June 6, 2006

Dr. Charles R. Fay
Vice Provost for Research Administration
Cornell University
314 Day Hall
Ithaca, NY 14853-2801

SUBJECT: WARD CENTER FOR NUCLEAR STUDIES AT CORNELL UNIVERSITY ZERO POWER REACTOR- AMENDMENT RE: DECOMMISSIONING PLAN APPROVAL (TAC NO. 9429)

Dear Dr. Fay:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 8 to Facility Operating License for the TRIGA Reactor, Docket No. 50-97, License No. R-89.

The amendment approves the decommissioning plan (DP) for the Ward Center for Nuclear Studies (WCNS) at Cornell University in response to your application of August 22, 2003, as supplemented on May 13, September 27, October 26 and December 13, 2005, and February 13, 2006. 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). In addition, in accordance with 10 CFR 50.82(b)(5), the staff has added a license condition to Facility Operating License No. R-89 deemed appropriate and necessary for approval of the decommissioning plan. The DP for WCNS also includes the decommissioning of the TRIGA reactor, Docket No. 50-157, License No. R-80.

A copy of the safety evaluation supporting Amendment No. 8 is also enclosed.

Sincerely,

/RA/

Daniel E. Hughes, Project Manager
Research and Test Reactor Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-97

Enclosures: 1. Amendment No. 8
2. Safety Evaluation

cc w/enclosures: Please see next page

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OFFICE	PRT:LA	ADM	PRT:PM	OGC	PRT:SC
NAME	EHylton*	HChang*	DHughes tls:*	SUttal*	BThomas:tls*
DATE	5/2/2006	4/25/2006	6/1/2006	6/1/06	6/6/06

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CORNELL UNIVERSITY ZERO POWER REACTOR

DOCKET NO. 50-97

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 8
License No. R-89

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

A. The application for an amendment to Facility Operating License No. R-89 filed by the Cornell University (the licensee) on August 22, 2003, as supplemented on May 13, September 27, October 26, December 13, 2005, and February 13, 2006, 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

2. Accordingly, the license is amended by the addition of paragraph 2.C.(4) to Facility Operating License No. R-89 which hereby reads as follows:

4. Decommissioning

a. The license is amended to approve the decommissioning plan described in the licensee's application dated August 22, 2003, as supplemented on May 13, September 27, October 26, December 13, 2005, and February 13, 2006, 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); and

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

c. The licensee shall submit reports of all characterization surveys performed that were not part of the license amendment application to justify the classification of areas that were not accessible. Those reports and the completed final status survey plan shall be submitted for review prior to performing the final status survey.

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

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Brian E. Thomas, Branch Chief
Research and Test Reactors Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Date of Issuance: June 6, 2006

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REGULATION

RELATED TO THE DECOMMISSIONING OF

THE

WARD CENTER FOR NUCLEAR STUDIES AT CORNELL UNIVERSITY

DOCKET NOS. 50-157/97

June 2006
Research and Test Reactors Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

ABSTRACT

This safety evaluation summarizes the findings of a technical review conducted by the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation. This review was conducted in response to a license amendment application filed by Cornell University (Cornell, or the licensee) for approval of the decommissioning plan (DP) for the Ward Center for Nuclear Studies (WCNS). The WCNS is located on the Cornell University campus in Ithaca, New York. On the basis of this review, the NRC staff concludes that Cornell can safely dismantle the training reactor and isotopes production, General Atomics and zero power reactors at the WCNS, and dispose of the component parts in accordance with its DP, as amended, and the NRC's rules and regulations.

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LIST OF TABLES

1.0 INTRODUCTION

By letter dated August 22, 2003 (Ref. 1), Cornell University (Cornell, or the licensee) submitted a license amendment request to the Nuclear Regulatory Commission (NRC) to approve its decommissioning plan (DP), Revision 1, issued July 2003 (Ref. 2), and to authorize dismantlement and disposal of component parts from the Ward Center for Nuclear Studies (WCNS) located in Ithaca, New York. After the submittal of the initial license amendment request supplements were received on May 13 (Ref. 3), September 27 (Ref. 4), October 26 (Ref. 5), and December 13, 2005 (Ref. 6), and February 13, 2006 (Ref. 7).

