March 26, 2002

Dr. Robert U. Mulder, Director
Nuclear Reactor Facility
University of Virginia
P.O. Box 400322
Charlottesville, VA 22904-4322

SUBJECT: UNIVERSITY OF VIRGINIA RESEARCH REACTOR - AMENDMENT RE: DECOMMISSIONING PLAN APPROVAL (TAC NO. MA8186)

Dear Dr. Mulder:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 26 to Amended Facility Operating License No. R-66 for the University of Virginia Research Reactor (UVARR).

The amendment approves the decommissioning plan for the UVARR in response to your application of February 9, 2000, as supplemented on April 26, June 6, and December 19, 2000, and May 4 and 11, 2001. The amendment authorizes the approved decommissioning plan to be included as a supplement to the Safety Analysis Report pursuant to 10 CFR 50.82(b)(5). The amendment also consists of changes to the Technical Specifications requested in your application. In addition, in accordance with 10 CFR 50.82(b)(5), the staff has added license conditions to Amended Facility Operating License No. R-66 deemed appropriate and necessary for approval of the decommissioning plan.

A copy of the safety evaluation supporting Amendment No. 26 is also enclosed.

Sincerely,

/RA/

Alexander Adams, Jr., Senior Project Manager
Research and Test Reactor Section
Operating Reactor Improvements Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-62

Enclosures: 1. Amendment No. 26
2. Safety Evaluation

cc w/enclosures: Please see next page

cc:

Department of Environmental Quality
Office of Grants
Management/Intergovernmental Affairs
629 East Main Street, Sixth Floor
Richmond, VA 23219

Dr. William Vernetson
Director of Nuclear Facilities
Department of Nuclear Engineering
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University of Florida
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Gainesville, FL 32611

Office of the Attorney General
900 East Main Street
Richmond, VA 23219

Virginia Department of Health
Radiological Health Program
P.O. Box 2448
Richmond, VA 23218

Dr. Ralph O. Allen, Chairman
Reactor Decommissioning Committee
University of Virginia
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DATE	02/ 19 /2002		02/ 20 /2002		02/ 27 /2002		03/ 04 /2002		03/ 26 /2002	

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UNIVERSITY OF VIRGINIA

DOCKET NO. 50-62

AMENDMENT TO AMENDED FACILITY OPERATING LICENSE

Amendment No. 26
License No. R-66

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that

   A. The application for an amendment to Amended Facility Operating License No. R-66 filed by the University of Virginia (the licensee) on February 9, 2000, as supplemented on April 26, June 6, and December 19, 2000, and May 4 and 11, 2001, conforms to the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the regulations of the Commission as stated in Chapter I of Title 10 of the *Code of Federal Regulations* (10 CFR);

   B. The facility will be possessed and decommissioned in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance that (i) the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) such activities will be conducted in compliance with the regulations of the Commission;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;

   E. This amendment is issued in accordance with the regulations of the Commission as stated in 10 CFR Part 51, and all applicable requirements have been satisfied; and

   F. Prior notice of this amendment was not required by 10 CFR 2.105 and publication of a notice for this amendment is not required by 10 CFR 2.106.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the enclosure to this license amendment, and paragraph II.C.(2) of Amended Facility Operating License No. R-66 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 26, are hereby incorporated in the license. The licensee shall possess and decommission the facility in accordance with the Technical Specifications.

3. Accordingly, the license is amended by the addition of paragraph II.C.(4) to Amended Facility Operating License No. R-66 which hereby reads as follows:

   (4) Decommissioning

   a. The license is amended to approve the decommissioning plan described in the licensee's application dated February 9, 2000, as supplemented on April 26, June 6, and December 19, 2000, and May 4 and 11, 2001, and authorizes inclusion of the decommissioning plan as a supplement to the Safety Analysis Report pursuant to 10 CFR 50.82(b)(5).

   b. The licensee may make changes to the decommissioning plan without prior approval provided the proposed changes do not:

      (i) Require Commission approval pursuant to 10 CFR 50.59;

      (ii) Use a statistical test other than the Sign test or Wilcoxon Rank Sum test for evaluation of the final status survey;

      (iii) Increase the radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs;

      (iv) Reduce the coverage requirements for scan measurements;

      (v) Decrease an area classification (i.e., impacted to unimpacted; Class 1 to Class 2; Class 2 to Class 3; or Class 1 to Class 3);

      (vi) Increase the Type I decision error;

      (vii) Increase the derived concentration guideline levels and related minimum detectable concentrations (for both scan and fixed measurement methods);

      (viii) Result in significant environmental impacts not previously reviewed.

   c. The licensee shall submit reports of any characterization surveys performed that were not part of the license amendment application and shall submit the

completed final status survey plan for review prior to performing the final status survey.

d. The licensee shall submit a report of their investigation of groundwater conditions including the groundwater flow system and groundwater flow rate to account for the leakage pathway from the reactor pool and to determine if radionuclides from licensed activities have or may potentially migrate offsite in the future.

3. This license amendment is effective as of the date of its issuance.

FOR THE U. S. NUCLEAR REGULATORY COMMISSION

/RA/

Patrick M. Madden, Section Chief
Research and Test Reactors Section
Operating Reactor Improvements Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Enclosure:
Appendix A, Technical
Specifications Changes

Date of Issuance: March 26, 2002

ENCLOSURE TO LICENSE AMENDMENT NO. 26

AMENDED FACILITY OPERATING LICENSE NO. R-66

DOCKET NO. 50-62

Replace the following pages of Appendix A, "Technical Specifications," with the enclosed pages. The revised pages are identified by amendment number and contain vertical lines indicating the areas of change.

Remove	Insert
2	2
	34a
37	37
40	40
49	49

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4.11 Surveillance of Decommissioning Instrumentation

Applicability: This specification applies to the traceability and frequency of the calibration of those field and laboratory radiation detection instrumentation, and associated detectors, used in decommissioning activities at the UVAR Facility.

Objective: The objective is to have only legally well-calibrated radiation survey and detection instrumentation used in decommissioning work.

Specification:

Laboratory instruments and associated detectors used in decommissioning activities shall be calibrated on an annual basis.

Field radiation detection instruments and associated detectors used in decommissioning activities shall be calibrated on an annual basis.

National Institute of Standards and Technology (NIST) traceable sources and appropriate calibration equipment shall be used in the calibration of this equipment.

Basis: Accurate measurements to meet license conditions and federal regulations require that properly calibrated instrumentation be used.

5.2. Reactor Building

TS 5.2 has been deleted, for the specifications on confinement, ventilation and reactor room free volume have been required to restrict leakage of radionuclides produced during reactor operation at power. The UVAR is no longer operated.

5.2.1 Temporary Pool Confinement

Applicability: This specification applies to the utilization of a confinement barrier surrounding the reactor pool, with an associated local ventilation system, operating whenever airborne hazards could arise within the reactor pool during decommissioning work.

Objective: The barrier surrounding the reactor pool and its associated ventilation and filtration system are intended to minimize potential risks associated with worker inhalation of radioactive material made airborne by D&D work.

Specification: While decommissioning activities involving the reactor pool are in progress, such that airborne hazards may be produced, a confinement barrier surrounding the reactor pool shall have been erected and placed into use. A local ventilation system shall be operating during these periods, to ensure negative pressure within the confinement with respect to the Reactor Room and to provide high-efficiency filtration of the air exhausted from the enclosure.

Basis: The barrier and ventilation system together will ensure that reactor pool confinement air is scrubbed clean by high-efficiency filters prior to release to the Reactor Room.

(rest of page intentionally left blank)

The Reactor Supervisor shall have the equivalent of a bachelor's degree in science or engineering and at least 2 years of experience in Reactor Operations at this facility, or an equivalent facility, or at least 6 years of experience in Reactor Operations. Equivalent education or experience may be substituted for a degree. Within nine months after being assigned to the position, the Reactor Supervisor shall obtain and maintain a NRC Senior Reactor Operator license if reactor fuel elements are still at the Facility. A NRC Senior Reactor Operator license, or a Reactor Operator license, is not required for level 3 and 4 personnel once all reactor fuel elements have been shipped offsite.

The Radiation Safety Officer shall be responsible for providing radiological support in the decommissioning of the UVAR. This function ensures that the activities involving potential radiological exposure are conducted in compliance with the applicable licenses, Federal and State regulations, and UVAR standard operating procedures. The position includes responsibility for maintaining the UVAR surveillance and monitoring program and for HP radiological protection procedures.

The minimum qualifications for the Radiation Safety Officer positions are a four-year degree in Health Physics or a related field, three years supervisory experience in Health Physics and five years operational experience related to radiation safety.

6.1.3. Staffing

A licensed Senior Reactor Operator shall supervise any movement of reactor fuel. One or more health physicists, organizationally independent of the Reactor Staff as shown in Figure 6.1, shall be responsible for radiological safety at the Reactor Facility.

6.1.4. Selection and Training of Personnel

The selection, training and requalification of Reactor Facility personnel shall follow the American National Standard for Selection and Training of Personnel for Research Reactors, ANSI/ANS-15.4-1988, Sections 4-6, to the extent applicable to the decommissioning status of the facility. The selected criteria for the personnel will be contained in the NRC-approved Operator Requalification Program, as amended.

Bases: Sections 6.1, 6.1.1, 6.1.2, 6.1.3 and 6.1.4 of the American National Standard ANSI/ANS 15.1-1990 "The Development of Technical Specifications for Research Reactors," describe a generic and generally acceptable organizational structure for U.S. research reactors.

They provide the bases for TS 6.1 above. Some of the ANSI standard recommendations apply to operable or operating reactor facilities, and are not necessarily valid for staff hired to perform decommissioning activities.

(rest of page intentionally left blank)

6.3. Standard Operating Procedures

Applicability: The specification below concerns the procedural controls used to operate the University of Virginia Reactor (UVAR) and conduct experiments.

Objective: The objective is the safe operation of the reactor in compliance with license conditions, federal regulations.

Specifications:

6.3.1. Items Covered by SOPs

Written procedures, reviewed and approved by the Reactor Safety Committee shall be in effect and followed for the items listed below. These procedures shall be adequate to ensure the safe decommissioning of the reactor, but should not preclude the use of independent judgment and action should the situation require such.

(1) Startup, operation and shutdown of the reactor.

(2) Installation or removal of fuel elements, control rods, experiments, and experimental facilities.

(3) Actions to be taken to correct specific and foreseen potential malfunctions of systems or components, including responses to alarms, suspected primary coolant system leaks, abnormal reactivity changes.

(4) Emergency conditions involving potential or actual release of radioactivity, including provisions for evacuation, re-entry, recovery, and medical support.

(5) Preventative and corrective maintenance operations that could have an effect on reactor safety.

(6) Periodic surveillance.

(7) Radiation control.

(8) Maintenance, response testing and record keeping involving radiation detecting field instrumentation and associated detectors utilized in the decommissioning of the Reactor Facility.

6.3.2. Changes to SOPs

Substantive changes to approved procedures shall be made only with the approval of the Reactor Safety Committee (or by the Reactor Decommissioning Committee after the ReSC ceases to exist). Changes that do not change the original intent of the procedures may be made with the approval of the Facility Director. All such minor changes shall be documented and subsequently reviewed by the Reactor Safety Committee (or by the Reactor Decommissioning Committee after the ReSC ceases to exist).

Basis: Section 6.4 of American National Standard ANSI/ANS 15.1-1990, "The Development of Technical Specifications for Research Reactors," suggests acceptable procedural controls to be applied to operating U.S. research reactors.

Safety Evaluation Report Related to the Decommissioning of

the University of Virginia Research Reactor

University of Virginia

March 2002

Office of Nuclear Reactor Regulation
Division of Regulatory Improvement Programs
Operating Reactor Improvements Program

ABSTRACT

This safety evaluation report summarizes the findings of a safety review conducted by the staff of the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation. The staff conducted this review in response to an application filed by the University of Virginia (the licensee or UVA) for approval of the decommissioning plan (DP) for the University of Virginia Research Reactor (UVAR). The UVAR is located on the UVA campus near Charlottesville, Virginia. On the basis of this review, the staff concludes that UVA can safely dismantle the UVAR and dispose of the component parts in accordance with their DP, as amended, and the NRC's rules and regulations.

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1.0 INTRODUCTION

By letter dated February 9, 2000, the University of Virginia (UVA or the licensee) (Ref. 1), submitted a request for approval of its decommissioning plan (DP) dated February 2000 (Ref. 2), and authorization to dismantle and dispose of component parts of the UVA Research Reactor (UVAR). By letter dated April 26, 2000 (Ref. 3), the licensee submitted replacement pages to update the DP. The licensee responded to a request for additional information from the Nuclear Regulatory Commission (NRC) staff dated November 2, 2000 (Ref. 4), on December 19, 2000 (Ref. 6), and a second request for additional information from the NRC staff dated April 13, 2001 (Ref 5), on May 4, 2001 (Ref. 7). By letter dated June 6, 2000, the licensee submitted their radiological characterization report (Ref. 8). On May 11, 2001 (Ref. 32), the licensee submitted additional information concerning facility site hydrology.

The decommissioning, as described in the plan, is the DECON option and will consist of transfer of licensed radioactive equipment and material from the site, and decontamination of the facility to meet the unrestricted release criteria given in Title 10, Code of Federal Regulations, Part 20.1402 (10 CFR 20.1402). In their application, the licensee describes how the final status survey plan will be developed once the Decommissioning Operations Contractor (DOC) is selected. The licensee will perform a final status survey to verify and document that the decommissioned areas and structures meet the requirements of release for unrestricted use. UVA will then submit documentation of the satisfactory completion of its final status survey to the NRC for review and acceptance.

A “Notice and Solicitation of Comments Pursuant to 10 CFR 20.1405 and 10 CFR 50.82(b)(5) Concerning Proposed Action to Decommission the University of Virginia, University of Virginia Reactor (UVAR)” was published in the FEDERAL REGISTER on April 4, 2000 (65 FR 17684), and in the Charlottesville Daily Progress on April 23, 2000. One comment was received from the Director, Radiological Health, Commonwealth of Virginia, Department of Health, Radiological Health Program that “the proposed decommissioning plan appears to adequately ensure the return of the facility to unrestricted use without adversely affecting the public health and safety.”

2.0 BACKGROUND

2.1 Regulatory Basis

The requirements for the contents of decommissioning plans for research and test reactor are in 10 CFR 50.82(b)(4). This regulation requires that the proposed decommissioning plan include:

- The choice of the alternative for decommissioning with a description of activities (See Section 3.1 below);
- A description of the controls and limits on procedures and equipment to protect occupational and public health and safety (See Section 3.2 below);
- A description of the planned final radiation survey (See Section 3.3 below);

- An updated cost estimate for the chosen alternative for decommissioning, comparison of that estimate with present decommissioning funds set aside, and plan for assuring the availability of adequate funds to complete decommissioning (See Section 3.4 below); and

- A description of technical specifications, quality assurance provisions and physical security plan provisions in place during decommissioning (See Sections 3.5, 3.6 and 3.7 below).

Title 10 CFR 50.82(b)(5) states that if the decommissioning plan demonstrates that the decommissioning will be performed in accordance with the regulations in this chapter and will not be inimical to the common defense and security or to the health and safety of the public, and after notice to interested persons, the Commission will approve, by amendment, the plan subject to such conditions and limitations as it deems appropriate and necessary. License conditions for this amendment were based on "Policy and Guidance Regarding Revising Approved License Termination Plans without NRC Approval," memorandum from Larry W. Camper, dated June 22, 2001. Further, the staff established a license condition in accordance with the requirement of 10 CFR 50.82(b)(5) that the approved decommissioning plan will be a supplement to the Safety Analysis report or equivalent.

The requirements after the approval of the decommissioning plans are in 10 CFR 50.82(b)(6). This regulation states that the Commission will terminate the license if it determines that the decommissioning was in accordance with the approved decommissioning plan, and that the terminal radiation survey and associated documentation show that the facility and site are suitable for release in accordance with the criteria for decommissioning in 10 CFR part 20, subpart E.

2.2 Site and Facility Description and Operating History

The UVAR site and facility is situated on property owned by the UVA near Charlottesville, Virginia. UVA was granted a construction permit for the reactor on September 13, 1957, from the U. S. Atomic Energy Commission. Immediately thereafter, working with the Architect/Engineer, Castle Construction Company of Charlottesville, Virginia, UVA began construction of a facility to house the UVAR and supporting systems.

The UVAR's initial startup was in June 1960. It was permanently shut down at midnight, June 30, 1998. Facility License No. R-66 was limited to possession-only by the issuance of Amendment No. 25 on February 9, 2000. All reactor fuel elements were removed from the reactor pool and returned to the Department of Energy. The integrated power generated during operation of the UVA Reactor is estimated at 2559 MW-days.

The UVAR is an open pool research reactor of the Materials Testing Reactor design. It is a light water moderated and cooled, and graphite or water reflected non-power reactor. It was licensed and first operated at 1 Megawatt thermal power [MW(t)] in June 1960. The licensed power was increased to 2 MW(t) in January 1971. The reactor was permanently shut down on July 1, 1998. All reactor fuel elements were removed from the reactor pool and returned to the Department of Energy. License Amendment No. 25 was issued to UVA on February 9, 2000 (Ref. 9). With that amendment, the licensee's authority was changed to possession-only of the residual radioactive materials and surveillance requirements related to reactor operation were

removed from the Technical Specifications (TSs). Table 2-1 provides the profile of general UVA reactor information.

