



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION II  
101 MARIETTA STREET, N.W.  
ATLANTA, GEORGIA 30323

APR 28 1988

Report No.: 50-62/88-01

Licensee: University of Virginia  
Charlottesville, VA 22901

Docket No.: 50-62

License No.: R-66

Facility Name: University of Virginia Pool Reactor

Inspection Conducted: April 5-7, 1988

Inspector: George B Kuzo  
G. B. Kuzo

25 April 1988  
Date Signed

Approved by: C. M. Hosey  
C. M. Hosey, Section Chief  
Division of Radiation Safety and Safeguards

4/27/88  
Date Signed

SUMMARY

Scope: This routine, unannounced inspection involved onsite review of radiation protection program areas, including radiation control activities, environmental surveillance and monitoring, transportation activities, and review of licensee actions concerning previously identified inspector followup items, enforcement activities, unresolved issues and NRC Information Notices (IENs).

Results: No violations or deviations were identified.

## REPORT DETAILS

### 1. Licensee Employees Contacted

- \*B. Copcutt, Radiation Safety Officer
- \*J. Farrar, Reactor Administrator
- \*D. Freeman, Research Scientist
- \*O. Hale, Reactor Health Physicist
- \*J. Hall, Health Physics Technician
- \*B. Hosticka, Research Scientist
- \*R. Mulder, Director, Reactor Facility
- \*T. Williamson, Chairman, Department of Nuclear Engineering

Other licensee employees contacted included technicians, operators, and office personnel.

\*Attended exit interview

### 2. Exit Interview (30703)

The inspection scope and findings were summarized on April 7, 1988, with those persons indicated in Paragraph 1 above. Licensee representatives acknowledged the inspector's comments. The licensee did not identify as proprietary any of the material provided to or reviewed by the inspector during this inspection.

### 3. Licensee Action on Previous Enforcement Matters

- a. (Closed) UNR (50-62/87-02-01) Liquid effluent releases to unrestricted areas potentially above 10 CFR Part 20 limits. This issue reviewed the potential for exceeding the 10 CFR Part 20 Appendix B, maximum permissible concentration (MPC) limits for liquid effluent releases based on the licensee's analytical measurement analyses for gross beta-gamma and tritium (H-3) activities, and subsequent dilution calculations. Licensee gross beta-gamma activity analyses did not include the H-3 concentrations in liquid effluents to be included in the radionuclide concentration results utilized for effluent release calculations. All H-3 measurements were conducted separately and were not expected to exceed MPC concentrations during releases. However, the ratios of gross beta-gamma and H-3 activities to their respective MPCs and a comparison of a sum of the ratios to unity "1" as required by 10 CFR Part 20, Appendix B, Note 1, for a mixture of radionuclides released were not being conducted. Licensee evaluation of the issue included estimating a "worst case" maximum release of H-3 directly from the reactor pool diluted by the average processing and waste tank volumes and combining these values with the known beta-gamma concentrations. Based on these calculations all liquid effluent releases were below the applicable 10 CFR Part 20 Appendix B limits. The licensee had initiated changes to Standard Operating Procedure (SOP) 10.5.B.2.c, Sampling of Pond, dated

September 1987, requiring a summation of the ratio of H-3 and gross beta-gamma activity, excluding H-3, to their respective 10 CFR Part 20, Appendix B, MPC limits to be compared to unity "1" as required for mixture of nuclides. All changes were initiated in September as verified by review of effluent release logs and release records. This item is considered closed.

- b. (Closed) Violation (50-62/87-03-01) Failure to perform a safety evaluation of the neutron beam port - 10 CFR 50.59 violation. The inspector reviewed and verified implementation of corrective actions stated in the University of Virginia Reactor (UVAR) facility response dated November 18, 1987.
  - c. (Closed) Violation (50-62/87-03-02) Failure to have approved written procedures. The inspector reviewed and verified implementation of corrective actions stated in the UVAR response dated November 18, 1987.
  - d. (Closed) Violation (50-62/87-03-03) Failure to make surveys. The inspector reviewed and verified implementation of corrective actions stated in the UVAR response dated November 18, 1987.
4. Radiation Control (83743)
- a. Organization and Staffing

Technical Specification (TS) Sections 6.1.1 and 6.1.2 detail organizational structure, management responsibility and the chain of command for safe operation of the University of Virginia Reactor (UVAR) facility.