Licensing activities related to decommissioning activities at the WCNS are limited to the training reactor and isotopes production, General Atomics (TRIGA) reactor, NRC Docket No. 50-157, Facility License No. R-80, and the zero power reactor (ZPR), NRC Docket No. 50-97, Facility License No. R-89.

The decommissioning, as described in the plan, is the decontamination decommissioning (DECON) option and will consist of a transfer of licensed radioactive equipment and material from the site and decontamination of the facility to meet the unrestricted release criteria provided in Title 10, Section 20.1402, "Radiological Criteria for Unrestricted Use," of the *Code of Federal Regulations* (10 CFR 20.1402) (Ref. 8). In its license amendment request, the licensee described how the final status survey (FSS) plan will be developed and submitted to the NRC for review. The licensee will perform an FSS to verify and document that the decommissioned areas and structures meet the requirements for release for unrestricted use. The licensee will then submit documentation of the satisfactory completion of its FSS to the NRC for review and acceptance.

A notice, titled "Notice and Solicitation of Comments; Pursuant to 10 CFR 20.1405 and 10 CFR 50.82(b)(5) Concerning Proposed Action To Decommission Ward Center for Nuclear Studies at Cornell University Reactor Facility," was published in the *Federal Register* on August 10, 2005 (70 FR 46549) (Ref. 9).

This SE was prepared by Mr. Daniel E. Hughes, Project Manager, Research and Test Reactors Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation. Other major contributors to the technical review are E.W. Abelquest, A. Boerner, S. Kirk, and T. Bauer of Oak Ridge Institute for Science and Education (ORISE) under contract to the NRC.

2.0 BACKGROUND

2.1 Regulatory Basis

The regulatory requirements for the contents of DPs for research and test reactors are contained in 10 CFR 50.82(b)(4)(Ref. 10). This regulation requires that the proposed DP include the following items:

- the choice of the alternative for decommissioning with a description of related activities (see Section 3.1 below)

- a description of the controls and limits on procedures and equipment to protect occupational workers and public health and safety from ionizing radiation (see Section 3.2 below)

- a description of the planned FSS (see Section 3.3 below)

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

- a description of quality assurance (QA) provisions, physical security plan provisions, and technical specifications (TS) in place during decommissioning (see Sections 3.5, 3.6, and 5.0 below)

The NRC conducted its review of the DP submitted by Cornell in accordance with 10 CFR 50.82(b)(5) to determine whether the preferred decommissioning alternative would be performed in accordance with applicable regulations and would not be inimical to the common defense and security or to the health and safety of the public. Furthermore, should the NRC find that these criteria are met, and after notice to interested persons, it may approve the DP as an amendment to the referenced license, subject to such conditions and limitations as deemed appropriate and necessary.

License conditions for this amendment are based on Appendix 2 to NUREG-1700, “Standard Review Plan for Evaluating Nuclear Power License Termination Plans,” Revision 1, issued April 2003 (Ref. 11). Furthermore, the staff established a license condition in accordance with the requirement of 10 CFR 50.82(b)(5) that the approved DP supplement the safety analysis report or equivalent.

The requirements following the approval of the DPs are provided in 10 CFR 50.82(b)(6). This regulation states that the NRC will terminate the license if it determines that the decommissioning was in accordance with the approved DP and that the FSS and associated documentation demonstrate that the facility and site are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, “Standards for Protection Against Radiation,” Subpart E (Ref. 12).

2.2 Site and Facility Description and Operating History

The Cornell University campus and the WCNS are shown on Figures 1-2 and 1-3 of the DP. The WCNS was constructed between 1959 and 1962 to house the TRIGA reactor, the ZPR, and the gamma cell and supporting systems (e.g., instrumentation and control systems, forced cooling system, water demineralization system, ventilation/exhaust system, radiation monitoring systems, etc.). Figures 1-4, 1-5, and 1-6 of the DP present plan views of the three floors of the WCNS. The reactor facility footprint is 10,000 square feet. The total building area is 20,000 square feet on three floor levels.