Table 2-1 Profile of University of Virginia Reactor

Item Description	UVAR
General Reactor information:	
Owner:	University of Virginia
Operator:	University of Virginia
Licensee:	University of Virginia
Architect/Engineer	Babcock & Wilcox
Nuclear Design:	EG&G, Idaho
Construction:	Castle Construction Co.
Principal Uses:	Training and Research
Reactor Operation and Authorization:	
Initial Criticality:	June 1960; increased power from 1MW(t) to 2 MW (t) January 1971
Date Secured:	July 1, 1998
NRC Utilization Facility License #:	R-66
NRC Facility Docket #:	50-62
Reactor Specifications:	
Maximum Power, Steady State, MW(t):	2 MW
$f_{thermal}$ Steady State, Graphite Reflected (nv):	2.2×10^{13}
$f_{thermal}$ Steady State, Water Reflected (nv):	0.17×10^{13}
Specific Power (kW/kg ^{235}U):	273.97
Core Power Density, (kW/l):	27.97
Fuel Material:	LEU, U_3Si_2
Fuel Uranium Content, vol.-% ^{235}U:	3.67%
Uranium Enrichment, % ^{235}U:	<20%
Fuel Element Geometry:	Flat Plate
Element Cladding Material:	Aluminum
Element Cladding Thickness:	0.015 in (0.038 cm)
Core Configuration:	Square Array
Core Active Height:	23.5 in (60 cm)
No. of Available Fuel Positions:	64
Coolant:	Light Water
Moderator:	Light Water
Reflector:	Graphite or Water

The following systems continue in operation:

1. The UVAR building utility services that are required for facility possession and maintenance under possession-only status.

2. The UVAR manually-actuated and automated fire alarm systems.

3. The UVAR security and radiological alarm systems.

4. The UVAR water demineralization system.

2.3 Scope of the Decommissioning Project

The UVAR DP lists the various areas, structures and components that are included in the decommissioning project. All areas inside the facility fence (~96,000 ft^2 or 8900 m^2) are included in the decommissioning process. Some of the specific areas included are listed below (see Figures 2-1 to 2-6).

The specific yard areas to be addressed in the decommissioning project:

Underground Tanks	~800 ft^2 (75 m^2)
Transfer Tank	~80 ft^2 (7.5 m^2)
Site Environs	~80,000 ft^2 (750 m^2)
Pond	~16,000 ft^2 (1486 m^2)

Some of the specific rooms to be addressed in the decommissioning project:

Reactor Room, Room 131	2648 ft^2 (246 m^2)
Instrument Shop, Room 128	305 ft^2 (28 m^2)
Shipping Room, Room 127	175 ft^2 (16 m^2)

The specific mezzanine floor rooms to be addressed in the decommissioning project:

Demineralizer Room, Room M021	246 ft^2 (23 m^2)
Mechanical Room, Room M020	507 ft^2 (47 m^2)
Health Physics (HP) Lab, Room M019	492 ft^2 (46 m^2)
Mezzanine Crawl Space, Room MCS	576 ft^2 (54 m^2)
Former HP Lab, Room M005	288 ft^2 (27 m^2)
Former Hot Lab, Room M008	338 ft^2 (31 m^2)

The specific ground floor rooms to be addressed in the decommissioning project:

Heat Exchanger Room, Room G024	297 ft^2 (28 m^2)
Source Storage Room, Room G022	110 ft^2 (10 m^2)
Hot Cell, Room G025	93 ft^2 (8.6 m^2)
Large Access Facilities	84 ft^2 (7.8 m^2)
Instrument Storage Room, Room G015	114 ft^2 (11 m^2)
Storage Room, Room G018	317 ft^2 (29 m^2)
Ground Floor Area, Room G028	2216 ft^2 (206 m^2)
Wood Shop, Room G008A	126 ft^2 (12 m^2)
Machine Room, Room G008	1042 ft^2 (97 m^2)
Counting Room, Room G004	451 ft^2 (42 m^2)
Rabbit Room, Room G005	229 ft^2 (21 m^2)