The independence of the reactor health physicist and the campus radiation safety officer to oversee facility activities was discussed. The reactor health physicist is assigned to and is responsible for health physics monitoring and surveillance activities at the reactor facility but does not report directly to UVAR management. The reactor health physicist provides independent review of radiation protection issues and reports to the radiation safety officer. Furthermore, the inspector noted that the reactor health physicist has the authority to stop work in progress if disagreements arise concerning proper operation of the UVAR facilities. This policy was detailed in a memorandum to the reactor safety committee from Dr. R. U. Mulder, Director, UVAR, dated September 22, 1987. The need to present this policy during general training required for UVAR personnel and to document its guidance in facility procedures was discussed. Licensee representatives agreed to evaluate the need to include this policy statement in their training and facility reference guides.

From discussions with, and observations of personnel conducting routine duties at the UVAR, the inspector verified that the current

facility management responsibilities and organizational structure met TS requirements. Review of current radiation protection activities at the facility indicated that management and staff personnel from both the UVAR and Radiation Safety Office appeared to interact and operate in an efficient and competent manner for issues identified during this and previous inspections.

Staff levels and training for UVAR facility and Radiation Control Office personnel supporting radiation protection activities for the reactor facility were reviewed. In addition to the full time reactor health physicist, a health physics (HP) technician is assigned half-time duties at the UVAR to assist in routine monitoring activities. The current UVAR staff included one reactor and four senior operators. The operators are approved to conduct limited HP duties, involving routine decontamination and survey activities at the facility.

Routine and specialized training for the UVAR staff was reviewed. Operators are required to complete a two month period of on-the-job training assisting the reactor health physicist. In addition, all personnel utilizing the UVAR facility complete an initial and subsequent yearly requalification training in security, emergency preparedness, and health physics issues associated with the facility. The inspector reviewed training material and verified UVAR staff attendance for the requalification course conducted September 7, 1987. In addition, specialized training regarding fuel handling techniques and shipping requirements was discussed. Selected licensee representatives had observed and videotaped fuel handling and shipping activities at another licensed facility. A specialized program was then developed and presented to the UVAR staff involved in the fuel shipping activities detailed in Paragraph 6 of this report.

No violations or deviations were identified.

b. Audits and Review

TS 6.2 requires the Reactor Safety Committee (RSC) to review and audit reactor operations to ensure that the facility is operated in a manner consistent with public safety and within the terms of the facility license. The RSC will meet semiannually to review and approve untried experiments, changes to the reactor, facility license, TS and Standard Operating Procedures. TS 6.2.1 and TS 6.2.2 detail RSC committee member composition and qualifications, and also meeting and audit frequency.

The inspector reviewed and discussed with cognizant licensee representatives, the RSC meeting minutes and audits conducted from March 1987 through March 1988. During the review period the RSC met approximately on a monthly basis. Issues discussed included review of experiments submitted for approval, changes to facility SOPs, and

results of licensee self-audits and NRC inspections. All issues addressed by the RSC were presented to committee members as "information" or "action" items prior to the scheduled RSC meetings. The majority of RSC meetings were in regard to radiation safety issues concerning the neutron irradiation facility identified in NRC Inspection Report 50-62/87-03. Subsequent to discussion of identified issues at the RSC meeting, unresolved items appeared to be tracked and completed in a timely manner.

The inspector discussed the use of "methods" versus "procedures" for conducting work at the UVAR facility as noted in the RSC minutes dated November 11, 1987. The use of methods during operations was initiated to allow minor modifications to an experiment or task, for example, the type of meter utilized for monitoring, without changing the control and intent of the RSC approved experimental and/or operating procedures. Although not reviewed or approved by the RSC prior to their use, all methods were to be reviewed by the reactor health physicist and approved by the Reactor Director prior to implementation, and subsequently would be sent to the RSC as an information item. The inspector noted these criteria defining the use of methods at the UVAR were not documented in any facility policy or reference guide. Licensee representatives agreed to incorporate the defining criteria for use of methods versus procedures at the UVAR during staff training and also in applicable facility documents.