Following construction and reactor hardware installation, the TRIGA reactor was brought to initial criticality in January 1962. The WCNS TRIGA reactor and ZPR provided training for nuclear engineering students and various services for researchers in all departments of the College of Engineering, the College of Arts and Sciences, and the College of Veterinary Medicine. Cornell concluded in 2001 that there was minimal demand for the TRIGA reactor to support the costs of continued reactor operations. The TRIGA reactor ceased operations on April 21, 2003. The TRIGA reactor's fuel was shipped to Idaho Falls, Idaho, arriving on November 20, 2003. The ZPR ceased operations, pursuant to Amendment No. 4 to Facility License No. R-89, dated February 12, 1997, in which authorization to operate the ZPR was removed and authorization for possession only of the reactor was approved. Following the removal of the ZPR fuel, the reactor was partially disassembled. The ZPR fuel was returned to the Department of Energy in April 2000. A summary profile for the WCNS TRIGA reactor and ZPR is provided in Tables 2-1 and 2-2, respectively.

The WCNS is contaminated with varying amounts of radioactivity and small amounts of hazardous materials based on the characterization study of the facility. The licensee reviewed the operating history to identify events that have, or could have, resulted in contamination of areas within the WCNS. A description of five such events is reported in Table 2-1 of the DP.

Decontamination and decommissioning (D&D) of the WCNS is being planned by the licensee to eliminate the potential for future inadvertent environmental releases. The goal of the proposed D&D activities is termination of the WCNS TRIGA reactor, Facility License No. R-80, NRC Docket No. 50-157, and the ZPR facility, Facility License No. R-89, NRC Docket No. 50-97, and the release of the reactor portions of the WCNS for unrestricted use.

In addition to the TRIGA reactor and ZPR, a gamma irradiation facility located in the WCNS will also be decommissioned to levels that will allow for its unrestricted use. This decommissioning activity will be conducted in accordance with a byproduct material license issued by the State of New York pursuant to Section 274 of the Atomic Energy Act of 1954 as amended. The term "unrestricted use" means that there will be no future restrictions on the use of the site other than those imposed by the City of Ithaca zoning ordinances.

The current facility status is as follows. The fuel assemblies were removed from the TRIGA reactor. With Amendment No. 13 to Facility License No. R-80 (Ref. 13), this facility will be placed in "possession-only license" (POL) status with no authorization to possess fuel. Amendment No. 4 to Facility License No. R-89 (Ref.14) authorized possession only of the ZPR and subsequently the fuel was shipped to the Department of Energy. Essential safety systems comprising the manually actuated and automated fire alarm and radiological alarm systems in the WCNS will remain operational during the decommissioning. In addition, the utility services at

the WCNS, required for facility operation and maintenance under POL status conditions and decommissioning, will also remain active.

Table 2-1 Profile of the WCNS TRIGA Reactor

General Reactor Information:	
Category:	research reactor
Type:	TRIGA Mark II
Owner:	Cornell University
Operator:	Cornell University
Licensee:	Cornell University
Architect/Engineer:	Vitro Engineering Company
Nuclear Design:	General Atomic Division of General Dynamics
Principal Uses:	training and research
Reactor Operation and Authorization:	
Initial Criticality:	January 12, 1962
NRC Utilization Facility License #:	R-80
NRC Facility Docket #:	50-157
Reactor Specifications:	
Thermal Power, Steady (kW):	500 as of 1983
Thermal Power, Pulsed (MW)	1000
Maximum Flux SS, Thermal (n/cm^2-s):	$3.0x10^{12}$
Coolant:	light water
Reflector:	graphite
Moderator:	light water
Reflector Number of Sides:	4
Control Rod Material:	B4C
Control Rod Number:	4
Equilibrium Core Size (Fuel Elements):	85
Rods per Element:	1
Dimension of Rods, mm:	37.3 x 720
Element Cladding Material:	aluminum and stainless steel

