ±2 s.d.)
1	0.5 ± 0.03
2	0.7 ± 1.0
3	0.2 ± 0.3
4	0.3 ± 0.2
5	0.3 ± 0.2
6	0.4 ± 0.2
7	0.4 ± 0.1
8	0.6 ± 0.2
9	1.1 ± 04
10	0.6 ± 0.4
11	0.7 ± 0.6
12	0.4 ± 0.2
13	0.6 ± 0.7
Average ± 2 s.d. =	**0.5 ± 0.5**

* Three samples are collected during the release. Number reported is the average (or mean) of the 3 samples and ± 2 s.d. of this mean.

A priori LLD: 0.3 x 10^{-8} μCi/ml

TABLE 7a			
1999 Sewer Release Data			
Nuclide	Release #1 % of Release Limit*		
H-3	0.42		
Mn-54	0.053		
Co-60	1.37		
Cs-137	6.2		
Cs-134	ND		
Cr-51	ND		
Zn-65	0.19		
Sb-124	ND		
Sb-125	ND		
ND - Not detected * Release Limit - 10CFR20 Appendix B, Table 3			

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 (x 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	0.9 $\pm$ 0.2	0.31 $\pm$ 0.2	0.6 $\pm$ 0.3
February	0.4 $\pm$ 0.2	0.1 $\pm$ 0.1	0.4 $\pm$ 0.01
March	0.4 $\pm$ 0.2	0.04 $\pm$ 0.1	0.3 $\pm$ 0.1
April	0.5 $\pm$ 0.2	0.3 $\pm$ 0.2	0.4 $\pm$ 0.4
May	0.6 $\pm$ 0.2	<0.3	0.3 $\pm$ 0.2
June	1.3 $\pm$ 0.2	0.1 $\pm$ 0.1	0.4 $\pm$ 0.2
July	No sample, dry	0.3 $\pm$ 0.2	0.9 $\pm$ 0.3
August	1.4 $\pm$ 0.2	0.2 $\pm$ 0.1	0.5 $\pm$ 0.2
September	1.2 $\pm$ 0.3	0.5 $\pm$ 0.2	1.1 $\pm$ 0.5
October	0.7 $\pm$ 0.2	<0.3	0.7 $\pm$ 0.2
November	0.4 $\pm$ 0.2	0.2 $\pm$ 0.1	0.4 $\pm$ 0.1
December	0.5 $\pm$ 0.2	0.2 $\pm$ 0.1	0.3 $\pm$ 0.4
Avg $\pm$ 2 s.d.	**0.8 $\pm$ 0.8**	**0.2 $\pm$ 0.3**	**0.5 $\pm$ 0.5**
A priori LLD: 0.3 x 10^{-8} μCi/ml			

2. Air Sampling

Environmental air samples were collected on a monthly basis until July 1999. In July 1998, operation of the reactor ended and all spent fuel was shipped from the site as of July 1999. As a result of these actions, the potential for airborne release of radioactive material from the facility was greatly diminished. Commensurate with the reduced potential, the environmental air sampling program was discontinued after collection of the last set of samples in June 1999. The air sampling equipment does, however, continue to be calibrated and maintained in operating condition for use on an as needed or emergency basis. Samples that were collected during the time period January - June 1999 were collected at the following locations:

A-1 Roof of reactor building
A-2 Indicator - approximately 0.13 mi. E of UVAR
A-3 Control - approximately 3.1 mi. NW of UVAR

Fixed sampling locations were utilized to collect air samples at locations A-2 and A-3. Sampling time for these off-site samples was approximately 96 hours. Air samples were collected at location A-1 using a portable air sampler that was run for approximately two hours. All air samples collected were particulate air samples and were analyzed for gross beta particle activity. Results are provided in Table 9. The airborne radioactivity detected was primarily due to naturally occurring radon and thoron daughters. The average activity measured at each location was less than the Effluent Concentration Limit of 1 x 10^{-12} μCi/ml.