Licensee findings and corrective actions for a January 1988 audit were reviewed and discussed with cognizant licensee representatives. Areas reviewed during the audit included completeness of required radiological surveys, instrument calibrations and instrumentation detection capabilities. The need to determine the lower limit of detection (LLD) calculations for particulate air sampling equipment and subsequent radiological analyses was identified as a finding. The inspector reviewed and discussed the air sampling LLD issue and subsequent corrective actions with licensee representatives. No violations of regulatory requirements were noted and licensee actions were considered adequate. Audit results were presented to the RSC and corrective action to identified items were completed in a timely manner.

No violations or deviations were identified.

c. Instrumentation and Contamination Control

During tours of the reactor building and associated UVAR laboratories, the inspector noted that all portable and fixed radiation survey instruments were calibrated properly. Licensee representatives stated calibration frequency for portable radiation protection instrumentation as required by standard operating procedures was changed from a quarterly to an annual frequency, and all instrumentation was operations checked on a quarterly basis. Licensee representatives stated that the new calibration frequency

was in accordance with guidance outlined in ANSI N232-1978, Radiation Protection Instrumentation Test and Calibration. Furthermore, the decreased calibration frequency reduced costs, thus allowing the increased use of a vendor laboratory to perform calibrations. The use of a vendor was expected to improve calibration by increasing the range of calibration sources while reducing exposure of UVAR staff who previously had conducted the majority of calibrations.

10 CFR 20.201(b) requires the licensee to perform such surveys as may be necessary and are reasonable under the circumstances to evaluate the extent of the hazards that may be present.

The licensee contamination limit was established as 1000 disintegrations per minute per 100 square centimeters (dpm/100 cm<sup>2</sup>). The inspector observed routine daily contamination surveys being conducted by the HP technician. All accessible areas of the UVAR reactor room and associated laboratory facilities were classified as noncontaminated. Highest contamination survey results for the facility noted during the inspection were slightly above 50 dpm/100 cm<sup>2</sup> for an area on the reactor pool bridge. Upon discovery of this slightly elevated measurement during routine daily surveys, this area was decontaminated to levels below 50 dpm/100 cm<sup>2</sup>.

Use of protective clothing (PC) and frisking requirements by UVAR personnel handling potentially contaminated materials were discussed. The low contamination levels at the UVAR facility allowed personnel to enter the reactor room without the use of protective clothing. Guidance for radiation contamination control was provided by training, individual experiment procedures and methods, and the reactor health physicist. In addition, all personnel exiting the reactor room are required to use a hand and foot monitor at the exit. The inspector noted that friskers were available for conducting contamination surveys within the reactor room, facility laboratories, and at the hand and foot frisking monitor. All personnel, both staff and escorted visitors, within the facility were observed properly utilizing the survey equipment.

d. External (Wholebody) Exposure Review

10 CFR 20.101 delineates the quarterly radiation exposure limits to whole body, skin of the whole body, and the extremities.

The inspector reviewed and discussed the licensee's exposure records for persons working at or visiting the UVAR facility for the reporting period from January 1, 1987 to December 31, 1987. Wholebody exposures are measured by film badges provided by an NAVLAP accredited vendor laboratory. Neutron doses are measured by proton-recoil plastics. Changes to the licensee badging procedures as a result NRC identified issues (IE Report No. 50-62/87-03) included all UVAR staff personnel being provided with both gamma and neutron dosimetry. The highest individual dose listed for the

facility was 430 mrem based on a measure gamma exposure and an estimated neutron exposure. There was a total of 11 individuals receiving greater than 100 mrem with the majority of UVAR personnel exposure below 30 mrem for 1987. A total of 2.49 man-rem was listed by reactor facility personnel for the year.

Monitoring of individual exposure during specific tasks involving external radiological exposure hazards were discussed. The licensee monitors individual radiation exposure using self-reading dosimeters (SRD) when following selected UVAR methods, procedures and/or when handling material with exposure rates greater than 100 mR/hour at one foot from the source. The inspector reviewed SRD data for UVAR personnel conducting fuel shipping operations during 1987 and 1988. Highest individual dose reported for any step of placing the fuel into a shipping cask and loading the transport vehicle was 3 mrem. A total of 0.027 man-rem was assigned to this fuel transfer and loading task. Based on SRD results, highest man-rem exposure, 0.183 man-rem, were for health physics surveillances, instrument calibrations and source leak tests. Licensee actions to reduce exposure from this task are discussed in Paragraph 4 c.