Table 2-2 Profile of the WCNS ZPR

General Reactor Information:	
Category:	critical assembly
Type:	tank
Owner:	Cornell University
Operator:	Cornell University
Licensee:	Cornell University
Principal Uses:	training and research
Reactor Operation and Authorization:	
Initial Criticality:	January 1, 1962
Date POL Issued:	February 12, 1997
NRC Utilization Facility License #:	R-89
NRC Facility Docket #:	50-97
Reactor Specifications:	
Maximum Power, Steady State, MW(t):	0.1 kW
Maximum Flux SS, Thermal (n/cm^2-s):	1.0x10^9
Maximum Flux SS, Fast (n/cm^2-s):	5.0x10^8
Coolant:	light water
Reflector:	light water
Moderator:	light water
Reflector Number of Sides:	4
Control Rod Material:	B4C
Equilibrium Core Size (fuel elements):	228
Rods per Element:	1
Dimension of Rods, mm:	15 x 1219
Cladding Material:	aluminum alloy
Uranium Density, g/cm^3:	10.2
Fuel Fabricator:	General Electric

2.3 Scope of the Decommissioning Project

The WCNS DP lists the various areas, structures, and components that are included in the Decommissioning Project. The major aspects of the Decommissioning Project include the TRIGA reactor, TRIGA bioshield and beam ports, the reactor complex, the office and laboratory wing, and the ZPR. Some of the specific areas include the reactor pool and associated structures and systems, activated concrete in the bioshield concrete monolith, thermal column and beam ports, process equipment, floor drains and ventilation systems, soil under and around the reactor pool, and other impacted interior and exterior building surfaces.

The licensee's DP provides the following items:

- a summary of the present radiological condition of the WCNS and site environs
- a description of the planned approach to be employed to decommission the WCNS
- a description of the methods that will be used to protect occupational and public health and the safety of the workers and the environment from radiological hazards associated with WCNS Decommissioning Project activities
- a description of WCNS physical security and material accountability controls
- a description of radioactive waste management and disposal
- a cost estimate for decommissioning the WCNS and the financial assurance instruments for these activities
- a schedule for the WCNS Decommissioning Project (not current)
- a description of the QA program applicable to the WCNS Decommissioning Project
- a description of the training program to be established for personnel performing work in support of the WCNS Decommissioning Project
- an environmental report concerning the expected impact of performing the activities involved in the WCNS Decommissioning Project

The areas covered by the WCNS DP include only those rooms in the building where remediation could be required based upon the characterization study survey performed in February 2003. The rooms excluded from planned decommissioning operations include classrooms and faculty/student offices in which radioactive materials had never been used.

The entire WCNS facility, including the building and any other areas, as necessary, will be included in the FSS and will meet the release criteria before being released for unrestricted use.

The DP was prepared using the guidance and format of NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," Revision 0, issued February 1996 (Ref. 15), as well as additional guidance from NUREG-1757, "Consolidated

NMSS Decommissioning Guidance—Decommissioning Process for Materials Licenses," issued September 2003 (Ref. 16).

3.0 EVALUATION

The licensee has safely conducted licensed operations involving the use of radioactive materials since the WCNS became operational in 1962. As such, the operational, security, QA, waste management, and radiological programs required under the referenced licenses have been effectively carried out. Because these programs will continue to remain in effect in accordance with regulatory and license requirements, the staff focused its review on the manner in which these required programs would be maintained and subsequently transitioned to support the mission of safely decommissioning the WCNS.

The NRC staff has reviewed the licensee's proposed actions to decontaminate, dismantle, and dispose of component parts of the WCNS, and to perform an FSS. After decommissioning activities are completed, the NRC will review the licensee's FSS report to determine if the facility has been adequately remediated to levels commensurate with unrestricted use in accordance with 10 CFR 20.1402. If the NRC concludes that the facility has been successfully decommissioned to permissible levels, then Cornell's Facility License Nos. R-80 and R-89 will be terminated.