TABLE 9

1999 Environmental Air Sampling Results

Gross Beta Particle Activity in Air Particulates (x 10^{-13} μCi/ml $\pm$ 2 sigma)

	Roof of UVAR Facility	0.13 miles east of UVAR Facility	3.1 miles northwest of UVAR Facility
January	3.5 $\pm$ 1.0	4.7 $\pm$ 0.3 [a]	1.8 $\pm$ 0.1
February	6.3 $\pm$ 0.6	3.9 $\pm$ 0. 3 [a]	1.9 $\pm$ 0.1
March	3.6 $\pm$ 0.2	4.9 + 0.3 [a]	1.3 $\pm$ 0.1
April	5.6 $\pm$ 0.4	4.1 $\pm$ 0.3 [a]	1.7 $\pm$ 0.1
May	2.3 $\pm$ 0.8	6.1 $\pm$ 0. 4 [a]	2.2 $\pm$ 0.09
June	3.8 $\pm$ 0.6	3.3 $\pm$ 0.3 [a]	1.4 $\pm$ 0.07
Avg. $\pm$ 2 s.d.	**4.2 $\pm$ 3.0**	**4.5 $\pm$ 1.9**	**1.7 $\pm$ 0.7**

* Sampler malfunction

a Sampler out of service, used reactor room sampler, shorter sampling time (lower volume)

Effluent Concentration (EC) Limit: 1.0 x 10^{-12} μCi

Roof sampler a priori LLD: 2.8 x 10^{-13} μCi/ml

Indicator and Control Environmental samplers apriori LLD: 6.2 x 10^{-15} μCi/ml

3. Outside Area TLD Network

TLDs are mounted at 8 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, additional Aluminum Oxide(Al_2O_3) dosimeters are in place alongside the TLD dosimeters. Table 10 shows the doses recorded by these dosimeters. The doses measured by the Al_2O_3 dosimeters are shown in parentheses beside the dose measured by the TLD. There was fairly good agreement between the 2 dosimeters except for the first quarter. This discrepancy is most likely due to the fact that the control Al_2O_3 dosimeter for this quarter was not shipped and analyzed with the rest of the badges. This may have introduced some uncertainty into the accuracy of the measurements for this quarter. The annual total dose measured at each location was less than the annual dose limit of 100 mrem.

TABLE 10						
1999 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	M (18.7)	M (-13.5)	M (5.5)	50 (3.7)	50 (14.4)	20
281	M (25.7)	M (-2.6)	10 (10.4)	60 (14.2)	70 (47.7)	40
282	M (19.6)	M (2.4)	M (9.9)	50 (11.3)	50 (43.2)	20
283	M (17.5)	M (-4.0)	M (5.2)	50 (4.0)	50 (22.7)	20
284	M	M	M	50	50	20
285	M	M	M	40	40	10
286	M (12.4)	M (18.5)	M (-0.6)	40 (-6.2)	40 (24.1)	10
287	M	M	M	40	40	10
Control	M	M	M	30	30	Control
Control	M	M	M	30	30	Control

M = min. detection limits: 10 mrem for gamma and x-rays, 40 mrem for energetic betas.
Minimum detectable for Al_2O_3 dosimeters: 0.02-0.03 mrem
* Annual Net = Annual Total - Control Annual Total

D. UVAR Facility Health Physics Surveys

1. Radiation and Contamination Surveys

Weekly and monthly surveys were performed throughout the Facility to monitor radiation and contamination levels. All required area radiation and contamination surveys were performed during 1999.

The levels of contamination detected in the Facility during 1999 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. No increase in background or systems related radiation levels was detected by the routine health physics surveys.

2. Airborne Radioactivity

Airborne particulate samples were collected in the reactor room as part of the weekly survey of the Reactor Facility until June 1999. The purpose of these samples was to monitor for airborne radioactivity that might result from a leaking fuel element or other experiment associated with the operating reactor. Following removal of all spent fuel from the reactor pool, the requirement for collection of a weekly reactor room air sample was deleted. For the period January - June 1999, the average concentration of radioactive material detected in reactor room air (as measured by gross beta particle activity analysis of the particulate samples) was 0.39×10^{-11} μCi/ml. The airborne radioactivity detected was primarily due to radon and thoron daughters. All of the measured concentrations were less than or

equal to 25% of the applicable Derived Air Concentration (DAC) of 3.0×10^{-11} μCi/ml.