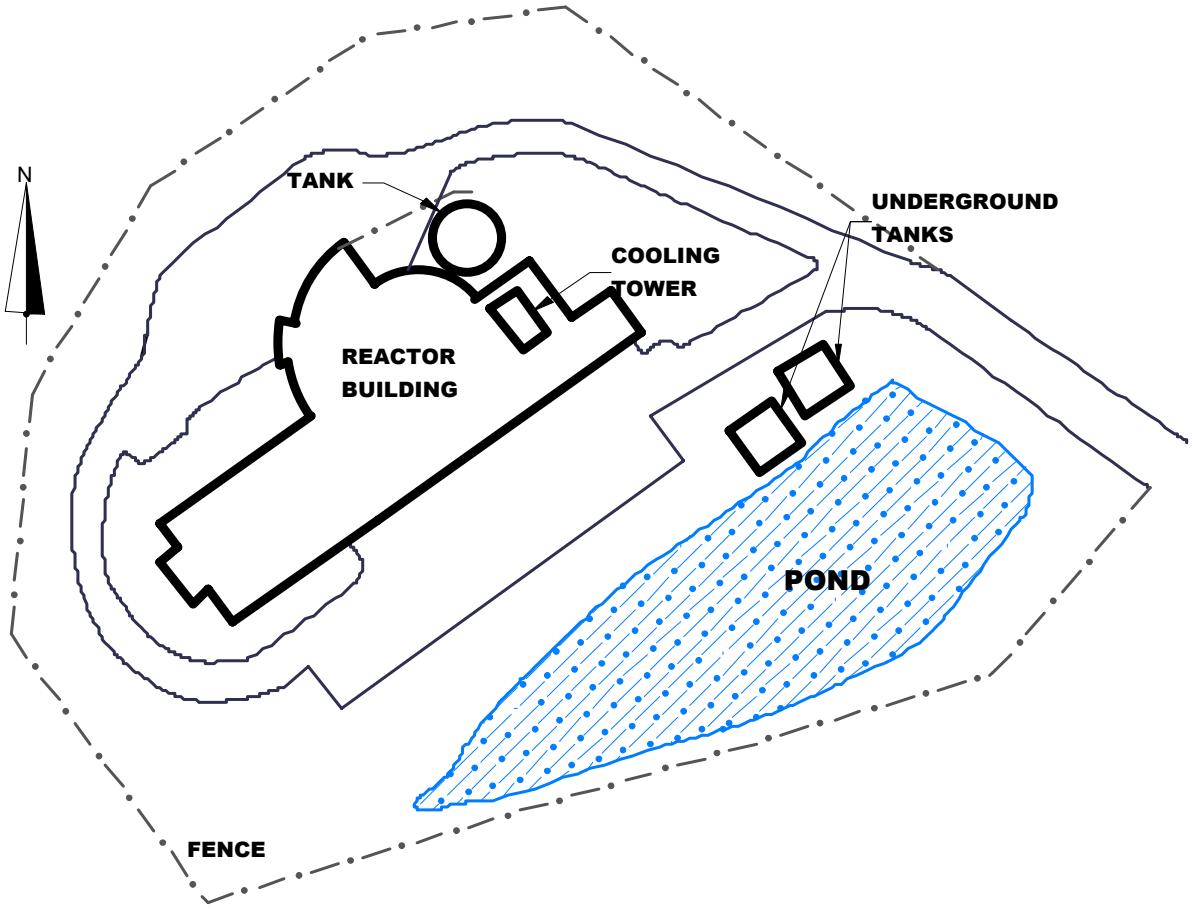

Figure 2-1 University of Virginia Reactor Site

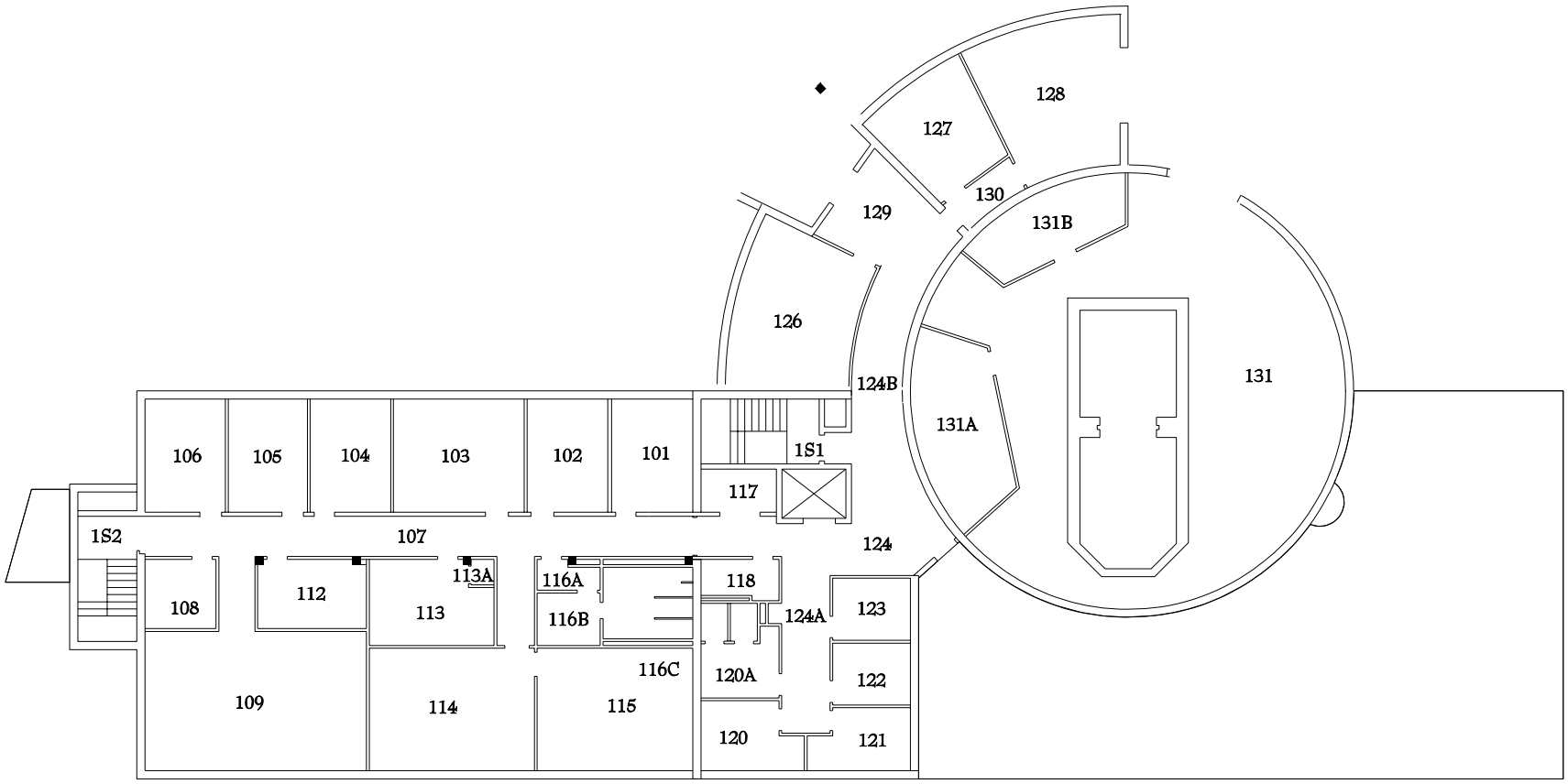

Figure 2-2 UVA Reactor First Floor Plan View

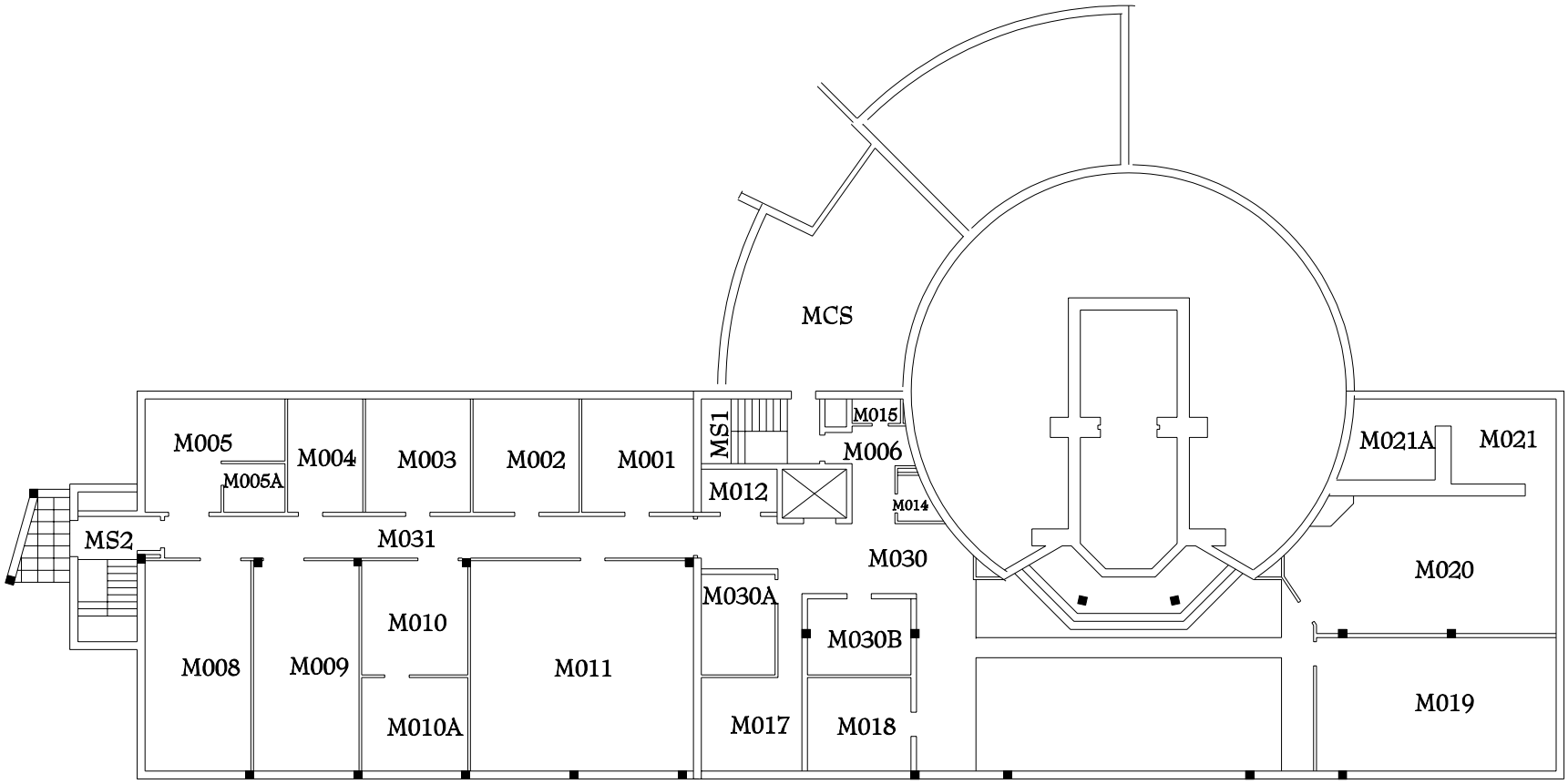

Figure 2-3 UVA Reactor Mezzanine Floor Plan View

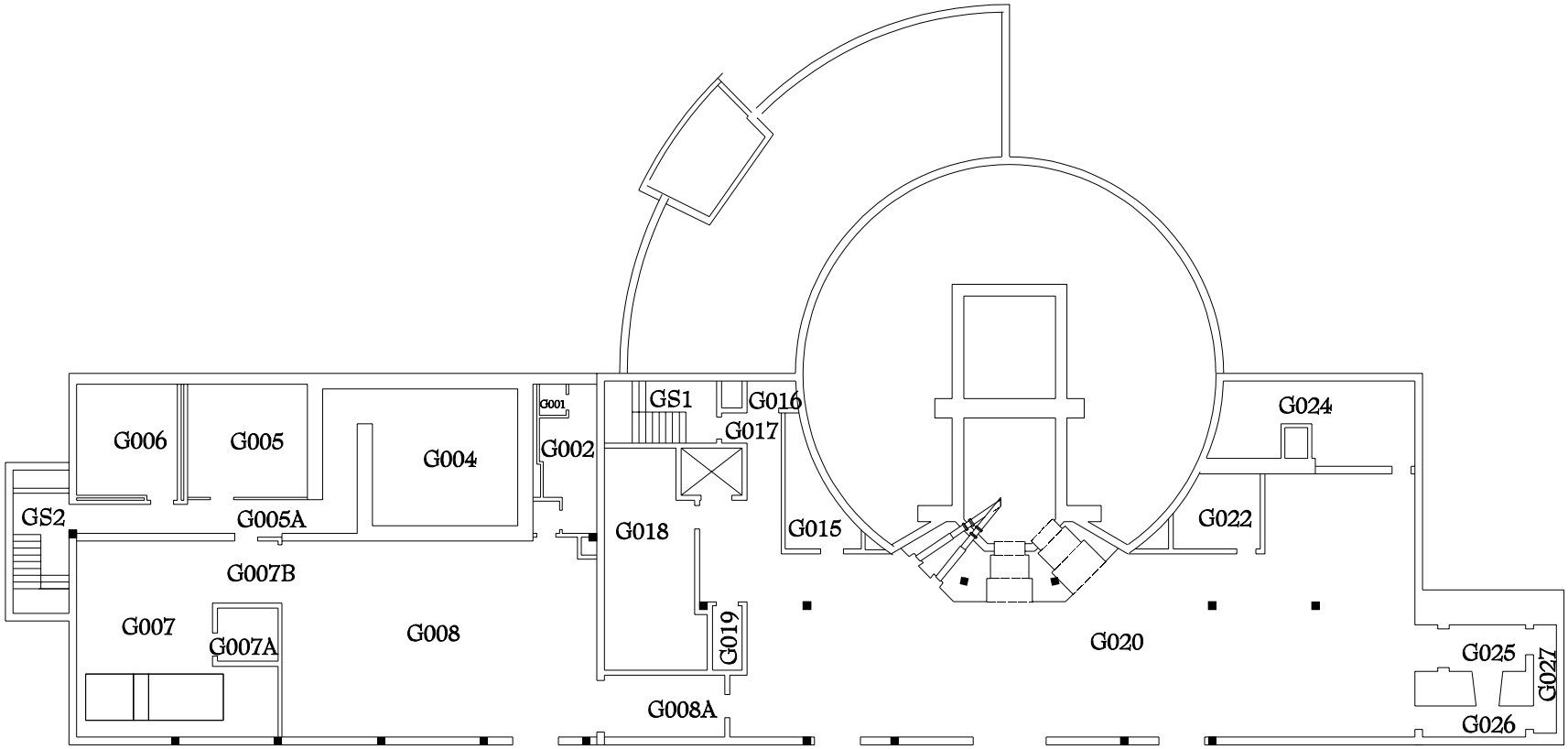

Figure 2-4 UVA Reactor Ground Floor Plan View

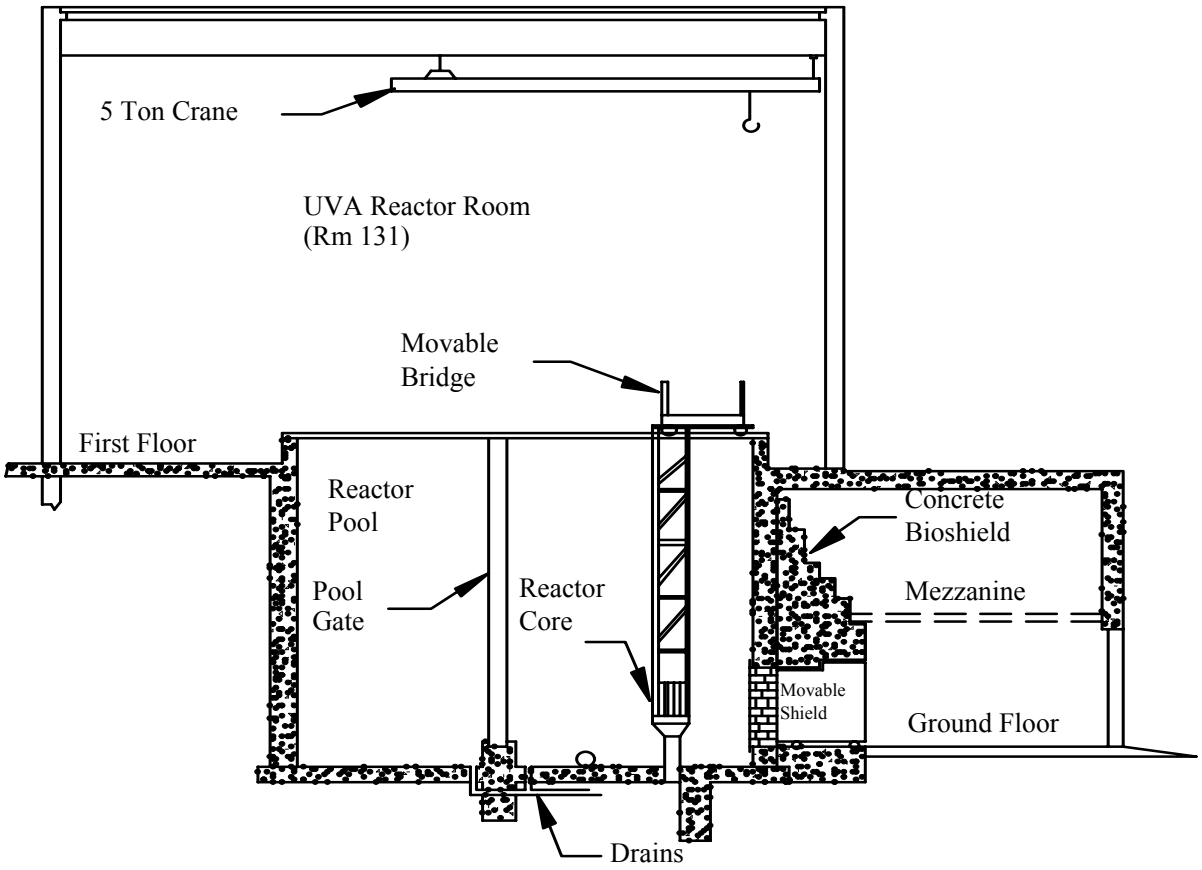

Figure 2-5 UVA Reactor Elevation View

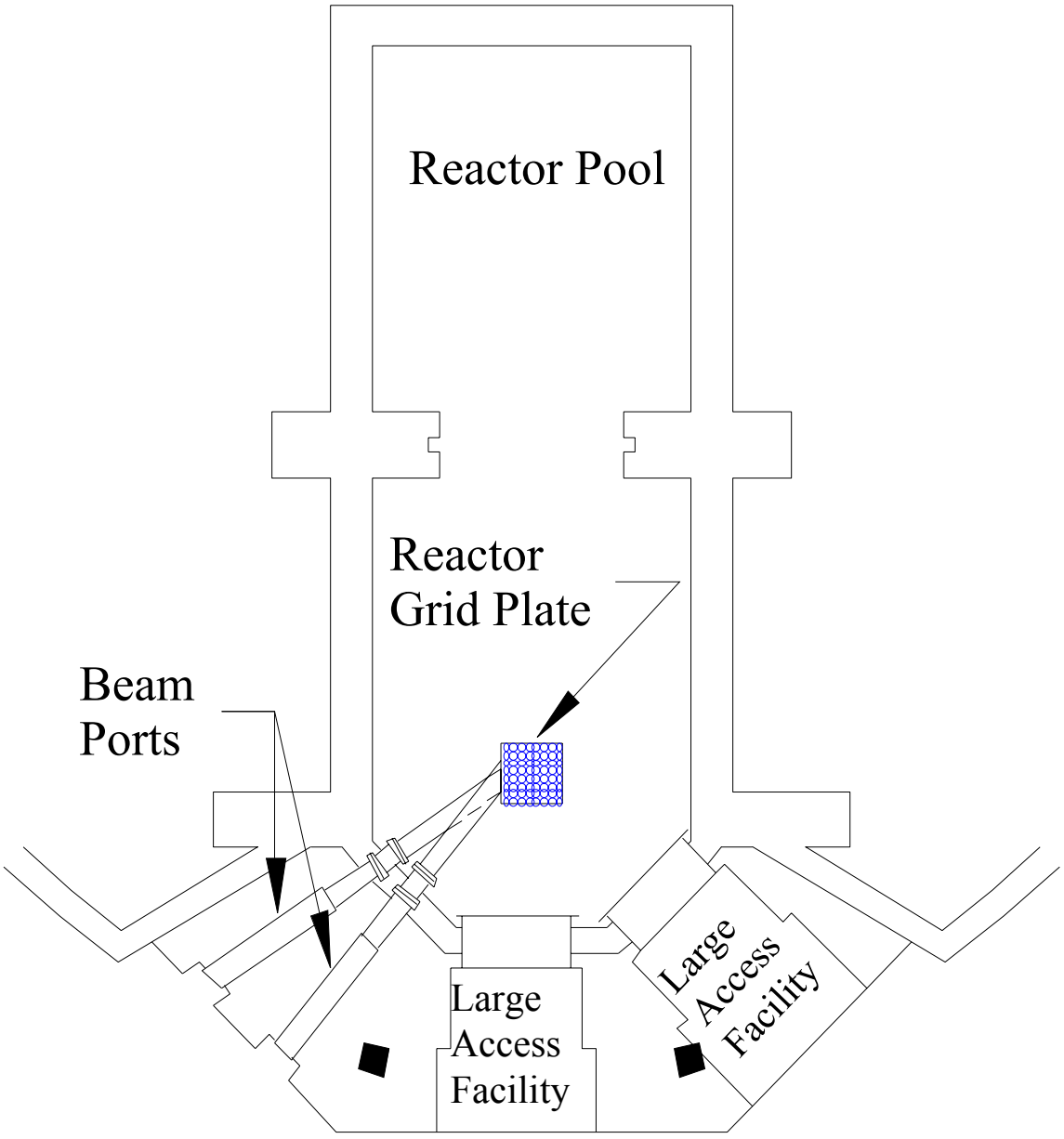

Figure 2-6 UVA Pool and Reactor Cross Section View

There are a few other rooms and areas that are not listed since they are part of the Cooperatively Assembled Virginia Low Intensity Educational Reactor (CAVALIER) DP (Ref. 10). The CAVALIER is a second reactor owned by UVA located in the same building as the UVAR. The NRC approved the DP for the CAVALIER on February 3, 1992. The licensee postponed decommissioning activities so that both reactors could be dismantled at the same time.

The entire facility (fenced in area), the building, and any other areas, as necessary, will be included in the final status survey and will meet the release criteria before they are released for unrestricted use.

3.0 EVALUATION

The NRC staff has reviewed the licensee's proposed actions to decontaminate, dismantle, dispose of component parts of the UVAR, and to perform a final status survey. After review and approval, if within acceptable limits, the final status survey results will demonstrate that the site and facility are suitable for release and Facility License No. R-62 can be terminated. The NRC staff's review focused on the licensee meeting the regulatory requirements discussed in Section 2.1 above and included consideration of (a) management responsibilities and commitments to continue following applicable regulations, regulatory guides, standards and personnel protection plans, including procedures, (b) use of appropriate equipment and instrumentation, radiation survey methods, training, personnel dosimetry, radioactive waste disposal, and (c) the plan to develop and perform the final status survey of the facility. Due to the iterative nature of the characterization plan and decommissioning methods particular attention was paid to the personnel qualifications and the licensee's commitment to meet the radiological release criteria and the quality assurance plan.

3.1 Decommissioning Alternative

The licensee's stated objective of UVAR Decommissioning is the regulatory release of the UVAR and adjacent contiguous facility site environs to unrestricted use. DECON is the decommissioning option chosen by UVA to meet that objective. Decontamination of facility equipment and structural components will be conducted to minimize radioactive waste. Structural portions of the building and surrounding soils and materials found to be radiologically contaminated and/or activated will be decontaminated, sectioned and removed, and/or processed, as necessary. This will be followed by an extensive and comprehensive final status survey to demonstrate that the UVAR meets the NRC criteria for release to unrestricted use. The results of this final status survey will be documented in a report to be submitted to the NRC in support of a request that the site be released to unrestricted use and the reactor license terminated.

3.1.1 Conclusions

The NRC staff has concluded that the choice of DECON and associated proposed plans meets the provisions of 10 CFR Part 50.82(b)(4)(i) for decommissioning without significant delay and are, therefore, acceptable.

3.2 Controls and Limits on Procedures and Equipment to Protect Occupational and Public Health and Safety

3.2.1 Project Management Structure

3.2.1.1 Decommissioning Organization and Responsibilities

UVA is committed to, and retains ultimate responsibility for full compliance with the existing NRC reactor license and the applicable regulatory requirements during decommissioning. In addition, University policies and goals will be followed to ensure high standards of performance in accomplishing the decommissioning tasks.

The planned organization for the UVAR Decommissioning as shown in Figure 2-1 of the DP will be maintained, however individuals performing the functions may vary over the project duration. The licensee states that specialized contractors may be utilized under the direction of the UVA Reactor Facility Director, when necessary and appropriate, to supplement the Decommissioning Operations Contractor (DOC).

3.2.1.2 Key Licensee Positions

The following are key licensee positions as proposed in the DP.

- The UVA Reactor Facility Director (RFD) has the overall responsibility for successful completion of the project. The RFD functions include:
    - Controlling and maintaining safety during decommissioning activities and protecting of the environment,
    - Determining UVA project staffing and organization,
    - Assuring performance to cost and schedule,
    - Reporting of performance,
    - Approving minor changes to the DP and procedures (which do not change the original intent and can be made under 10 CFR 50.59),
    - Approving subcontracts,
    - Approving budgets and schedules,
    - Oversight and coordination of UVA functional groups and decommissioning contractors,
    - Assuring that the conduct of decommissioning activities complies with applicable regulations and is in accordance with UVA licenses, and
    - Assuring that decommissioning data is accurately logged and that the corresponding hard copies are filed in a timely manner.

The DP lists and the TS 6.1.2, “Responsibility,” specify the minimum qualifications for this position.

- The functions of the UVA Reactor Supervisor include:
    - Maintaining the UVAR in a safe and proper condition during the evolution of decommissioning project activities, in accordance with the requirements set forth in the applicable NRC facility licenses,
    - Review of plans and procedures, and
    - Providing engineering support for the decommissioning activities.

The DP lists and the TS 6.1.2, “Responsibility,” specify the minimum qualifications for this position.

- The UVA Radiation Safety Officer (RSO) is responsible for providing radiological support in the decommissioning of the UVAR. The responsibilities of the UVA RSO include:
    - Maintenance of the UVAR surveillance and monitoring program
    - Issuance and maintenance of HP radiological protection procedures
    - Compliance of activities involving potential radiological exposure with the applicable licenses, Federal and State regulations and UVA procedures.

The DP lists the minimum qualifications for this position. In addition, the licensee proposes to change TS 6.1.2, “Responsibility,” to include the minimum qualifications of the RSO (See Section 3.5.3).

3.2.1.3 Decommissioning Operations Contractor Assistance

The licensee provided their criteria for the selection of a DOC. The licensee stated that a successful contractor should demonstrate experience in the performance of the following tasks:

- Integration of decommissioning, dismantlement, and demolition plans,
- Waste management and other methods used to minimize final waste disposal costs,
- Decontamination and remediation of facilities and equipment,
- Use of survey equipment and techniques suitable for compliance with current NRC or MARSSIM survey criteria,
- Use of inventory and tracking mechanisms to assure accurate waste tracking,

- Provision of data collection packages that can capture data used in job estimate, work tasks and other data that will assist in the planning and execution of the decommissioning,

- Development and execution of radiological and industrial safety that will be used during the decommissioning,

- Selection, design and /or procurement of appropriate containers and packaging for radioactive and hazardous waste, and transportation to approved treatment and disposal facilities,

- Performing license termination surveys on a project of similar size and scope,

- Package, manifest, transport, process and dispose of radioactive waste, and

- Instrumentation and procedures to perform embedded pipe surveys.

The licensee also stated that the decommissioning contractor selected must have a QA program that meets the requirements of 10 CFR Part 71, Subpart H. In addition, the contractor's QA program must meet the applicable criteria from 10 CFR Part 50, Appendix B; and the American Society of Mechanical Engineers (ASME) NQA-1 (Ref. 17). One of the applicable criteria that must be included is a QA Approved Suppliers List.

The selected DOC, as proposed by the licensee, should be prepared to provide qualified personnel, including but not limited to the following:

- Project Manager,

- Certified Health Physicist that meets American National Standards Institute (ANSI) 3.1 (Ref. 18) qualifications with MARRSIM survey experience,

- Waste Management Specialist,

- Industrial Hygienist,

- Civil and Mechanical Engineer,

- Quality Assurance Engineer,

- Construction Supervisor who has completed Federal Occupational Safety and Health Acts (OSHA) 40-hour compliance training,

- Cost Estimating and Control Specialist,

- Planning and Scheduling Specialist,

- Database Administrator,

- Decontamination and Waste Technicians, and

- Radiological Safety Engineer, Foreman and Technicians.

3.2.1.4 UVA Reactor Decommissioning Committee

The licensee mandates the Reactor Decommissioning Committee (required by TS 6.2.C) to monitor decommissioning operations to ensure they are being performed safely and according to Federal, state, and local regulatory requirements. The Reactor Decommissioning Committee is required to review major decommissioning activities dealing with radioactive material and radiological controls. In addition, the Reactor Decommissioning Committee will review and approve changes to the facility and procedures as described in the DP that do not require prior NRC approval under the provisions of 10 CFR Part 50.59.

3.2.1.5 Conclusions

The DP identifies the overall organizational structure by which the licensee will manage the facility decontamination and dismantlement leading to decommissioning. The staff has determined that the project management structure for the decommissioning of the UVA reactor is consistent with the guidance provided in Appendix 17.1 of NUREG-1537 (Ref. 16). UVA's previous management practice gives reasonable assurance that they will continue to be responsible for the overall supervision, compliance with regulations, and the health and safety of the public. Therefore, the staff concludes that the proposed project management structure is acceptable.