The NRC staff review focused on the licensee meeting the regulatory requirements discussed in Section 2.1 above and included consideration of the following items:

- management responsibilities and commitments to continue following applicable regulations, regulatory guides, standards, and personnel protection plans, including procedures

- use of equipment/instrumentation, radiation survey methods, worker training, and radioactive waste disposal

- plans to develop/perform the FSS of the facility

3.1 Decommissioning Alternative

The licensee's stated objective for decommissioning the WCNS is the regulatory release of the WCNS for unrestricted use. The DECON option is the decommissioning alternative chosen by the licensee to permit termination of the reactor licenses and provide beneficial reuse of the property. Decontamination of facility equipment and structural components will be conducted to minimize radioactive waste. Structural portions of the building and materials found to be radiologically contaminated and/or activated will be decontaminated, sectioned and removed, and/or processed, as necessary. The licensee will perform an FSS to demonstrate that the WCNS meets the NRC criteria for unrestricted use. The FSS results will be documented in a report to be submitted to the NRC in support of a request that the site be released for unrestricted use and the reactor licenses 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 50.82(b)(4)(I) for decommissioning without significant delay and is, therefore, acceptable.

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

3.2.1 Project Management Structure

3.2.1.1 Decommissioning Organization and Responsibilities

Cornell is committed to, and retains ultimate responsibility for, full compliance with the existing NRC reactor licenses and the applicable regulatory requirements during decommissioning. The Office of the Vice Provost for Research (Project Director), with support from the Cornell D&D Oversight Committee and the Cornell Project Manager (PM), will monitor decommissioning operations to ensure they are being performed safely and according to Federal, State, and local regulatory requirements.

Cornell management has committed to selecting a qualified contractor to perform the WCNS Decommissioning Project. The team will consist of Cornell personnel and the selected contractor. Cornell will be responsible for overall project management. A decommissioning operations contractor will manage the physical decommissioning work and provide health physics (HP) support; radiation surveys; and waste packaging, processing, and shipping.

3.2.1.2 Key Licensee Positions

The following key licensee positions are proposed in the DP:

(A) Cornell PM

The PM is responsible to Cornell administration and management for the successful completion of decommissioning work. The role of PM includes many activities from prequalifying and selecting contractors to reviewing and recommending changes to the contract, as well as ensuring communication between Cornell staff during the decommissioning process.

Specifically, the role of PM includes the following duties:

- selecting a decommissioning contractor to assist Cornell with the decommissioning of the WCNS
- overseeing the decommissioning contractor's performance relative to the terms of its contract related to the DP and all subsequent plans and procedures
- ensuring that all decommissioning activities comply with applicable regulations and are performed in accordance with all license conditions
- approving minor changes to this DP and subsequent plans and procedures (which do not change the original intent of the plans and procedures) in accordance with 10 CFR 50.59, "Changes, Tests, and Experiments,"(Ref. 17) and the D&D change control provisions of the referenced licenses

- managing the decommissioning budget and approving contractor payments
- communicating with the Cornell D&D Oversight Committee and Project Director
- overseeing inspections and QA activities associated with decommissioning and reporting findings
- communicating with regulators

The minimum qualifications for the Cornell PM are as follows:

- a professional engineering degree
- 10 years of project management experience
- experience managing site remediation projects for Cornell
- a thorough understanding of Cornell's policies and procedures for working with contractors on multimillion-dollar projects

(B) WCNS Director for Nuclear Studies

The WCNS Director for Nuclear Studies (Center Director) is responsible for maintaining the WCNS in a safe and proper condition during the decommissioning, in accordance with the requirements set forth in applicable facility licenses.

Specifically, the Center Director's functions include the following:

- reviewing plans and procedures
- providing engineering and logistical support during decommissioning

The minimum qualifications for this position are as follows:

- current or previously certified reactor operator
- at least 2 years of experience in reactor operation at the TRIGA facility, or at least 6 years of experience in reactor operations

(C) Cornell University Radiation Safety Officer

The Cornell University Radiation Safety Officer (RSO) will be responsible for providing radiological support in the decommissioning of the WCNS. This function ensures that the activities involving potential radiological exposure are conducted in compliance with the applicable licenses, Federal and State regulations, and WCNS standard operating procedures. The position includes responsibility for maintaining the TRIGA surveillance and monitoring program and for Health Physics (HP) radiological protection procedures.