E. Quality Assurance

In 1999, the UVAR Facility was no longer able to participate in the U.S. Environmental Protection Agency (EPA) Laboratory Intercomparison Studies Program as part of its quality control program for radiation measurement of air and water samples. Effective March 1999, the U.S. EPA's *Radiochemistry Performance Evaluation Program* was terminated. The last report to be issued from this program was for the Gross Alpha-Beta, Nov. 13, 1998 sample. Currently, UVAR Facility personnel periodically submit samples to an independent laboratory for analysis or for comparison to results obtained from split samples.

F. Tech. Spec. Compliance, Unusual Occurrences and Reportable Events

In May 1999, Health Physics staff unloaded the tubes of natural uranium slugs from the subcritical assembly tank. The tubes were placed in PVC tubes in preparation for shipment to a DOE facility. The operation was performed without event and no measurable exposures or contamination resulted from the operation.

In June 1999, the last shipment of spent fuel was completed. Exposure and contamination resulting from this operation was minimal.

In July 1999, in support of the decommissioning effort, GTS Duratek began site characterization. The characterization was completed in September with no exposure to the personnel involved.

In August 1999, the Co-60 pins were moved from the pool to a storage/shipping cask. The collective doses to personnel from this operation were 70 mrem whole body deep dose equivalent and 360 mrem extremity dose.

G. Summary

During 1999, no State or Federal limits for exposure to personnel or the general public were exceeded.

V. EDUCATIONAL ACTIVITIES

A. Academic Courses and Laboratories

During June 1999, 16 high school and middle school teachers from the state of Virginia attended a one week special course at the Reactor Facility. The title of the course was "Science of Nuclear Energy and Radiation: Environmental Issues and Safety." It consisted of lectures by University of Virginia nuclear engineering faculty, laboratory experiments at the Reactor and a tour of the North Anna Nuclear Power Station.

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

The following number of degrees were awarded during 1999 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	2
TOTAL	2

The following PhD dissertations by students majoring in Nuclear Engineering were completed during 1999 in part using services or facilities provided at the U.Va. Reactor Facility.

Experimental Evaluation of Boron Neutron Capture Therapy of Human Breast Carcinoma Implanted in Nude Mice, PhD dissertation in Nuclear Engineering by Satya Bose.

Design Development and Characterization of a Full-Field Digital Mammography Detector, PhD dissertation in Nuclear Engineering by Piero Simoni.

Three remaining PhD candidate students are finishing their work in the now terminated U.Va. nuclear engineering program.

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 has estimated that the cost of decommissioning the UVAR will be slightly in excess of $3,000,000.

C. Preparation of 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.

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 on the following Monday the cask was moved to the hot cell in the Facility for interim storage.

E. Major Equipment Transfers

1. A lead-glass window was donated to the Massachusetts Institute of Technology Reactor Facility for use in conjunction with their ongoing Boron Neutron Transport Therapy project.

2. Approximately 10 tons of high purity graphite blocks which were used in a "stack" with a neutron source to perform foil irradiations were transferred to the Armed Forces Radiobiology Research Institute in Bethesda, Maryland.

3. A large quantity of NIM type electronic instruments and other laboratory equipment was transferred to the Virginia Military Institute in Lexington, Virginia.

VII. FINANCES

A. Expenditures

Expenditures for 1999 were as follows:

	State Support	Locally Generated Monies
Salaries + Fringe benefits:	$178,431	$6,590
Operating Expenses:	240,212	18,364
Subtotals:	$418,643	$24,954
TOTAL EXPENDITURES:		**$443,597**

B. Income

There was no income from outside sources, other than Virginia state monies, in 1999.

C. State Support / Research and Service Income

The University of Virginia is supported by allocations from the State of Virginia and internally generated monies. Of these monies, a portion is allocated for the activities at the Nuclear Reactor Facility. While the reactor was operating, additional funds were generated by services provided to other educational institutions and to industry. These funds covered expenses not covered by the University budgeted monies. Primarily, these "local" funds covered the hiring of necessary additional personnel. The balance in the local account has not been utilized in a while so these monies have been placed in an interest generating account until expended during the Reactor Facility decommissioning.