The DOC is an integral part of the organization. The licensee intends to select the DOC using the selection criteria presented above. The interface between the contractor and the UVA is described in the DP. The staff has reviewed the criteria the licensee intends to use to select the contractor. The selection criteria cover all skill areas necessary for successful decommissioning project management and performance. Therefore, the staff concludes there is reasonable assurance that the licensee will select a DOC with adequate qualifications.

The staff reviewed and compared the licensee's organizational and control structures with those of decommissioning projects of similar facilities. Based on that review, the staff concludes that the DP provides acceptable organizational structure and control to decontaminate and dismantle the UVAR facility while maintaining due regard to protecting the public, environment and workers from significant radiological risk.

3.2.2 Occupational and Public Health and Safety

3.2.2.1 Radiation Protection

3.2.2.1.1 ALARA Program

The licensee states that the decommissioning activities at the UVA Reactor Facility involving the use and handling of radioactive materials will be conducted in a manner such that radiation exposure will be maintained As Low As Reasonably Achievable (ALARA), taking into account the current state of technology and economics of improvements in relation to the benefits. The RFD and RSO are the decommissioning project management positions responsible for radiation protection and implementing the ALARA program.

The licensee provides further details of the ALARA program in the DP.

3.2.2.1.2 Methods for Occupational Exposure Reduction

In the DP, the licensee presents various methods that will be utilized during the decommissioning project work to ensure that occupational exposure to radioactive materials is minimized. The methods include the use of Radiological Work Permits (RWPs), special equipment, techniques, and other practices as described in the DP. Work will be performed in accordance with the reactor license, the DP, and implementing procedures.

RWPs for jobs with low dose commitments will require approval at the HP technician or HP supervisory level. RWPs for jobs with potentially high dose commitment or significant radiological hazards must be approved by the RSO.

The HP organization will ensure that radiation, surface radioactivity and airborne surveys are performed as required to define and document the radiological conditions for each job.
The licensee states that as a first choice, engineering controls will be used at the source to control the concentrations of airborne radioactive material. If that is not practical and access is required, respiratory protective equipment will be utilized to limit internal exposures. Any situation wherein workers are allowed access to an airborne radioactivity area, or allowed to perform work that has a high degree of likelihood to generate airborne radioactivity in excess of 0.1 Derived Air Concentration, additional measures as described in the DP or required by implementing procedures will be used to assess worker intake.

3.2.2.1.3 Control and Storage of Radioactive Materials

The UVA HP Program establishes radioactive material controls that ensure:

- Deterrence of inadvertent release of licensed radioactive materials to unrestricted areas,
- Confidence that personnel are not inadvertently exposed to licensed radioactive material, and
- Minimization of the volume of radioactive wastes generated during the decommissioning.

All material leaving the Restricted Area will be surveyed to ensure that radioactive material is not inadvertently released from the UVAR.

3.2.2.1.4 Conclusions

The licensee has had extensive experience in radiation protection while operating the reactor facility that is directly applicable to decommissioning. The DOC will provide further experience and resources. Based on the review of the DP and other information provided by the licensee, the staff concludes that the licensee's radiation protection plan is acceptable.

3.2.2.2 Health Physics Program

UVAR Health Physics has procedures in place that will be implemented during the UVAR decommissioning project. If additional Health Physics procedures are required at some point in the work to support the decommissioning, the licensee will develop and approve them in accordance with UVA Health Physics policies and procedures, and TS 6.3, "Standard Operating Procedures."

The licensee states that the UVA senior management will be readily accessible to ensure timely resolution of difficulties that may be encountered. The RSO and Reactor Health Physicist, while organizationally independent of the project staff, have direct access to the RFD on a daily basis, and have full authority to act in all aspects of protection of workers and the public from the effects of radiation. Conduct of the UVAR decommissioning project HP program will be implemented according to UVA policy.

3.2.2.2.1 Audits, Inspections and Management Review

The DP contains the statement that all aspects of the decommissioning project will be assessed and reported by the DOC's Quality Assurance Department, through audits, assessments and inspections of various aspects of decommissioning performance, including HP, as described in Section 3.6.

Audits of the UVA Health Physics program are conducted in accordance with the requirements of 10 CFR 20.1101. These audits will include all aspects of the UVAR decommissioning project.

Additional assessments or management reviews will be performed when deemed appropriate by the Director of Environmental Health and Safety and/or the RFD.

3.2.2.2.2 Health Physics Equipment and Instrumentation

The licensee states that HP equipment and instrumentation will be chosen to ensure the validity of measurements taken during remediation and the final status survey. The selection will be based upon detailed knowledge of the radiological contaminants, concentrations, chemical forms and chemical behaviors that are expected to exist as demonstrated during radiological characterization, and as known from process knowledge of the working history of the UVAR. Equipment and instrumentation will be selected to ensure that it works properly and accurately independent of the working conditions, contamination levels, and source terms during the performance of decommissioning work.

The DP identifies the equipment and instrumentation that is planned for use during the decommissioning. The licensee anticipates that through retirement of worn or damaged equipment/instrumentation or increase in quantities of available components or instruments, that new technology will permit upgrades or, at minimum, like-for-like replacements. The licensee states that they are committed to maintaining conformance to minimum performance capabilities as detailed in the DP whenever new components or instruments are selected.

3.2.2.2.3 Storage, Calibration, Testing and Maintenance of Health Physics Equipment and Instrumentation

The licensee states that survey instruments will be stored in a common location under the control of UVAR decommissioning project HP personnel. A program to identify and remove from service inoperable or out-of-calibration instruments or equipment as described in HP procedures will be adhered to throughout the UVAR decommissioning project. The calibration of survey instruments, counting equipment, air samplers, air monitors, and personnel contamination monitors in use will be maintained current based on the license-required intervals or manufacturer-prescribed intervals (if shorter frequency). The calibrations will be done using standards that are NIST traceable and in accordance with approved calibration laboratory procedures, HP procedures, or vendor technical manuals. Survey instruments will be operationally checked daily when in use. Counting equipment operability will be verified daily when in use. The personnel contamination monitors will be operationally tested on a daily basis when work is being performed.

The licensee has proposed a change to TS 6.3, "Standard Operating Procedures," by adding a specification requiring a Standard Operating Procedure (SOP) that covers the maintenance, response testing, and the record keeping involving radiation detecting field instrumentation and associated detectors to be used during the decommissioning. This change to TS 6.3 was added as implementation of the proposed addition of TS 4.11, "Surveillance of Decommissioning Instrumentation" (See Section 3.5).

3.2.2.2.4 Specific Health Physics Equipment and Instrumentation Use and Capabilities

In Table 3-1 of the DP the licensee provides details of typical HP equipment and instrumentation that is planned for use in the UVAR decommissioning project. The licensee states that this list is neither inclusive nor exclusive.

3.2.2.2.5 Policy, Method, Frequency and Procedures

The licensee will utilize the existing UVA HP program for the decommissioning project. This program prescribes policy, method, and frequency for effluent monitoring, conduct of radiological surveys, personnel monitoring, contamination control methods, and protective clothing usage. The licensee states that the program may be augmented on a temporary basis to provide additional items related only to the UVAR decommissioning project. The DP presents further details of the planned implementation, airborne effluent monitoring, radiation surveys, and personnel monitoring, both internal and external.

3.2.2.2.6 Respiratory Protection

The licensee states in the DP that the respiratory protection program will include direction for use of National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) certified equipment. This program will be reviewed and approved by UVA HP and UVA Office of Environmental Health and Safety to ensure adherence to the requirements of 10 CFR Part 20.

The licensee will use NIOSH/MSHA approved air purifying respirators which include full face piece assemblies with air purifying elements to provide respiratory protection against hazardous vapors, gases, and/or particulate matter to individuals in airborne radioactive materials areas. Individuals may be required to use continuous or constant flow full-face airline respirators for

work in areas with actual or potential airborne radioactivity. The RSO will also ensure that the respiratory protection program meets the requirements of 10 CFR Part 20, Subpart H.

The DP presents further details on the maintenance and storage of the respiratory protection equipment.

3.2.2.2.7 Contamination Control

In the DP the licensee lists contamination control measures that will be employed during the decommissioning.

Personnel entries into radiological contaminated areas will require the use of protective clothing. Examples of suitable clothing are listed in the DP. The licensee states that the clothing required to be worn and the contamination control measures that will be used for any task will be outlined in the RWP for the particular task.

3.2.2.2.8 Access Control

During the decommissioning the licensee states that Restricted Areas will be established and properly posted to prevent unauthorized access.

3.2.2.2.9 Engineered Controls

The licensee plans to minimize personnel exposure to airborne radioactive materials by utilizing engineering controls such as the following:

- Ventilation devices - in-place or portable HEPA filters or UVAR ventilation systems, local exhaust by use of vacuums,
- Containment devices - designed containment barriers, containers, plastic bags, tents, and glove-bags, and
- Source term reduction - application of fixatives prior to handling or misting of surfaces to minimize dust and resuspension.

3.2.2.2.10 Airborne Radioactivity Monitoring

Monitoring for the intake of radioactive material is required by 10 CFR 20.1502(b) if the intake is likely to exceed 0.1 annual limit on intake during the year for an adult worker, or if the committed effective dose equivalent is likely to exceed 0.10 rem (1.0 mSv) for the occupationally exposed minor or declared pregnant woman. The licensee will perform air sampling in areas where airborne radioactivity is present or likely. The DP outlines the procedures and methods that will be used by the licensee to implement effective airborne radioactivity monitoring.

3.2.2.2.11 Potential Sources of Radiation or Contamination Exposure to Workers and Public and Proposed Controls

The licensee intends to utilize process knowledge, radiological survey data, surveys performed during characterization, previous and current job coverage surveys, or daily, weekly, and monthly routine surveys when assessing sources of radiation or contamination exposure.

The licensee has determined that worker exposure to significant external deep-dose radiation fields is minimal during this project due to the nature of the contaminants and/or the work precautions and techniques to be employed. Worker exposure to airborne radioactivity may occur during decontamination operations/work evolutions that may involve abrasives or methods that volatilize loose and/or fixed contamination.

The maximum TEDE at the site boundary from any credible accident was analyzed by the licensee to be 43 mrem (see Section 3.2.5). Exposure of the public to external or internal radiation from this decommissioning project is considered by the licensee to be well within the limits of 10 CFR Part 20 because of the confinement and the access control provided for the Facility and the area surrounding it.

3.2.2.2.12 Controls of Sources of Radiation and Contamination

The licensee plans to control potential sources of radiation exposure to workers and the public because of decommissioning activities with the use of administrative, engineering and physical controls.

The licensee's administrative controls consist of, but are not limited to:

- Administrative dose limits that are lower than regulatory limits,
- Training, and
- Radiological surveys.

Engineering controls used by the licensee may include but are not limited to:

- HEPA ventilation/enclosures,
- Protective clothing/equipment,
- Access restrictions/physical barriers (i.e., radiological warning rope/ribbon in combination with radiological warning tape and locking doors/gates),
- Posting (i.e., information signs and flashing lights), and
- Confinement.

3.2.2.2.13 Health Physics Policies for Contractor Personnel

The licensee intends that contractor personnel will actively take part in the UVAR decommissioning project. Those personnel working with licensed radioactive materials will be required to:

- Meet the requirements of the licensee's HP program,
- Attend and complete an appropriate radiation safety course,

- Provide required exposure history information,
- Read and sign an applicable RWP and comply with instructions, and
- Follow all special instructions given by HP.

3.2.2.2.14 Radioactive Materials Controls

UVA's radiation protection program establishes radioactive material controls that ensure the following:

- Prevention of inadvertent release of radioactive material (licensed material) to uncontrolled areas,

- Prevention of inadvertent exposure of personnel to radiation from licensed radioactive materials, and

- Minimization of the amount of radioactive waste material generated during decommissioning.

The licensee states in its December 19, 2000, submittal that decommissioning waste materials will not be released as clean waste. Such waste materials to be removed from the decommissioning site will be shipped to a licensed, off-site radioactive waste processing facility for survey, processing, and disposal.

The licensee also states in its May 4, 2000, submittal that all equipment, materials, instrumentation, and tools that are used during the decommissioning will be handled in the following way:

- The above items may be surveyed and released on site using the NRC standard for the release of materials as clean waste as provided in IE Circular 81-07, "Control of Radioactively Contaminated Material," May 14, 1981 (Ref. 19), and IE Information Notice 85-92, "Survey of Wastes Before Disposal From Nuclear Reactor Facilities," December 2, 1985 (Ref. 20).

- The above items may be shipped directly for disposal as radioactive waste.

- The above items may be shipped to a licensed radioactive material processing facility for survey and release, decontamination followed by survey and release, or shipment for disposal as radioactive waste.

- The above items may be shipped to a licensed facility for holding until they are utilized on another project involving radioactive material.

- No contaminated items as listed above will be left on site.

The licensee states that pool water releases will be analyzed to insure that discharges to sanitary sewerage will meet the requirements of 10 CFR 20.2003 and University of Virginia liquid discharge procedures.

3.2.2.2.15 Conclusions

The licensee has the personnel, program, and experience to provide acceptable health physics coverage of the proposed decommissioning project. The DOC's experience should complement that of the licensee. There is reasonable assurance that the radiation exposure of

the workers and the public will be minimized by the implementation of the procedures and guidance of the health physics and ALARA programs. The staff concludes that the licencee's health physics program is acceptable and meets the requirements in 10 CFR 20.1101.

Based on the review of the respiratory protection program proposed in the DP the staff concludes that the licensee has the necessary organizational structure and management controls to establish and maintain a program that meets the requirements of 10 CFR Part 20, Subpart H.

3.2.2.3 Dose Estimates

The total projected occupational exposure for the complete decommissioning of the UVAR is estimated to be four person-rem. A task-by-task breakdown of the dose estimate is noted in Table 3-1. Task-specific dose estimates are based on the nature of the work involved in each task item, the expected number of persons to be assigned to each task, and the individual task duration periods as shown on the UVAR decommissioning schedule. This schedule is included in the licensee's submittal dated February 9, 2000. The licensee provided the estimate for planning purposes. The licensee acknowledges that the characterization of the pool and the leakage pathways is not complete. The licensee will update exposure estimates and exposure controls in accordance with the requirements of the UVA ALARA program as detailed planning of the decommissioning activities develop.

The licensee estimates that doses to members of the public from decommissioning activities will be negligible due to carefully planned decommissioning activities and site perimeter controls that will restrict members of the public from the area where decommissioning activities are taking place. The estimated dose is consistent with the estimate given for the "reference research reactor" in the NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities" (Ref. 21). The dose to the public during decommissioning and truck transport of radioactive waste from the reference research reactor referred to in the Final Generic Impact Statement is estimated to be "negligible (less than 0.1 person-rem)."

Activated pieces and any contaminated debris will be removed and shielded if required to meet U.S. Department of Transportation shipping requirements and waste acceptance criteria of the disposal site.

3.2.2.3.1 Conclusions

Based on its review of the UVA DP and the decommissioning of other research and test reactors that have been completed, the staff concludes that the licensee's estimates for occupational and public dose during decommissioning activities are reasonable. The staff also finds that the estimates of occupational dose may be revised as additional characterization data are developed.

3.2.2.4 Radioactive Waste Processing and Disposal

The licensee in its DP states that the decommissioning project will generate solid and liquid low-level radioactive waste, mixed waste and hazardous waste. The licensee proposes that this waste will be handled (processed and packaged), stored and disposed of in accordance with

Table 3-1 UVAR Estimated Decommissioning Occupational Exposure

Task No.	Task Description	Subtotal person-rem	Total Dose person-re
1.0	Prepare Plans and Procedures		0.000
2.0	Decontamination and Dismantling		
2.1	Undistributed Labor and Costs	0.137	
2.2	Mobilization and Training	0.001	
2.3	Site Verification Survey	0.018	
2.4	Remove Reactor Room Components	0.026	
2.5	Remove Reactor Components in Pool	1.234	
2.6	Reactor Pool Water	0.024	
2.7	Install Confinement Barrier Around Pool	0.006	
2.8	Reactor Hardware Removal	0.215	
2.9	Pool Remediation	1.247	
2.10	Ship Activated Material to Barnwell	0.000	
2.11	Dismantle Barrier and Package for Disposal	0.001	
2.12	Remove Control Rm and Equipment Rm	0.001	
2.13	Decontaminate Reactor Room	0.002	
2.14	Decommission Demineralizer Room	0.171	
2.15	Decommission Heat Exchanger Room	0.441	
2.16	Decommission Beam Port Facilities	0.162	
2.17	Decommission Hot Cells	0.035	
2.18	Decommission Labs and Structure	0.018	
2.19	General Outside Clean-Up	0.001	
2.20	Remove Fuel Transfer Tank	0.001	
2.21	Remove Cooling Tower	0.003	
2.22	Remove Buried Waste Tanks	0.088	
2.23	Remove Buried Hot Cell Tanks	0.033	
	Decontamination and Dismantling Total		3.875
3.0	Perform MARSSIM Site Release Survey		0.019
4.0	NRC Verification Survey		0.000
5.0	Facility Remediation		0.007
	Total Project		3.903

applicable sections of the Code of Federal Regulations, the disposal site's waste acceptance criteria, Virginia Administrative Codes, UVA Licenses and Permits, and the applicable implementing plans and procedures (See also Section 3.2.2.2.14).