The RSO will have oversight of all D&D operations, including those that involve work with systems or materials that have a radiological component.

The minimum qualifications for this position are as follows:

- an advanced degree in HP or a related field
- 10 years supervisory experience in HP
- 10 years operational experience related to radiation safety

The RSO is responsible for ensuring the following:

- Radiological controls are in place prior to and during any work involving radiation.
- Applicable license conditions are satisfied.
- Applicable State and Federal regulations are met.

The RSO has the authority to do as follows:

- take any actions necessary to ensure that radiological controls are implemented and followed

- stop or modify radiological work immediately and then make changes to radiation work permits (RWPs) within 24 hours

3.2.1.3 Decommissioning Prime Contractor

The staff reviewed the criteria specified by the licensee for selecting a prime contractor to manage and supervise all or part of the WCNS Decommissioning Project. The selected prime contractor will manage and supervise operations and services such as characterization, dismantlement, decontamination, waste handling, and QA.

Cornell proposes to select a contractor through university-established procurement procedures and standards requiring a rigorous source evaluation and review process. The review and evaluation specifications define the scope and method of selection and criteria for contractor qualifications, experience, and reputation.

The contractor qualifications and experience required include the following:

(A) The decommissioning contractor must demonstrate experience in performing 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 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) survey criteria (Ref. 18)

- use of inventory and tracking mechanisms to assure accurate waste tracking

- development and execution of radiological and industrial safety programs that will be used during D&D

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

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

- packaging, manifesting, transporting, processing, and disposing of radioactive waste

(B) The decommissioning contractor selected must have a QA program that meets the requirements of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," Subpart H (Ref. 19). In addition, the contractor's QA program must meet the applicable criteria from Appendix B to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities,"(Ref. 20) and American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1, "Quality Assurance Requirements for Nuclear Facility Applications," issued 2001 (Ref. 21). One of the applicable criteria that must be included is a QA approved suppliers list.

(C) The contractor should be prepared to provide qualified personnel, including but not limited to the following:

- PM
- certified health physicist with FSS experience using the MARSSIM
- waste management specialist
- industrial hygienist
- civil and mechanical engineer
- QA engineer
- construction supervisor
- planning and scheduling specialist
- decontamination and waste technicians
- radiological safety engineer, foreman, and technicians

3.2.1.4 Cornell D&D Oversight Committee

On May 13, 2005, the licensee submitted a response to the NRC's request for additional information (RAI) that delineates the roles and responsibilities of the Cornell D&D Oversight Committee. In addition, the TSs to implement the Cornell D&D Oversight Committee are part of a separate amendment request, for Facility License No. R-80, to remove authorization to operate the TRIGA reactor, to possess special nuclear material, and to make TS changes to implement and support decommissioning. In addition, an amendment to Facility License No. R-89 for the ZPR was requested to bring the administrative controls section of the TSs in alignment with Facility License No. R-80 and the WCNS DP. As such, the licensee has committed to maintaining management oversight of decommissioning-related activities for the WCNS.

Cornell has established this committee to ensure that the decommissioning work is performed safely, efficiently, and effectively. Its role is to assist the PM and Project Director as needed to ensure that adequate resources and funding for the project are available.

The responsibilities of the D&D Oversight Committee include, but are not limited to, the following:

- review and approval of rules, procedures, and proposed TSs
- review and approval of all proposed changes in the facility that could have a significant effect on safety, as well as of all proposed changes in rules, procedures, and TSs, in accordance with procedures in Section 6.3
- review and approval of experiments using the reactor in accordance with procedures and criteria in Section 6.4
- determination of whether a proposed change, test, or experiment would constitute an unreviewed safety question or change in the TSs (see 10 CFR 50.59)
- review of the current operation and operations records of the facility
- review of abnormal performance of plant equipment and operating anomalies
- review of unusual or abnormal occurrences and incidents which are reportable under 10 CFR Part 20 and 10 CFR Part 50
- inspection of the facility, review of safety measures, and audit of operations at a frequency not less than once per year
- approval of appointments of responsible persons

3.2.1.5 Conclusions

The staff has reviewed the criteria the licensee will use to select the decommissioning 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 prime contractor with adequate qualifications.