No violations or deviations were identified.

e. Radiation Control During Experiments

TS 6.3 requires written operating procedures to be in effect for the installation or removal of fuel elements, control rods, experiments and experiment facilities.

Control of radioactive contamination and exposure levels in handling and manipulating experimental materials were discussed. SOP 6, Material Irradiation and Post Irradiation Handling, dated December 1984, details the use of Irradiation Request Forms (IRF) to estimate exposure rates. The inspector reviewed selected IRFs completed from January to December 1987, and compared the calculated radiation levels to the measured results. All forms were completed properly and the calculated estimated dose rates were reasonable. In addition SOP 6 provided guidance for radioactive material control and radiation exposure rates requiring dosimetry (greater than 100 mR/hr), handling and notification requirements (greater than 1 R/hr), and RSC review of handling (greater than 10 R/hr) for personnel handling radioactive materials. Licensee representatives stated that standard practice does not allow the transfer of irradiated material having dose rates greater than 250 mR/hr from the reactor pool using the transfer "rabbi" system. Dose rates from all irradiated experiment material are measured and recorded while maintained in the reactor pool, and, if necessary, radiation levels are permitted to decay to acceptable levels prior to removal from the pool. A review of the UVAR Control Room log for experiment material radiation measurements from June 1987 to April 1988 verified that all irradiated material dose rates were less than, or allowed to decay

below 250 mR/hr prior to transfer from the reactor pool. However, the inspector noted that this control level was not specified in licensee procedures. Licensee representatives agreed to include this action level in their radiation control procedures.

The maintaining of the low levels of radioactive material on surfaces within the facility, less than 50 dpm/100 cm<sup>2</sup> was discussed with licensee representatives. Contamination control for experiment material is maintained by use of containment structures, for example, ventilated hoods, opening of irradiated containers within the reactor pool, and/or appropriate HP monitoring while manipulating experiment materials in open areas. In addition, the Restricted Users and UVAR annual requalification training classes provide training regarding the opening of potentially contaminated samples and control of radioactive contamination.

No violations or deviations were identified.

## 5. Environmental (80745)

### a. Monitoring and Surveillance Methods

10 CFR 20.201(b) requires the licensee to make or cause to be made such surveys as (1) may be necessary for the licensee to comply with regulations in this part, and (2) are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present.

TS 3.4 details release limits for radioactive effluents discharged from the UVAR facility.

The following issues concerning licensee effluent measurement analytical capabilities were discussed.

- ° IE Report No 50-62/87-02 noted that a standard self-absorption curve (Radiological Health Handbook) was utilized for correcting gross beta-gamma activity measurements. Licensee representatives stated during the referenced audit that a new curve for the radionuclide and environmental matrices sampled at the facility would be calculated. At the time of this inspection development of the self absorption curve was in progress but had not been completed. Licensee representatives stated that this issue would be completed in a timely manner.
- ° The inspector reviewed and discussed selected EPA and vendor laboratory crosscheck results with licensee representatives. The inspector noted that results for the gross beta analyses were biased from approximately 30 to 50% above known EPA values. At the time of the inspection the licensee had not determined the source of the observed bias. The inspector noted that although a large error associated with gross beta-gamma analyses



was common, the consistency of the positive bias for their crosscheck results indicated a systematic error in their counting equipment and/or methodology. Licensee representatives agreed to review this issue.

- The licensee had completed an evaluation of the use of distilling liquid samples prior to measuring H-3 in liquid effluents to remove interfering radionuclides and thus improve the accuracy of their H-3 measurements. Licensee review of this issue indicated that for their system and nuclides, distillation did not have a significant effect, less than a 5%, change in the reported H-3 values. At the present time, the licensee did not regard the need to distill liquid effluent samples for H-3 analyses as necessary.
- The licensee has calculated the lower limit of detection (LLD) for radionuclide analyses of both liquid effluent and air particulate sample measurements. The LLD for gross beta/gamma analyses in liquid effluents and for portable air sample analyses were  $2.71 \text{ E-9 } \mu\text{Ci/ml}$  and  $6.67 \text{ E-13 } \mu\text{Ci/ml}$ , respectively. The required sample size and counting times to achieve these LLDs were not detailed in specific procedures, however, the licensee data sheets required a LLD calculation and a review of this value for each analysis for comparison to 10 CFR Part 20, Appendix B, MPC criteria. The licensee considered this review adequate to ensure that detection limits were adequate to meet regulatory limits.
- The potential interference of radon and radon daughter products for radionuclide analyses of particulate air samples was discussed. For each sample, an initial, that is, within several hours of collection, gross radionuclide analysis and a second analysis, approximately 24-48 hours later are conducted for gross radionuclide determinations. This allows for decay of radon daughter products collected. All particulate air sample results are reviewed and approved by the reactor health physicist to verify the two analyses have been completed properly for each particulate air sample collected.