The licensee proposes that the low-level radioactive waste will be processed and packaged for disposal at a licensed low-level waste site. The estimated volume of low-level radioactive waste is 12,500 ft^3 (354 m^3). Mixed low-level waste will be prepared for shipment to a licensed off-site commercial processing and disposal facility.

The regulations in 10 CFR Part 61, Subpart D, establishes minimum radioactive waste classification, characterization, and labeling requirements. The licensee through the implementation of project packaging and characterization procedures, disposal site's waste acceptance criteria, and the Quality Assurance Project Plan (QAPP) (See Section 3.6), will ensure these requirements.

The licensee will provide training for project waste management personnel to assure conformance to applicable 10 CFR Part 61 requirements as stated in the specific implementing procedures and plans. Audits and surveillance will be conducted per the QAPP based on ASME-NQA-1 (Ref. 17) and the requirements of 10 CFR Part 71.

The regulations in 10 CFR Part 71 establishes requirements for packaging, shipment preparation and transportation of licensed material. UVA is licensed by the NRC to receive, possess, use, and transfer licensed special nuclear, byproduct and source materials. The licensee states that the 10 CFR Part 71 requirements will be met through the implementation of UVA approved packaging and shipping procedures.

The licensee will train the waste management personnel in the implementation of the UVA QAPP. The QAPP will incorporate the "UVA Quality Assurance Program for Radioactive Materials Packages, Appendix I, Rev 2," which was written to assure compliance with 10 CFR Part 71, Subpart H. This program was submitted to the NRC on August 11, 1997, and was subsequently approved by the NRC. This plan has an expiration date of September 30, 2002. The regulations in 10 CFR 20.2006 establish requirements for controlling transfers of low-level radioactive waste intended for disposal at a land disposal facility; establishes a manifest tracking system; supplements requirements concerning transfers and record keeping; and requires generator certification that transported materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transport. The licensee states that these requirements will be met through the implementation of project and UVA packaging and shipping procedures with the oversight of the DOC and UVA Quality Assurance.

Radiological and mixed wastes will be disposed of at disposal sites according to the applicable licensed disposal site's waste acceptance criteria. Associated implementing plans and procedures will reflect the characterization, processing, removal of prohibited items, packaging, and transportation requirements. Appropriate documentation will be submitted to designated disposal sites including, as required, certification plans, qualification statements, assessments, waste stream analysis, evaluations and profiles, transportation plans, and waste stream volume forecasts. Waste characterization, waste designation, waste traceability, waste segregation, waste packaging, waste minimization, and quality assurance and training requirements of the designated disposal sites will be incorporated in implementing procedures to assure conformance to disposal site requirements.

The requirements for radioactive and mixed waste management of the generator state (Virginia) and treatment/storage/disposal facility states (i.e., Utah and South Carolina) will be incorporated into plans and procedures to assure conformance with applicable state regulations, licenses, and permits.

The licensee states that radioactive waste will be staged in designated controlled areas in accordance with 10 CFR Parts19 and 20 requirements. Mixed wastes will be staged in designated controlled areas per CFR Title 40 (U.S. Environmental Protection Agency) requirements, 10 CFR Parts 19 and 20, and per local and state permits. The licensee proposes that measures will be implemented through plans and procedures to control the spread of contamination, limit radiation levels, prevent unauthorized access, prevent unauthorized material removal, prevent tampering, and prevent weather damage. UVA will approve designated controlled areas by RWPs, and/or hazardous work permits. The licensee indicates in the DP that radioactive and mixed waste material will be packaged for shipment per CFR Title 10, CFR Title 40, CFR Title 49, and the designated Disposal Site Criteria and placed in permitted interim storage (staged) until shipped. These radioactive material storage areas will be contained inside posted restricted areas according to existing UVA procedures and consistent with 10 CFR Part 20.

3.2.2.4.1 Conclusions

Based on the review of the licensee's program, as described in the DP and the licensee's experience, the staff concludes that the licensee's proposed radioactive waste processing and disposal plans for the decommissioning project are acceptable and will conform to the regulations.

3.2.3 Training Program

The licensee indicated in its DP that individuals (employees, contractors, and visitors) who require access to the work areas or a radiologically restricted area will be trained commensurate with the potential hazards to which they may be exposed.

Personnel who will be performing remediation work in radiological areas or handling radioactive materials will receive appropriate radiation protection training. The principle objective of the training program is to ensure personnel understand the responsibilities and the required techniques for safe handling of radioactive materials and for minimizing exposure to radiation through ALARA goals and objectives.

Records of training will be maintained by the licensee and will include trainees names, dates of training, type of training, test results, authorization for protective equipment use, and the instructor's name.

The licensee in its submittal dated December 19, 2000, indicated that the qualifications of the training instructors will comply with requirements of ANSI/ANS-3.1, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants."

In its DP, the licensee provides elements of the training programs applicable to remediation activities. The various types are training are discussed in the following sections.

3.2.3.1 General Site Training

A general training program designed to provide orientation to project personnel and meet the requirements of 10 CFR Part 19 will be implemented. General Site Training will be required for all personnel assigned on a regular basis to the remediation project. This training will include:

- Project orientation/access control,
- Introduction to radiation protection,
- Quality assurance,
- Industrial safety, and
- Emergency procedures.

3.2.3.2 Radiation Worker Training

The licensee states that Radiation Worker Training will be required for all individuals directly associated with the UVAR Decommissioning, and the training will include the following topics:

- Fundamentals of radiation,
- Biological effects of radiation,
- External radiation exposure limits and controls,
- Internal radiation limits and controls,
- ALARA Program (Program, Objectives, Investigation Limits, and Keeping Doses ALARA),
- Contamination limits and controls,
- Management and control of radioactive waste, including waste minimization practices,
- Response to emergencies, and
- Worker rights and responsibilities.

In addition to a presentation of the topics identified above, participants in Radiation Worker Training are required to participate in the following demonstrations:

- The proper procedures for donning and removing a complete set of protective clothing (excluding respiratory protection equipment),
- The ability to read and interpret self-reading and/or electronic dosimeters,
- The proper procedures for entering and exiting a contaminated area, including use of proper frisking techniques, and
- An understanding of the use of a RWP by working within the requirements of a given RWP.

Personnel who have documented equivalent Radiation Worker Training from another site may be waived from taking training except for training on UVA administrative limits and emergency response, and will be required to pass the written examination and demonstration exercises.

3.2.3.3 Respiratory Protection Training

The licensee states that personnel whose work assignments require the use of respiratory protection devices will receive respiratory protection training in the devices and techniques that they will be required to use. The training program will follow the requirements of 10 CFR Part 20, Subpart H, Regulatory Guide 8.15 (Ref. 22), NUREG 0041 (Ref. 23) and 29 CFR Part 1910.134 (OSHA regulations). Training will consist of a lecture session and a simulated work session. Personnel who have documented equivalent respiratory protection training may be waived from this training.

3.2.3.4 Conclusions

Based on the review of the licensee's training program as outlined in the DP and the licensee's acceptable performance in past similar training during reactor operations, the staff concludes that the licensee's training program is acceptable.

3.2.4 General Industrial Safety Program

The DP specifies that the Industrial Safety and Industrial Hygiene personnel, with Project Management, will be responsible to ensure that the project meets occupational health and safety requirements for project personnel and the general public. The primary functional responsibility is to ensure compliance with the Federal Occupational Safety and Health Act (Ref. 24). Specific responsibilities are listed in the DP.

The licensee states in its submittal dated May 4, 2001, that Hazardous Work Permits will be used when controls are placed on non-radiological hazards. The personnel of the Environmental Health and Safety have the responsibilities associated with the issuance and control of Hazardous Work Permits.

The DP states that all personnel working on the UVAR decommissioning project will receive health and safety training in order to recognize and understand the potential risks involving personnel health and safety associated with the work at the UVAR. The health and safety training implemented at the UVAR is to ensure compliance with the requirements of the CFR Title 10, the U.S. Environmental Protection Agency (CFR Title 40), and OSHA (CFR Title 29). In addition the licensee requires that workers and regular visitors will be familiarized with plans, procedures and operation of equipment. Each worker must be familiar with procedures that provide for good quality control.

3.2.4.1 Conclusions

Based on the review of the licensee's proposed industrial safety program as outlined in the DP, the staff concludes the program is acceptable.

3.2.5 Radiological Accident Analyses

The licensee in its submittals dated December 19, 2000, and May 4, 2001, provided the document, "Radiological Accident Analysis for UVAR Decommissioning Plan" (Ref. 25). This analysis contains the licensee's postulated decommissioning accident scenarios with assumptions and the calculations of the consequences.

Based on the decommissioning activities outlined in the DP and the radiological inventories identified the licensee evaluated the following potential radiological accident scenarios.

1. A waste shipping liner containing activated hardware is dropped while moving it from the pool to a transportation cask.

2. There is a fire in the reactor room area involving combustible material such as wood framing and asphalt roofing.

3. A waste tank is dropped during removal and it bursts and produces airborne particles.

4. A container with contaminated excavated soil is dropped, bursts, and produces airborne particles.

3.2.5.1 Dropped Waste Shipping Liner

During removal and packaging of activated components and equipment a shipping liner could be dropped leading to a release of radioactive material. The licensee concludes that the likelihood of this accident occurring is very low considering the administrative precautions they plan to take during decommissioning (See Section 3.2.2.2.12). The licensee contends that their experience and that of the decommissioning contractor in handling of activated/contaminated components, and control of job activities utilizing written and approved procedures, minimizes the risk related to the movement of waste shipping liners.

The licensee has analyzed this scenario using what they consider as worst-case assumptions. The licensee postulated that the waste shipping liner contains the largest curie content possible of any operation during the decommissioning. The licensee assumed that a waste shipping liner contains 1460 curies of radioactive material and is dropped during the transfer to the transportation cask. Since the activated hardware is solid material that does not become airborne easily, the licencee assumed that only 0.01% of the curie content escapes the liner and becomes airborne. The licensee's calculation shows that this would result in a TEDE of 43 mrem to a person at the fence line of the facility.

In a separate calculation the licensee calculated the dose to the workers in this scenario from inhalation of airborne material to be 28.2 mrem. This is lower than the fence line dose because it is assumed that the workers would be using administrative and engineering controls (i.e., protective clothing and respiration equipment) to minimize exposure by inhalation.

3.2.5.2 Fire

The licensee states that portable extinguishers will be provided as needed. The UVAR Emergency Plan provides for external fire department support. The licensee has determined

that the radiological hazard resulting from a fire will be minimal. Even so, the licensee evaluated a fire scenario of the Reactor Room. Their worst-case estimate of the contamination inventory in the Reactor Room was 3.62×10^{-4} curies. The licensee's assumption is that 10 percent of that inventory becomes airborne. The licensee's calculation shows that this would result in a TEDE of less than 1 mrem at the fence line of the facility.

The licensee concluded, that because the inventories of radioactive material were much lower than for the dropped waste shipping liner, the staff dose would be much lower that the 28 mrem calculated for that scenario.

3.2.5.3 Dropped Waste Tank

The licensee's characterization survey indicates that the east buried waste tank has the highest concentration of radionuclides in an outdoor area. The licensee states that the waste tank conservatively contains 4.23×10^{-4} curies of various isotopes. The scenario analyzed is that this tank is dropped while being lifted from the ground. The assumption is that 50% of the material is in respirable form and 20% of that material becomes airborne. The licensee's calculation shows that this would result in a TEDE of less than 1 mrem at the fence line of the facility.

The licensee concluded, that because the inventories of radioactive material were much lower than for the dropped waste shipping liner, the staff dose would be much lower that the 28 mrem calculated for that scenario.

3.2.5.4 Dropped 55 Gallon Drum of Contaminated Soil

The licensee has determined that the soil surrounding the buried waste tanks has the highest concentration of radionuclides in an outdoor area. The licensee states that this soil has estimated concentrations of 6.4 pCi/g Cs-137 and 8.4 pCi/g Co-60. The scenario analyzed is that this drum is dropped while being lifted from the ground. The assumption is that 20 percent of the material becomes airborne in respirable form. The licensee's calculation shows that this would result in a TEDE of less than 1 mrem at the fence line of the facility.

The licensee concluded, that because the inventories of radioactive material were much lower than for the dropped waste shipping liner, the staff dose would be much lower that the 28 mrem calculated for that scenario.

3.2.5.5 Other Events Considered

The licensee postulates that the consequences of a pool leak are low because the pool water is continuously filtered and de-ionized and contains negligible radioactivity. A pool leak could result in flowing water carrying loose contamination to a new location within the facility, outside the facility, or into the soil. The licensee's characterization survey showed that loose contamination is minimal therefore the risk of spread of contamination is low. There is insignificant potential for airborne contamination from such an event.

3.2.5.6 Conclusions

The licensee analyzed bounding accidents that may occur during a decommissioning project. Based on the review of similar research reactor decommissionings, the staff concludes these

analyzed accidents are bounding. The licensee's use of engineering judgement for the airborne percentages of radionuclides is acceptable for these scenarios. The staff reviewed the accident analyses and concludes that the assumptions are conservative, the calculations are correct and the consequences to the public and the staff are within 10 CFR Part 20 limits.

3.3 Decommissioning Activities

3.3.1 Radiological Status of the Facility

3.3.1.1 General

The licensee states that routine radiological surveys show that the radiation levels and contamination levels measured at the UVAR have been consistently low. A radiological characterization study that was completed in September 1999 confirmed that only minor quantities of residual radioactivity or radioactive contamination are present. A detailed survey of the pool, leakage pathways, or its contents was not included in this characterization survey because of inaccessibility. The licensee will conduct these surveys after radioactive components are removed from the pool. The results of these additional surveys may affect decommissioning actions. For example, pool leakage pathways may require remediation of the pool structure and consideration of leakage pathways to the environment.

The information indicates that the radioactive portions of the facility are primarily confined to the reactor internals and reactor pool. The licensee estimated the radioactivity inventory by considering the constituent elements of the material in question and calculating the duration of exposure to the neutron flux and the energies of the incident neutrons. The licensee and the DOC will use direct measurements during actual removal and/or dismantlement of components. Those data will be used as the basis for specifying the necessary safety measures and procedures to maintain exposures as low as is reasonably achievable during the various dismantlement, removal, decontamination, and waste packaging and storage operations.

3.3.1.2 Principal Radioactive Components

The licensee stated in its DP that based upon process knowledge and direct measurements the most highly radioactive components (over 5 R/hr) to be handled and processed during decommissioning are:

- Control rods reading about 117 to >200 R/hr at about 6 in (15 cm).
- Three hot thimbles reading about 21 to 27 R/hr.
- Two Electric Power Research Institute experiment stands reading about 19 R/hr.
- Mineral Irradiation Facility shield reading about 13 R/hr.
- An old control rod (stored in the pool) reading about 10 R/hr.
- Three tangential beam port targets reading about 6 to 8 R/hr.
- Hydraulic Rabbit [about 25 ft (7.6 m) long] reading about 6 R/hr.

Near-contact dose measurements in the reactor pool were taken underwater.

3.3.1.3 Radionuclides

The licensee listed the radionuclides known to be present, or possibly present in detectable quantities within the UVAR (see Table 3-2).

The licensee reviewed the “decommissioning file” that was kept current during the operational life of the UVAR, as well as all the memoranda sent to the Reactor Safety Committee, to identify events which have, or could have, resulted in contamination of areas within and without the reactor facility. The events that were considered significant by the licensee were listed and discussed in their submittal dated December 14, 2000. This historical site assessment (HSA) review had and will have a direct influence on the conduct of the initial characterization survey, planned follow-up characterization survey (in areas that were not accessible during the performance of the initial survey), remediation activities, and final status survey.

3.3.1.4 Conclusions

The staff has reviewed the dose rates and contamination levels identified by the licensee, and the licensee’s plans for follow-up surveys. Based on the experience and engineering judgment of the staff, the staff concludes that the licensee’s estimates of the radiological conditions and radiation measurements are acceptable. The staff finds that a follow-up characterization survey will be necessary after the removal of material from the pool is complete and the pool is drained. This survey will include the pool and any leakage pathways. Based on review of the licensee’s application, the staff concludes that no significant events occurred during operation of the facility that would prevent decommissioning of the reactor as proposed by the licensee.

3.3.2 Radiological Release Criteria

The licensee is proposing the DECON decommissioning alternative for the reactor with minor dismantlement of the UVAR Facility building. The licensee states that the results of the site and facility radiological characterization survey indicate that the building structures may not need extensive decontamination to meet the release criteria.

The licensee proposes that the final status survey will use Derived Concentration Guideline Levels (DCGL’s) developed from the characterization survey data and the current NRC guidance for license termination in 10 CFR Part 20.