No violations or deviations were identified.

- b. TS 3.4.1 states that exposure to the public resulting from the release of Ar-41 and other airborne effluents from UVAR will be below 10 CFR Part 20 limits for unrestricted areas.

Licensee representatives stated that facility Ar-41 monitors were set to alarm at concentrations which would result in concentrations approximately five hundred times less than MPC at the restricted area boundaries. During 1987, no indications that this concentration was exceeded was noted to the inspector. Based on the known operating

time and reactor power levels, a total of 1.76 Ci of Ar-41 was estimated to be released during 1987.

No violations or deviations were identified.

- c. TS 3.4.2 states that the activity of liquids released beyond the site boundary shall not exceed 10 CFR 20 limits for unrestricted areas.

Liquid radioactive effluent discharges from the UVAR facility were reviewed and discussed with licensee representatives. During 1987, approximately 42 releases were conducted. Gross beta-gamma and H-3 concentrations averaged approximately  $1 \text{ E-}8 \text{ uCi/ml}$  and  $1 \text{ E-}6 \text{ uCi/ml}$ , respectively. The total activity discharged for each release ranged from 1.25 - 153 uCi/per batch. The total gross beta-gamma activity released for 1987 was listed as 0.745 Ci. From January 1, 1988, to April 1, 1988, approximately 10 liquid waste tank effluent releases were conducted and radionuclide concentrations were similar to values measured during 1987.

No violations or deviations were identified.

#### 6. Transportation (86740)

10 CFR 71.5 requires that each licensee who transports licensed material outside the confines of its plant or other place of use to comply with the applicable requirements of the Department of Transportation (DOT) in 49 CFR Parts 170 through 189.

Transportation of radioactive waste material from the UVAR facility was reviewed and discussed. Since the last inspection (IE Report No. 50-62/87-02) the licensee had not conducted any shipments of radioactive waste material generated by the UVAR facility.

Licensee records for radioactive material transferred from the UVAR facility were reviewed. Approximately 11 shipments were transferred to other campus facilities and 19 shipments were sent off campus. All shipments appeared to be in accordance with appropriate NRC and DOT regulatory requirements.

During 1987, four shipments of irradiated fuel, each containing nine elements, were shipped offsite to a process facility. The inspector verified that DOE/NRC Form 741, Nuclear Material Transaction Reports, were completed as required for each transfer. In addition, the shipping manifest records and licensee checklists, (DOT/49 CFR Quality Assurance Checklist), associated with each shipment were reviewed. For each shipment, the transportation index (TI) did not exceed one and radiation levels measured on all external surface of the shipping cask were less than 200 mR/h. The inspector noted that for two of the shipments, external dose rates measured beneath the lower external surface of the vehicle, were not recorded on the licensee DOT/49 CFR checklist. Discussion with cognizant licensee representatives indicated that the

required measurements were conducted but were not recorded on the sheet. Further review determined that the surveys were conducted and the results entered on the operations procedure, Procedure for Transferring UVAR Fuel Elements to GE Series Shipping Cask. The need for the data to be documented and properly reviewed by a responsible staff person for completeness was discussed. Licensee representatives stated that the overlap between the health physics checklist and the operations procedure would be evaluated and improvements to the procedures implemented.

No violations or deviations were identified.

7. IE Information Notices (IEN) (92717)

The inspector determined that the following NRC IE Information Notices (IENs) had been received by the licensee, distributed to the appropriate personnel, and reviewed for applicability to the radiation protection program.

- a. IEN 87-03: Segregation of Hazardous and Low-Level Radioactive Wastes
- b. IEN 87-31: Blocking, Bracing, and Securing of Radioactive Materials Packages in Transportation