The regulations in 10 CFR 20.1402 allow termination of a license and release of a site for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent to an average member of a critical group that does not exceed 25 mrem (0.25 millisevert) per year and the residual radioactivity has been reduced to levels that are ALARA. The licensee proposes the use of the current NRC guidance for acceptable license termination screening values (meeting the 10 CFR 20.1402 criteria) of common radionuclides for building surface contamination as presented in “Supplemental Information on the Implementation of the Final Rule on Radiological Criteria for License Termination,” (Ref. 11) and calculated using the DandD computer code (Ref. 26). These are tabulated in Table 3-3 which was taken from the updated Table 2-6 presented by the licensee in its submittal dated December 12, 2000.

Table 3-2 Expected Radionuclides

Nuclide	Half-Life (yr)	Decay Mode/Major Radiations	Notes
^{14}C	5,730	β^-/β^-	AP; from n-activation of graphite reflector structure
^{54}Mn	0.86	ε/λ	AP; short-lived specie; from n-activation of SS hardware
^{55}Fe	2.73	ε	AP; from n-activation of SS hardware
^{60}Co	5.27	$\beta^-/\beta^-,\lambda$	AP; from n-activation of SS hardware; expected to be predominant AP specie present
^{59}Ni	76,000	ε/λ	AP; from n-activation of SS hardware
^{63}Ni	100	β^-/β^-	AP; from n-activation of SS hardware. Also from liquid solution in research project
^{90}Sr	29.1	β^-/β^-	FP; probable FP constituent; activity expected to be proportional to that of ^{137}Cs
^{94}Nb	20,000	$\beta^-/\beta^-,\lambda$	AP; unlikely AP inventory constituent; possible from n-activation of SS hardware, if Nb impurities are present
^{99}Tc	213,000	β^-/β^-	FP, and minor AP inventory constituent; possible from n-activation of SS hardware, if Mo impurities are present. Also from acidic liquid solution in research project
^{125}Sb	2.76	$\beta^-/\beta^-,\lambda$	FP; relatively short-lived specie
^{134}Cs	2.07	$\beta^-/\beta^-,\lambda$	FP; minor FP inventory constituent
^{137}Cs	30.17	$\beta^-/\beta^-,\lambda$	FP: expected to be predominant FP specie present
^{152}Eu	13.48	β^-, $\beta^+,\varepsilon/\beta^-$, β^+,λ	FP, and minor AP inventory constituent; possible from n-activation of concrete, if Eu impurities exist in biological shield structure
^{226}Ra	1,600	$\alpha/\alpha,\lambda$	Natural background source, sealed & liquid sources
^{nat}U		$\alpha/\alpha,\lambda$	Natural background sources, sealed and unsealed sources
$^{233/234}U$	>159,200	$\alpha/\alpha,\lambda$	Natural and failed fuel sources, trace quantities only anticipated
^{241}Pu	14.4	$\beta^-/\beta^-,\alpha,\lambda$	Failed fuel source, trace quantities only anticipated, sealed sources
^{241}Am	432	$\alpha/\alpha,\lambda$	Research project
$^{235/238}U$	>7.0E+8	$\alpha/\alpha,\lambda$	SNM material used or stored at facility

Symbols/Abbreviations: α = Alpha Particle β^- = Beta Particle β^+ = Positron
ε = Electron Capture λ = Gamma-Ray
AP = Activation Product FP = Fission Product

The DCGL's for soil areas were developed using the regulatory positions on dose modeling in "Supplemental Information on the Implementation of the Final Rule on Radiological Criteria for License Termination," (Ref. 12) and the "Draft Regulatory Guide DG-4006" (Ref. 13). The soil DCGLs were calculated using the computer code DandD. The soil DCGLs are tabulated in Table 10 of the "Dose Assessment for UVAR Decommissioning Plan," REFS-CALC-UVAR-001, Revision 0 (Ref. 14). The soil DCGLs are reproduced in Table 3-4. The licensee states that when the final status survey plan is complete, because of ALARA evaluations, the actual surface and soil contamination screening values may be less than the DCGLs listed in Tables 3-3 and 3-4. The ALARA calculations will meet the requirements of 10 CFR Part 20.1402 and DG-4006. The licensee has provided examples of such calculations in the "Dose Assessment for UVAR Decommissioning Plan," REFS-CALC-UVAR-001, Revision 0.

Upon completion of the decontamination and remediation activities, a final status survey of the UVAR Facility will be performed by the licensee (see section 3.3.5), with proper notification of the NRC, using the method described in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (Ref. 15). In addition, NRC DG-4006 will be used for additional specific guidance on acceptable values for use in the MARSSIM method, on the use of the MARSSIM method consistent with the dose modeling, on the use of the MARSSIM method to meet NRC's regulations, and on the extension or supplementation of the MARSSIM method to address subsurface residual radioactivity. The licensee will summarize results of the survey(s) in a report and submit it to the NRC, consistent with NUREG 1537 (Ref. 16), in support of a license termination request.

The licensee states that removable surface contamination will be eliminated by proven decontamination methods. Release criteria for fixed and smearable residual radioactivity for beta-gamma emitters will be based upon the relative concentrations of isotopes in the material.

Radiological and mixed wastes will be disposed of at disposal sites according to the applicable licensed disposal site's Waste Acceptance Criteria. Associated implementing plans and procedures will reflect the characterization, processing, removal of prohibited items, packaging, and transportation requirements. Appropriate documentation will be submitted to designated disposal sites including, as required, certification plans, qualification statements, assessments, waste stream analysis, evaluations and profiles, transportation plans, and waste stream volume

3.3.2.1 Conclusions

The licensee has outlined in the DP, and as supplemented by the licensees submittals dated December 19, 2000, and May 4, 2001, the radiological release criteria that will be used for license termination, the development of their surface and soil DGCLs, and methods that will be used to develop the final status survey plan. They propose that the final status survey plan will be developed with the help of the DOC when the follow-up characterization survey of the pool and the leakage pathways is completed. The NRC staff finds that the licensee's proposed methods for planning the final status survey that will be used to show compliance with the release requirements are acceptable. The actual final status survey plan is to be reviewed later. The staff concludes that the licensee and the DOC as chosen based on the criteria listed in the licensee's submittals dated December 19, 2000, and May 4, 2001, will have the experience and resources to develop and implement an acceptable final status survey plan. The staff concludes that the licensee understands the release criteria for license termination for the UVAR and has proposed acceptable DGCLs in accordance with applicable guidance.

Table 3-3 License Termination Screening Values for Building Surface Contamination

Radionuclide	Symbol	Acceptable screening levels[1] for unrestricted release (dpm/100 cm^2)
Hydrogen-3 (Tritium)	^{3}H	1.2E+08
Carbon-14	^{14}C	3.7E+06
Manganese-54	^{54}Mn	3.2E+04
Iron-55	^{55}Fe	4.5E+06
Cobalt-57[2]	^{57}Co	2.12E+05
Cobalt-60	^{60}Co	7.1E+03
Nickel-63	^{63}Ni	1.8E+06
Zinc-65[2]	^{65}Zn	4.81E+04
Strontium-90	^{90}Sr	8.7E+03
Niobium-94[2]	^{94}Nb	8.28E+03
Technetium-99	^{99}Tc	1.3E+06
Antimony-125[2]	^{125}Sb	4.43E+04
Cesium-137	^{137}Cs	2.8E+04
Europium-152[2]	^{152}Eu	1.27E+04
Europium-154[2]	^{154}Eu	1.15E+04
Lead-210[2]	^{210}Pb	5.43E+02
Radium-226[2] +Decay Chain	^{226}Ra	3.14E+02
Natural Uranium[2]	Unat	9.51E+01
Uranium-233[2] +Decay Chain	^{233}U	4.96E+00
Uranium-234[2]	^{234}U	8.99E+01
Uranium-238[2] +Decay Chain	^{238}U	1.94E+01
Plutonium-241[2]	^{241}Pu	1.41E+03
Americium-241[2]	^{241}Am	2.68E+01

[1] Screening levels are based on the assumption that the fraction of removable surface contamination is equal to 0.1.

[2] The screening values represent surface concentrations of individual radionuclides that would be deemed in compliance with the < 0.25 mSv/yr (25 mrem/yr) and were calculated using the NRC DandD code version 1.0, Build 1.00.02.

Table 3-4 Soil DCGLs

Radionuclide	Symbol	Limit (pCi/g)
Hydrogen-3 (Tritium)	^{3}H	110
Carbon-14	^{14}C	12
Manganese-54	^{54}Mn	15
Iron-55	^{55}Fe	10,000
Cobalt-57	^{57}Co	150
Cobalt-60	^{60}Co	3.8
Nickel-63	^{63}Ni	2,100
Zinc-65[1]	^{65}Zn	6.3
Strontium-90	^{90}Sr	1.7
Niobium-94	^{94}Nb	5.8
Technetium-99	^{99}Tc	19
Antimony-125[1]	^{125}Sb	26
Cesium-137	^{137}Cs	11
Europium-152	^{152}Eu	8.7
Europium-154	^{154}Eu	8.0
Lead-210	^{210}Pb	0.9
Radium-226/Radium-226+Decay Chain	^{226}Ra	0.7/0.6
Natural Uranium[1]	^{Nat}U	0.6
Uranium-233+Decay Chain[1]	^{233}U	0.46
Uranium 234	^{234}U	13
Uranium-238/Uranium-238+Decay Chain	^{238}U	14/0.5
Plutonium-241	^{241}Pu	72
Americium-241	^{241}Am	2.1

[1]The screening values represent soil concentrations of individual radionuclides that would be deemed in compliance with the < 0.25 mSv/yr (25 mrem/yr) and were calculated using the NRC DandD code version 1.0, Build 1.00.02.

3.3.3 Decommissioning Tasks

3.3.3.1 Preparation of the UVAR for Decommissioning

3.3.3.1.1 Characterization Surveys

As part of decommissioning project planning actions, the licensee and contractor conducted studies to determine the type, quantity, condition and location of radioactive and/or hazardous materials that are, or may be, present in the UVAR and surrounding areas. GTS Duratek, UVA's subcontractor for developing the DP completed a characterization survey of the UVAR in September 1999. Data and results from that survey were provided in the DP as Appendix A, "Summary of Characterization Results." This survey did not include the pool, its contents, or all of the leakage pathways. The licensee states in its submittals dated December 19, 2000, and May 4, 2001, that this follow-up characterization will be performed after the DOC is chosen and decommissioning work begins.

3.3.3.1.2 General Cleanup of UVAR and Adjacent Controlled Yard Areas

In preparation for decommissioning activities, the licensee has collected, surveyed, packaged and appropriately disposed of non-reactor related equipment and materials situated throughout the Reactor Facility in accordance with established procedures.

3.3.3.2 Decontamination of the Facility

In the DP the licensee proposes to dismantle the reactor and associated systems in a safe manner and in accordance with ALARA principles, and to decontaminate and survey the entire UVAR facility. The licensee provided a list of expected radionuclides based on the assumption that reactor operation resulted in neutron activation of reactor core components and other integral hardware or structural members situated adjacent to, or in close proximity to, the reactor core (see Table 3-2). Specific items to be considered exposed to neutron activation include materials composed of aluminum, steel, stainless steel, graphite, cadmium, lead, concrete, and possibly others. The licensee plans a follow-up characterization survey in areas that were not accessible during the performance of the initial survey such as the pool internals and leakage pathways.

3.3.3.2.1 Reactor Confinement Structure

The licensee listed the major steps in the DP for decommissioning the reactor confinement structure. They include:

- All reactor confinement structure, equipment, and materials will be surveyed and designated as contaminated or uncontaminated.

- Uncontaminated equipment and materials will be released for unrestricted use or disposed as clean waste.

- Contaminated equipment will be decontaminated and handled as other uncontaminated material or removed and packaged for processing and direct disposal as radioactive waste.

- Control room and equipment storage rooms will be demolished, processed and removed.

- Reactor ventilation system will be removed and packaged for processing and disposal or direct disposal as radioactive waste.

- Concrete floors will be decontaminated by removing a portion of the upper concrete surface, as necessary. Tubes and drains will be surveyed and decontaminated as required.

- Building off-gas stack will be surveyed and released for disposal as salvage, or disposal as clean waste.

- The Polar Crane will be utilized during the decommissioning activities. It will be surveyed, decontaminated in place as required and left intact and in operating condition.

3.3.3.2.2 Reactor and Pool

The licensee states in the DP that:

- Reactor components and activated pool hardware will be removed for disposal as low-level radioactive waste. A cask will be brought in, loaded and shipped to a disposal facility. The removal of these items can take place with the pool either filled or drained.

- Reactor pool water will be surveyed and discharged when it is no longer useful as a radiological shield.

- Characterization surveys of the pool walls and the leakage pathways will be performed.

- Dismantlement of the reactor support structure and pool will proceed after installation of a confinement barrier in the reactor room with a dedicated ventilation system to prevent the spread of airborne contaminants. The dedicated ventilation system is specified in the proposed TS 5.2.1, “Temporary Pool Confinement” (See Section 3.5.4).

- Beam port extension tubes (nose pieces) will be removed.

- Other hardware and debris present in the pool will be removed and similarly processed.

- Piping embedded in the concrete pool walls and floors will be surveyed and decontaminated, as necessary, and left in place if clean.

- Surface and core samples of the pool concrete walls will be performed to determine the extent of the contaminated areas. Contaminated material will be removed and packaged. The structural integrity of the pool will be augmented as necessary if it is threatened because of removal of material.

- Required sampling and analysis of surrounding soils will be done by coring, and repair after sampling. Shoring and covering of the pool will provide industrial-protection until the final status survey has been performed.

- Portions of the pool walls that extend 3-feet above the reactor room floor slab will be cut off and is expected to be handled as clean waste.

- Remaining tasks are dismantlement of the confinement barrier, removal of residual surface contamination in the rooms, and final status survey. The packaged waste is to be shipped to a licensed processing or disposal facility.

3.3.3.2.3 Remaining Rooms and Structure

The licensee states in the DP that:

- Reactor-associated equipment and materials will be surveyed and designated as contaminated or uncontaminated.

- Contaminated room surfaces will be decontaminated.

- Uncontaminated equipment and materials will be released for unrestricted use or disposal as clean waste.

- Contaminated equipment will be decontaminated and handled either as uncontaminated material, or removed and packaged for processing and direct disposal as radioactive waste. This includes process equipment in the demineralizer room, process equipment in the heat exchanger room, contaminated hoods in laboratory rooms, process equipment in the beam port facility and equipment in the hot cell facility.

- 7,000 curies of Co-60 stored in a cask and possessed under a separate NRC materials license in the facility's hot cell will be relocated prior to the end of decommissioning.

3.3.3.2.4 Underground Tanks and Vaults

The licensee states in the DP that:

- All underground tank and vault process piping and equipment will be removed, surveyed, and designated as contaminated or uncontaminated.

- Uncontaminated piping, equipment and materials will be released for unrestricted use or disposal as clean waste.

- Contaminated piping and equipment will be decontaminated and handled as other uncontaminated material, or removed and packaged for processing and direct disposal as radioactive waste.

- Buried piping from the building to underground tanks will be surveyed and decontaminated as necessary.

- Soil surrounding these tanks will be excavated, surveyed, sampled, and piled for later use in backfilling the excavation if uncontaminated.

3.3.3.2.5 Outdoor Areas, Drains and Sewers

The licensee states in its submittals dated December 19, 2000, and May 4, 2001, that remediation may be required for the outdoor areas, sanitary and storm sewers, the pond, the pond discharge creek, paved areas and unpaved areas at the UVAR site. The licensee's plan is:

- If they exceed DCGLs, the contaminated pond sediments near the vertical reactor building discharge pipe will be removed and packaged for processing or direct disposal as radioactive waste.

- If they exceed DCGLs, the contaminated surface soil on the pond bank between the underground tanks and the pond will be removed and packaged for processing or direct disposal as radioactive waste.

- If they exceed DCGLs, the sediments with elevated activity in the storm drain will be removed and packaged for processing or direct disposal as radioactive waste. The drains will be surveyed using pipe probes to determine if there is any additional sediment with elevated activity that requires removal.

- Residual radioactivity will be reduced to levels that are ALARA.

- When the pool is drained the pool leakage pathways will be surveyed. It is possible that a drain line is located around the pool perimeter that discharges into the storm drain system. If this is correct the drain line and the storm drains will be surveyed with pipe monitors and decontaminated as necessary.

3.3.3.2.6 Groundwater

The reactor pool has experienced leaks over the years of operation with leak rates of up to several hundreds of gallons per day. The licensee has performed several repairs to the reactor pool to control increasing leak rates. The licensee believes that water leaking from the reactor pool goes to the on-site pond. In 1977 during a period of high leak rates, sodium-24 activity was detected in the pond. However, the leakage pathway is not known. Facility drawings show a drain line around the perimeter of the pool that discharges into the storm drain system. If this system exists is not known. Three groundwater wells were installed around the facility in 1997 to monitor groundwater conditions. Monitoring of groundwater detected very low concentrations (near the lower limit of detection) of tritium in the well closest to the reactor pool on several occasions while the UVAR was still in operation. The licensee has installed two additional groundwater monitoring wells. As part of the approval of the decommissioning license amendment, the NRC is adding a license condition that requires the licensee to submit a report on their investigation of groundwater conditions.

3.3.3.3 Dismantlement Sequence

The licensee indicates that dismantling will occur sequentially by the detailed schedule shown in Section 2.3.2 of the DP. Items removed will be grouped as follows:

- Equipment that does not have induced radioactivity but may have surface contamination. This group includes reactor systems and laboratory equipment, beam access facilities, hot cell systems, and liquid waste systems.

- Core components and other components that have induced radioactivity, including pool concrete that has been neutron activated. This group includes items such as control rods, beam port nose pieces, graphite elements, and experimental facilities such as the rotating irradiation and the EPRI experimental facilities.

- Reactor support systems, equipment, and materials associated with laboratory and research facilities. This group includes contaminated pool and bio-shield concrete and activated pool and beam port concrete.

- Equipment, tools and systems that become contaminated during decommissioning operations. This group includes the general and temporary localized ventilation systems, confinement barriers, and contaminated tools, equipment and clothing.

The licensee plans to follow the following steps in its dismantling process:

- The licensee's characterization survey found that the control rods in the UVAR pool are expected to have the highest levels of induced radioactivity. The control rods and other Group 2 items will be hoisted from the pool within shielded containers that will have been prepared to accept the items.

- After pool components, equipment and parts in groups 1 and 2 have been removed, a confinement barrier will be erected to surround the reactor pool. There will be an independent, localized, ventilation system to ensure a negative pressure with respect to the Reactor Room and provide high efficiency filtration on the exhausted air. The licensee proposes a new UVAR TS 5.2.1, "Temporary Pool Confinement." This TS addresses the temporary structure to be erected in the Reactor Room while decommissioning work involving the UVAR pool is in progress (See Section 3.5.4).

- When necessary, the licensee will maintain the Reactor Room at a slightly negative pressure with respect to the surrounding areas but less than the pressure differential maintained between the confinement barrier and the Reactor Room. This will ensure that the air will travel from the non-contaminated area to the increasingly contaminated areas.

- The contaminated and activated pool/biological shield concrete will be removed. To minimize dust dispersal, a localized High Efficiency Particulate Air Filter (HEPA) vacuum system may be used in the area where concrete is being demolished. Contaminated concrete will be removed by surface removal equipment from the upper surfaces down to the floor. Activated concrete will be removed a section at a time and shoring supports will be placed in the cavity formed as needed, before proceeding with the next section. The embedded piping that passes from the pool to the heat exchanger and the demineralizer system will be surveyed and decontaminated if necessary.

- Post-remediation surveys such as concrete and soil coring sampling and analysis will be done as necessary. As the removal of activated material proceeds, the radioactive material will be packaged for shipment and disposal.

- To minimize the risk during occupancy, the work areas will be physically monitored frequently and radiation levels will be monitored continuously to determine sudden changes in the radiological conditions.

- The pool structural integrity will be evaluated prior to work in the pool and shoring will be installed. A professional engineer will approve the support system design. Only authorized personnel will be allowed entry into the pool area.

- Upon completion of dismantlement tasks in the reactor pool, the confinement barrier will be dismantled and the plastic sheets compacted and packaged. Surface contamination will be removed from contaminated portions of the facility ventilation system and they will then be packaged for disposal. The reactor room will then be cleared and all surface contamination removed. Following remediation and the completion and approval of the final status survey the pool pit will be backfilled and capped with a concrete slab.

- The waste tank excavation stability will be evaluated prior to work in the excavation and shoring will be installed as necessary. A professional engineer will approve the support system design. Only authorized personnel will be allowed entry into the tank excavation area.

- All process equipment in the waste tank vault and hot cell tank vault will be removed. The piping that passes underground to the reactor building and to the pond will be surveyed and decontaminated, if necessary. The soil over the top of the buried waste tanks and hot cell tanks will be excavated, surveyed, sampled and piled for later use in backfilling the hole. The tanks will be removed, cut to size and packaged for processing and disposal or direct disposal as radioactive waste. Following remediation and the completion and approval of the final status survey the buried tank area will be backfilled to grade.

3.3.3.4 Surveys

Following decontamination and remediation activities of the reactor, a final status survey of each of the reactor rooms and other applicable locations covering the entire UVAR Facility will be performed and documented in accordance with the developed and approved final status survey plan.

3.3.3.5 Conclusions

Based on review of the DP, the licencee's responses dated December 19, 2000, and May 4, 2001, to the NRC's requests for additional information, and the staff's prior review of decommissioning plans for similar facilities, the staff concludes that the licensee's plan for decommissioning the UVAR facility follows an acceptable sequence and is acceptable to the staff.

3.3.4 Schedule

The project schedule is presented in the DP. The scheduled time from regulatory approval of the decommissioning plan to the request for release of the site to unrestricted use is estimated at 13 months. Based on project schedule information, UVA estimates that a formal request for termination of Facility License No. R-66 will be submitted to the NRC approximately twelve months after the approval of the DP is received from the NRC. The licensee proposes that changes to the schedule may be made at UVA's discretion. Those changes may be as a result of resource reallocation, availability of a radioactive waste burial site, conflicts with ongoing UVA activities, ALARA considerations, further characterization measurements, and/or temporary on-site radioactive waste storage operations.

3.3.4.1 Conclusions

Based on a review of the licensee's proposed decommissioning schedule and the staff's experience with other decommissionings similar to UVA, the staff concludes that the licensee proposed schedule is acceptable.

3.3.5 Proposed Final Status Survey Plan

In Section 4 of its DP and their submittals dated December 19, 2000, and May 4, 2001, the licensee provides a plan for the development, review, and approval of the final status survey plan once the site is fully characterized. The licensee's stated objective of the final status survey is to ensure that the facility meets the unrestricted release criteria.

The licensee indicates that during the planning stage for the final status survey the facility will be sectioned into survey units according to the guidance in MARSSIM. During that planning plots, diagrams, and facility layout drawings will be developed to illustrate the classification of the survey units. It is the licensee's intention that the final status survey plan will serve as the guidance document for the development of the survey package portfolio that will contain instructions used during implementation of the final status survey. A survey package portfolio will be developed for each survey unit and will include a discussion regarding the facility history, characterization survey results, and evaluations used to support survey unit classification. It will also contain survey unit specific instructions, describe the survey unit size, grid spacing, scan area, and the number of static measurements including the location and spacing. The licensee states that once the planning stage is complete, the survey packages with instructions, plots, diagrams, and facility layout drawings illustrating the classification of the survey units will be provided for review.

The licensee proposed surface contamination DCGLs in its submittal dated December 19, 2000, as corrected, in its submittal dated May 4, 2001. The DCGLs are given in Table 3-3 of this document. The table includes radionuclides that the licensee verified present with the characterization survey or expects to find in any further characterization surveys or remediation. The source of the DCGLs is indicated by annotation.

The licensee proposes soil concentration DCGLs in Table 10 of "Dose Assessment for the UVAR Decommissioning Plan," REFS-CALC-UVAR-001, Revision 0 (Ref. 14). This table is reproduced as Table 3-4 in this document. The tables include radionuclides that the licensee verified present with the characterization survey or expects to find in any further

characterization surveys or remediation. The DCGLs are based on the regulatory positions on dose modeling from “Draft Regulatory Guide DG-4006" using the DandD computer code as noted in the Table.

The licensee states in its submittal dated December 19, 2000, that surrogate ratio DCGLs will be developed for the final status survey for “hard-to-detect” radionuclides in the soil. In addition, gross activity DCGLs and $DCGL_{EMC}$ (elevated measurement comparison DCGLs) will be developed during the planning stage for the final status survey that will consider “hard-to-detect” radionuclides for surfaces. Site specific DCGLs will be calculated based on the relative fraction of each radionuclide in the expected radionuclide mix.

The licensee will describe the criteria used for designated areas, such as Class 1, 2, or 3, in the final status survey plan. Compliance with the classification criteria will be demonstrated in the final status survey report. The licensee will provide the basis for each area’s classification using a through analysis of HSA findings and the results of the characterization survey. The licensee allows for reevaluation of area classification if it is found necessary based on newly acquired survey data. The licensee states two examples:

1. If contamination is identified in a Class 3 area greater than 50 percent of the DCGL, an investigation and reevaluation of that area will be performed to determine if the classification was appropriate. The investigation may result in part or all of the area being reclassified as a Class 1 or Class 2 survey unit for re-survey after remediation, as necessary.

2. If survey results identify residual contamination in a Class 2 area exceeding the DCGL or suggest that there may be a reasonable potential that contamination is present in excess of the of the DCGL, an investigation will be initiated to determine if all or part of the area should be reclassified as a Class 1 survey unit.

The licensee states that the final status survey plan will contain the criteria used to assess all final survey data. These will include the statistical tests performed and state the conclusion based upon statistical test results.

The licensee states in its submittal dated May 4, 2001, that UVA will use Method 1 from section 14 of NUREG/SR-1727, “NMSS Decommissioning Standard Review Plan (SRP)” (Ref. 27), to submit information to the NRC on facility surveys. The licensee has submitted information to the NRC on release criteria, characterization surveys, and operational surveys as part of the DP. The licensee commits to use the MARSSIM approach in developing the final survey plan. They will submit sufficient information to allow the NRC to determine that the final status survey plan is adequate to demonstrate compliance with the radiological criteria for license termination. The licensee provided an outline of the information they will provide to the NRC in its submittal dated May 4, 2001.

The licensee states also that as the final status survey progresses, they may reevaluate the plan based on newly acquired survey data. If a condition not encompassed by the survey plan is discovered, the licensee may revise the survey plan to address the condition. In addition, the licensee stated that they will fully disclose the condition and provided it and the revised plan to the Reactor Decommissioning Committee. The revised plan will be reviewed and approved by

the Reactor Decommissioning Committee prior to continuation of the final status survey as it applies to the revised information.

The licensee will assess the final status survey data according to the guidance provided in MARSSIM based upon the following assumptions:

- The results of the HSA and the characterization have been reviewed and based on the operational history, characterization data, and professional judgment the site is determined as impacted.

- The null hypothesis recommended for use in the MARSSIM is: "The residual radioactivity in the survey unit exceeds the release criterion."

- The decision error rates will be set to 0.05 for type I (a) error and 0.05 for Type II (b) error.

- The Sign test, non-parametric statistical test, will be used to compare the distribution of a set of measurements in a survey unit to the DCGL. Values from a background study for materials of construction performed during the characterization survey will be used to adjust final survey direct measurements for background radiation. The material background adjustment to the final survey direct measurements will eliminate the need for background reference area requirements if using the Wilcoxon Rank Sum (WRS) test.

- Once the final status survey is performed, survey data will be converted to DCGL units and compared to the DCGLs. Individual measurements and sample concentrations will be compared to DCGL levels for evidence of small areas of elevated activity. Data will then be evaluated using the Sign test statistical method to determine if they exceed the release criterion. If the release criterion has been exceeded (null hypothesis proven true) or if results indicate the need for additional data points, appropriate further actions will be determined by the UVA.

- If the release criterion has not been exceeded (null hypothesis proven false), the results of the survey will be compared with the data quality objectives established during the planning phase of the project. If data quality objectives have been satisfied, the survey unit will be suitable to release the site for unrestricted use.

UVA will submit documentation of the satisfactory completion of its Final Status Survey to the NRC. The NRC will review and evaluate this documentation prior to license termination.

3.3.5.1 Conclusions

The staff has reviewed the licensee's DP and its submittals dated December 19, 2000, and May 4, 2001, concerning the planning of the final status survey. The staff finds that the licensee has adequate experience to develop and implement an acceptable final status survey. Once that plan is developed, it will be presented for review and approval prior to implementation. The licensee has planned for resolution of anticipated changes to DCGLs and the final status survey plan. The staff concludes this aspect of the DP meets the requirements of 10 CFR Part 50.82(b)(4)(iii) and is therefore acceptable.

3.4 Estimated Cost

Dismantlement and decommissioning of the UVAR will be accomplished without dismantlement of the building. The detailed estimated cost to decommission the UVAR licensed areas is presented in the "Decommissioning Cost estimate for the UVA Reactor Facility, Charlottesville, VA" (Ref. 28). The licensee estimates that the project will cost $3,547,048. A cost breakdown is given in Table 3-5 below. The DP states in accordance with 10 CFR Part 50.75 (e)(iv), that the University of Virginia is committed to providing the funding for decommissioning of the University of Virginia Reactor.

3.4.1 Conclusions

The staff has reviewed the licensee's decommissioning cost estimate. The staff finds that the licensee's cost estimate is consistent with the scope of work covering dismantlement and decommissioning of the UVA Reactor. However, changes may have to be made to the cost estimate when complete characterization of the pool, pool walls, the soil surrounding the pool walls, and the pool leakage paths are completed. The licensee has stated that it is committed to provide the funds necessary to satisfactorily bring the decommissioning to completion. The staff concludes the cost estimate is reasonable and funding commitment acceptable.

3.5 Technical Specifications

Amendment No. 25 to Facility License No. R-66 for the University of Virginia Reactor, Docket No. 50-62, issued by the NRC February 9, 2000, contained many of the applicable Technical Specifications for the UVA Reactor for decommissioning.

In its submittal dated December 14, 2000, the licensee proposes four changes or additions to the TSs.

3.5.1 Addition of TS 4.11

The licensee proposes the addition of a new TS 4.11, "Surveillance of Decommissioning Instrumentation." The proposed TS follows:

> 4.11 Surveillance of Decommissioning Instrumentation
>
> Applicability: This specification applies to the traceability and frequency of the calibration of those field and laboratory radiation detection instrumentation, and associated detectors, used in decommissioning activities at the UVAR Facility.
>
> Objective: The objective is to have only legally well-calibrated radiation survey and detection instrumentation used in decommissioning work.
>
> Specification:
>
> Laboratory instruments and associated detectors used in decommissioning activities shall be calibrated on an annual basis.
>
> Field radiation detection instruments and associated detectors used in decommissioning activities shall be calibrated on an annual basis.

Table 3-5 Decommissioning Cost Summary - UVA Reactor

D&D Operation	Labor Plus Travel & Living $1000's	Waste Processing & Transport $1000's	Equipment Contracts & Supplies $1000's	Waste Shipping & Disposal $1000's	Total Cost $1000's
Reactor Confinement Structure	$149	$32	$37	$64	$282
Reactor, Pool & Pool Contents	$70		$47	$325	$442
Old Labs & Structure	$271	$50	$69	$132	$522
Newer Labs & Structure	$101	$13	$23	$2	$139
Underground Tanks	$31		$23	$144	$198
Controlled Yard	$99	$20	$24	$28	$170
D&D Planning	$23				$23
Characterization Surveys	$58		$7		$65
Final Surveys	$232		$29		$260
Planning, Training & Mobilization	$9				$9
Contractor Project Oversight	$167				$167
Owner Oversight & Licensing	$154				$154
NRC Verification Survey					$20
Total	**$1,364**	**$115**	**$258**	**$695**	**$2,452**
				25 % CONTINGENCY	**$613**
				GRAND TOTAL	**$3,065**

The estimate for LLW disposal is based upon the assumption that the activated waste will be buried at the Barnwell, South Carolina site and all other radioactive waste will be buried at the Envirocare of Utah site.

National Institute of Standards and Technology (NIST) traceable sources and appropriate calibration equipment shall be used in the calibration of this equipment.

Basis: Accurate measurements to meet license conditions and federal regulations require that properly calibrated instrumentation be used.

It is important that the decommissioning instrumentation be calibrated to traceable sources in order to ensure that the health and safety of the public is protected. The staff concludes that the proposed TS is adequate for the intended objective and therefore acceptable.

3.5.2 Addition of TS 6.3.1 (8)

To help implement TS 4.11 the licensee also proposed adding to TS 6.3.1, "Items Covered by SOPs" specification (8). The proposed TS follows:

6.3.1 Items Covered by SOPs

Written procedures, reviewed and approved by the Reactor Safety Committee shall be in effect and followed for the items listed below. These procedures shall be adequate to ensure the safe decommissioning of the reactor, but should not preclude the use of independent judgement and action should the situation require such.

Items (1)-(7) are unchanged.

(8) Maintenance, response testing and record keeping involving radiation detecting field instrumentation and associated detectors utilized in the decommissioning of the Reactor Facility.

This specification requires a Standard Operating Procedure (SOP) covering maintenance, response testing and record keeping involving radiation detecting field instrumentation and associated detectors utilized in the decommissioning of the Reactor Facility.

The proposed TS 6.3.1 (8) ensures that procedures exist to implement TS 4.11. Based upon a review of the proposed TS, the staff concludes that the addition of a requirement for a SOP to cover instrumentation maintenance is adequate and acceptable.

3.5.3 Addition to the Existing TS 6.1.2

A change is proposed to TS 6.1.2 "Responsibility," with the addition of the last two paragraphs (see TS below) which include the responsibilities and the minimum qualifications for the RSO position. The proposed TS follows:

6.1.2 Responsibility

During the UVAR permanent shutdown and decommissioning period, the Reactor Facility Director (Level 2) shall be responsible for overall facility operation and the direction of decommissioning activities at the Reactor Facility.

During periods when the Reactor Facility Director is absent, the Director's responsibilities are automatically delegated to the Reactor Supervisor (Level 3).

The Reactor Facility Director shall have at least a bachelor's degree in science or engineering and a minimum of 5 years of experience in the nuclear field. A graduate degree may fulfill 4 years of experience on a one-for-one time basis.

The Reactor Supervisor shall be responsible for the day-to-day activities at the UVAR and ensuring that these are conducted in a safe manner and within the limits prescribed by the facility license. During periods when the Reactor Supervisor is absent, his responsibilities are delegated to a person at (Level 4).

The Reactor Supervisor shall have the equivalent of a bachelor's degree in science or engineering and at least 2 years of experience in Reactor Operations at this facility, or an equivalent facility, or at least 6 years of experience in Reactor Operations. Equivalent education or experience may be substituted for a degree. Within nine months after being assigned to the position, the Reactor Supervisor shall obtain and maintain a NRC Senior Reactor Operator license if reactor fuel elements are still at the Facility. A NRC Senior Reactor Operator license, or a Reactor Operator license, is not required for level 3 and 4 personnel once all reactor fuel elements have been shipped offsite.

The Radiation Safety Officer shall be responsible for providing radiological support in the decommissioning of the UVAR. This function ensures that the activities involving potential radiological exposure are conducted in compliance with the applicable licenses, Federal and State regulations, and UVAR standard operating procedures. The position includes responsibility for maintaining the UVAR surveillance and monitoring program and for HP radiological protection procedures.

The minimum qualifications for the Radiation Safety Officer positions are a four-year degree in Health Physics or related field, three years supervisory experience in Health Physics and five years operational experience related to radiation safety.

Having well qualified people in key positions helps to ensure that the decommissioning is performed as planned in the DP. Radiation Safety is a key aspect of decommissioning. After review of the proposed addition to TS 6.1.2 the staff finds that the addition of the responsibilities and minimum qualifications to TS 6.1.2 for the Radiation Safety Officer is appropriate and consistent with guidance of ANSI/ANS 15.4-1988 (Ref. 29). The staff therefore concludes that the addition to TS 6.1.2 is acceptable.

3.5.4 Addition of TS 5.2.1

The licensee proposes the addition of TS 5.2.1, "Temporary Pool Confinement." The objective of this specification is to assure that while decommissioning activities involving the pool area are in progress there will be a barrier surrounding the pool with a ventilation and filtration system to minimize the potential risks associated with worker inhalation of radioactive material made airborne by the decommissioning work. The proposed TS follows:

5.2.1 Temporary Pool Confinement

Applicability: This specification applies to the utilization of a confinement barrier surrounding the reactor pool, with an associated local ventilation system, operating whenever airborne hazards could arise within the reactor pool during decommissioning work.

Objective: The barrier surrounding the reactor pool and its associated ventilation and filtration system are intended to minimize potential risks associated with worker inhalation of radioactive material made airborne by D&D work.

Specification: While decommissioning activities involving the reactor pool are in progress, such that airborne hazards may be produced, a confinement barrier surrounding the reactor pool shall have been erected and placed into use. A local ventilation system shall be operating during these periods, to ensure negative pressure within the confinement with respect to the Reactor Room and to provide high-efficiency filtration of the air exhausted from the enclosure.

Basis: The barrier and ventilation system together will ensure that reactor pool confinement air is scrubbed clean by high-efficiency filters prior to release to the Reactor Room.

The staff finds that the proposed TS specifies good engineering and radiological practice for dismantlement and decommissioning of the pool and is appropriate to control the release of contamination from the control areas. The staff concludes that the proposed TS is necessary and adequate and is therefore acceptable.

3.5.5 Conclusions

The staff has reviewed the changes to the TSs proposed by the licensee. The staff finds that the requested TS changes are needed to decommission the UVAR. As discussed above for each proposed new TS, the addition of surveillance requirements for decommissioning instrumentation, a requirement for a SOP for decommissioning radiation detection instrumentation, the addition of responsibilities and qualifications of the Radiation Safety Officer, and requirements for temporary pool confinement are acceptable to the staff.

3.6 Quality Assurance

3.6.1 Quality Assurance Project Plan (QAPP)

The licensee's QAPP will be developed to incorporate the portions of 10 CFR Part 50, Appendix B, that the licensee finds applicable (note that Appendix B is not a requirement for research reactors). The QAPP will incorporate the "UVA Quality Assurance Program for Radioactive Materials Packages, Appendix, Rev 2" (Ref. 30), which was written to assure compliance with 10 CFR Part 71, Subpart H. This program was submitted to the NRC on August 11, 1997, and was subsequently approved by the NRC. The plan has an expiration date of September 30, 2002. In addition, the licensee states that the QAPP will identify

additional procedures and requirements that are applicable based on government and regulatory requirements, contractual commitments and supplemental quality standards.

The licensee states in RAI2 that the QAPP will utilize a graded approach that bases the level of controls on the intended use of the results and the degree of confidence needed in their quality. ANSI/ASQC E4-1994 (ASQC 1995) (Ref. 31) and Appendix K of MARSSIM will be used to provide guidance in quality for the collection and evaluation of environmental data, and for developing the QAPP.

An extensive quality assurance program will be used throughout the UVAR decommissioning effort to assure that work does not endanger public safety, and to assure the safety of the decommissioning staff.

An outline of the quality assurance efforts that the licensee plans to use during the UVAR decommissioning is provided in the DP.

The QAPP will be issued and approved by UVA and it will be documented by written procedures and implemented throughout the decommissioning project in accordance with those procedures. The management of those organizations participating in the QAPP will regularly review the status and adequacy of that part of the plan that they are implementing. All changes to the QAPP will be governed by measures commensurate with those applied to the original issue.

3.6.2 Quality Assurance Responsibilities

The licensee states that the quality assurance organizations of the DOC and UVA have the responsibility, authority and organizational freedom to:

- Identify quality problems,
- Take action to stop unsatisfactory or unsafe work and control further processing, delivery, installation or use of nonconforming items,
- Initiate, recommend or provide solutions, and
- Verify implementation of solutions.

The UVA has ultimate responsibility for the proper implementation of the QAPP. The DOC is responsible to UVA for the effective execution of the plan.

3.6.3 Quality Requirements

The DP addresses the various features of the QAPP that are necessary to assure quality during the decommissioning. Those associated with instrumentation include:

- Instrumentation Calibration,
- Instrumentation Response Testing,
- Instrumentation Maintenance, and
- Instrument Record Keeping.

Those aspects of the QAPP that concern sampling and analysis quality control and are described in the DP include:

- Sample Collection,
- Sample Quality Control,
- Sample Identification,
- Sample Labeling,
- Sample Chain-of-Custody,
- Sample Analysis, and
- Sample Documentation.

The licensee states that the QAPP will address record keeping. The following are some of the topics concerning record keeping that are described in the DP:

- Procedure Control,
- Radioactive Shipment Package Documents, and
- Final Survey Documents.

3.6.4 Quality Assurance Records

The licensee states that sufficient records will be maintained to furnish evidence of activities important to safe decommissioning as required by code, standard, specification or project procedures. The licensee's stated QA records goals are:

- Records will be identifiable, available, and retrievable.

- Records will be reviewed to ensure their completeness and ability to serve their intended function.

- Requirements will be established concerning record collection, safekeeping, retention, maintenance, updating, location, storage, preservation, administration and assigned responsibility.

- Requirements will be consistent with applicable regulations and the potential for impact on quality and radiation exposure to the workers and the public.

Typical records will include:

- Proposed DP (and record of changes and approvals),

- QAPP (and record of changes and approvals),

- Final Status Survey Plan (and record of changes and approvals),

- Procedures,

- Reports,

- Personnel qualification records,

- Radiological and environmental site characterization records, including final site release records,

- Dismantlement records, and

- Inspection, surveillance, audit and assessment records.

3.6.4.1 Records of Health and Safety Related Activities

The licensee plans to maintain the following records that have a potential for impact on quality and radiation exposure to the workers and the public:

- Work Permits,
- Work Procedures,
- Contamination Survey Reports,
- Airborne Survey Reports,
- Counting data or air samples and gamma spectrum analysis,
- Instrument calibrations,
- Source inventory and storage,
- Radioactive material inventory and storage,
- Shipment records,
- Incidents and accidents,
- Confined space entry permits, and
- Monitoring records for oxygen deficient explosive atmosphere.

3.6.5 Personnel Records

The licensee plans to maintain personal information records that may impact quality and radiation exposure to the workers and the public. Typical records would be:

- Bioassay analysis,
- Respiratory protection qualifications (medial/clearance and fit test),
- Training records, and
- Visitor logs and exposure information.

3.6.6 Audits

The licensee states that the QAPP will contain requirements for audits. They will be implemented to verify compliance with the QAPP and to determine the effectiveness of the QAPP plan. Trained and qualified personnel not having direct responsibility in the areas being audited will perform the audits in accordance with written procedures or checklists. The DP outlines the following requirements for audits, reports, and corrective actions:

- Content of the reports including identification of discrepant areas,

- Distribution of reports,

- Identification of the individual responsible for implementation of the audited provisions and for performance of the audit,

- Identification of the measures that will be established to ensure that discrepancies identified by audits are resolved,

- Identification and notification of the manager responsible for verification of satisfactory resolution of any discrepancies,

- Identification of the manager responsible for resolving any discrepancies, and

- Identification of the level of management responsible for resolving disputed discrepancies.

The licensee states that follow-up action, including additional audits of deficient areas, will be taken as indicated.

3.6.7 Conclusions

Based on the review of the DP and other documentation provided by the licensee the staff has reasonable assurance that an adequate quality assurance plan can be developed and implement in accordance with 10 CFR 50.82 (b)(4)(v). The staff concludes that a DOC picked using the criteria provided by the licensee and the licensee will have adequate experience to develop and implement an acceptable quality assurance plan.

3.7 Physical Security

Since the fuel was shipped off the site, the physical security task has been reduced to ensuring access control of the facility and security of radioactive material in storage and control of material not in storage. All UVA radiation restricted areas are secured from unauthorized entry. During non-working hours, all nuclear facility sensitive areas are locked. UVA maintains routine, periodic police surveillance of the reactor site. Existing physical security procedures, as may be amended, will continue to be implemented.

3.7.1 Conclusions

Based on the review of the DP and RAI1 the staff finds the licensee has acceptable access control to prevent inadvertent exposure to workers and members of the public. The staff concludes that the existing physical security procedures meet the requirements of 10 CFR Part 20, Subpart I and 10 CFR 50.82 (b)(4)(v) and are therefore, acceptable.

3.8 Additional License Conditions

The regulations in 10 CFR 50.82(b)(5) states in part that the licensee's DP will be approved by license amendment subject to such conditions and limitations as it deems appropriate and necessary. Based on the requirements of the regulations and the staff's review of the licensee's application, the staff has added the following conditions to the UVA license:

(4) Decommissioning

a. The license is amended to approve the decommissioning plan described in the licensee's application dated February 9, 2000, as supplemented on April 26, June 6, and December 19, 2000, and May 4 and 11, 2001, and authorizes inclusion of the decommissioning plan as a supplement to the Safety Analysis Report pursuant to 10 CFR 50.82(b)(5).

b. The licensee may make changes to the decommissioning plan without prior approval provided the proposed changes do not:

(i) Require Commission approval pursuant to 10 CFR 50.59;

(ii) Increase the radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs;

(iii) Use a statistical test other than the Sign test or Wilcoxon Rank Sum test for evaluation of the final status survey;

(iv) Reduce the coverage requirements for scan measurements.;

(v) Decrease an area classification (i.e., impacted to unimpacted; Class 1 to Class 2; Class 2 to Class 3; or Class 1 to Class 3);

(vi) Increase the Type I decision error;

(vii) Increase the derived concentration guideline levels and related minimum detectable concentrations (for both scan and fixed measurement methods);

(viii) Result in significant environmental impacts not previously reviewed.

c. The licensee shall submit reports of any characterization surveys performed that were not part of the license amendment application and shall submit the completed final status survey plan for review prior to performing the final status survey.

d. The licensee shall submit a report of their investigation of groundwater conditions including the groundwater flow system and groundwater flow rate to account for the leakage pathway from the reactor pool and to determine if radionuclides from licensed activities have or may potentially migrate offsite in the future.

License condition 4.a. makes the licensee's DP part of the Safety Analysis Report for the facility in accordance with the regulations. License condition 4.b. helps to ensure that changes to the DP that may impact compliance with the release criteria in the regulations in Part 20 are not made without NRC review. License 4.c. ensures that important information to the decommissioning process still under development by the licensee are submitted to the NRC when complete. The licensee is in the process of determining the behavior of groundwater at

their site. License condition 4.d. ensures that the results of the licensee's investigations are submitted to NRC for review.

3.8.1 Conclusions

The staff has added requirements to the UVAR license in accordance with the regulations in 10 CFR 50.82(b)(5). The staff concludes that these license conditions are necessary to meet the requirements of 10 CFR 50.82(b)(5) and to allow the licensee to develop the terminal radiation survey and documentation necessary to allow the staff to make the required findings to terminate the license in accordance with 10 CFR 50.82(b)(6).

4.0 ENVIRONMENTAL CONSIDERATION

The Commission has prepared an Environmental Assessment and Finding of No Significant Impact (EA), which was published in the Federal Register on December 6, 2001 (66 FR 63418). On the basis of the EA and this safety evaluation, the Commission has determined that no environmental impact statement is required and that issuance of this amendment approving decommissioning will have no significant adverse effect on the quality of the human environment.

5.0 CONCLUSIONS

Based on the staff's review of the licensee's application for approval of decommissioning, the staff finds that the licensee is adequately cognizant of its continuing responsibilities to protect the health and safety of both workers and the public from undue radiological risk. The DP provides reasonable evidence that the licensee is prepared to dismantle the reactor, and dispose of all significant reactor-related radioactive materials in accordance with applicable regulations and applicable NRC guidance.

The staff concludes that the choice of the DECON decommissioning alternative is acceptable and meets the requirements of 10 CFR 50.82(b)(4)(i) for decommissioning without significant delay.

The staff concludes that the DP provides acceptable organizational structure and control to decontaminate and dismantle the UVAR while maintaining due regard to protecting the public, environment and workers from significant radiological risk. Further, the staff concludes that the licensee's plan on radiation protection, and radioactive material and waste management is acceptable based on the use of standard guidance and practices for such programs. The staff finds the personnel training program that UVA proposes in the DP to be acceptable because its scope covers all aspects of decommissioning activities that need to be performed safely. The industrial safety program, procedural and equipment controls are consistent with such programs at decommissioning reactors, and are therefore acceptable. The staff concludes that the accident analyses show potential radiological consequences well within acceptable limits. The staff concludes that the licensee's DP contains a description of the controls and limits on procedures and equipment to protect occupational and public health and safety as required by 10 CFR 50.82(b)(4)(ii).

The staff concludes that the licensee has adequately described the radiological status of the UVAR facility and has proposed acceptable release criteria for the UVAR facility. The licensee

has acceptably described the tasks, and sequence of activities and schedule needed to decommission the UVAR facility. The staff also concludes that the licensee has provided an acceptable description of their planned final radiation survey as required by 10 CFR 50.82(b)(4)(iii).

The staff concludes that the licensee has provided in accordance with 10 CFR 50.82(b)(4)(iv) an acceptable updated cost estimate for the DECON decommissioning alternative and has an acceptable plan for assuring the availability of adequate funds for the completion of decommissioning.

The licensee has provided a description of TSs, quality assurance provisions and physical security plan provisions to be in place during decommissioning. The staff has determined that these aspects of the DP meet the regulations in 10 CFR 50.82(b)(4)(v).

Therefore, based on the discussion above, the staff concludes that the licensee's DP meets the requirements of 10 CFR 50.82 (b)(4).

The staff has concluded, on the basis of the considerations discussed above, that (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously evaluated, or create the possibility of a new or different kind of accident from any accident previously evaluated, and does not involve a significant reduction in a margin of safety, the amendment does not involve a significant hazards consideration; (2) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities; and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

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Date: March 26, 2002

ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Is Reasonably Achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAVALIER	Cooperatively Assembled Virginia Low Intensity Educational Reactor
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DCGL	Derived Concentration Guideline Levels
DECON	Decontamination Decommissioning Option
DOC	Decommissioning Operations Contractor
DP	Decommissioning Plan
HEPA	High Efficiency Particulate Air (Filter)
HP	Health Physics
HSA	Historical Site Assessment
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual, NUREG-1575
MSHA	U.S. Mine Safety and Health Administration
MW(t)	Megawatt thermal power
NIOSH	National Institute for Occupational Safety and Health
NIST	U.S. National Institute of Standards and Technology
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
OSHA	Federal Occupational Safety and Health Acts
QA	UVA Quality Assurance Organization
QAPP	Quality Assurance Project Plan
RAI1	First Response to the Request for Additional Information
RAI2	Second Response to the Request for Additional Information
RFD	Reactor Facility Director
RSO	Radiation Safety Officer
RWP	Radiation Work Permit
SNM	Special Nuclear Material
SOP	Standard Operating Procedure
SS	Stainless Steel
TEDE	Total Effective Dose Equivalent (see 10 CFR Part 20)
TS	Technical Specification
UVA	University of Virginia
UVAR	University of Virginia Reactor

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