Furthermore, the staff, as separate licensing actions, will issue a license amendment with TS changes, as requested by the licensee, delineating the roles and responsibilities of the Cornell D&D Oversight Committee (see TSs 6.2 and 6.3 and the safety evaluation for Amendment No. 13 to Facility License No. R-80) and the responsibilities and qualifications of key university personnel (see TS 6.1, Section 6.0 of this document, and the safety evaluation for Amendment No. 13 to Facility License No. R-80). In addition, in response to the licensee's amendment request on January 19, 2006, concurrently with this amendment, Amendment No. 7 to Facility License No. R-89 is being issued (Ref. 22). This latter amendment will remove authority for possession of fuel, make this safety evaluation report a part of the safety analysis report for Facility License No. R-89, add license conditions, and approve administrative TS changes to ensure that both WCNS licenses are under the same management, license conditions, and

oversight. As such, the licensee has adequately committed to maintaining management oversight of decommissioning-related activities for the WCNS, including the TRIGA reactor and the ZPR.

The NRC concludes that the licensee has provided reasonable assurance that organizational structures needed to safely decommission the WCNS, including the TRIGA reactor and ZPR, are in place. In addition, the licensee has committed to ensuring the Cornell D&D Oversight Committee will properly oversee all decommissioning activities conducted by the decommissioning contractor, including the review and approval of changes to the facility and of decommissioning-related plans and procedures. The staff finds that the project management structure for the decommissioning of the WCNS is consistent with the guidance on the role and composition of the facility safety committee provided in Appendix 17.1 to NUREG-1537 and is, therefore, acceptable.

3.2.2 Occupational Worker and Public Health and Safety

3.2.2.1 Radiation Protection

3.2.2.1.1 ALARA Program

The licensee committed to conducting decommissioning activities in a manner that will ensure that radiation exposures 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 WCNS DP provides details on its ALARA program that will ensure compliance with the radiation dose standards specified in 10 CFR Part 20, as follows. A documented ALARA evaluation will be required for specific tasks if a project health physicist determines that 5 percent of the applicable dose limits (collective dose) for the following may be exceeded:

- total effective dose equivalent (5 rem)
- the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye (50 rem)
- eye dose equivalent (15 rem)
- shallow dose equivalent to the skin or any extremity (50 rem)

3.2.2.1.2 Methods for Occupational Exposure Reduction

In the DP, the licensee committed to methods that will be used during the Decommissioning Project work to ensure that occupational exposure to radioactive materials is minimized. The methods include the use of RWPs, special equipment, techniques, and other practices as described in the DP.

The licensee committed to implementing RWPs to administratively control personnel entering or working in areas that have radiological hazards present. As such, work techniques will be specified in a manner that the exposures for all personnel, individually and collectively, are

maintained at ALARA levels. The RWPs will not replace work procedures, but will act as a supplement to procedures. Radiation work practices will be considered when procedures are developed for work that will take place in a radiologically controlled area.

According to the DP, project RWPs will describe the job to be performed, define protective clothing and equipment to be used, and identify personnel monitoring requirements. The RWPs will also specify any special instructions or precautions pertinent to radiation hazards in the area, including listing the radiological hazards present, area dose rates, and the presence and intensity of hot spots, loose surface radioactivity, and other hazards as appropriate. 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 RWPs for jobs with low dose commitments will be approved at the HP technician or HP supervisory level, while the RWPs for jobs with a potentially high dose commitment or significant radiological hazards will be approved by the RSO. Examples of topics covered by implementing procedures for the RWPs include the following:

- identifying requirements, classifications, and scope for RWPs
- initiating, preparing, and using RWPs
- extending expiration dates of an RWP
- terminating RWPs

3.2.2.1.3 Control and Storage of Radioactive Materials

According to the DP, the Cornell HP program commits to establishing radioactive material controls that will ensure the following:

- Any inadvertent release of licensed radioactive materials to unrestricted areas will be prevented and/or minimized.

- Personnel radiation exposures are maintained at ALARA levels.

- Radioactive waste volumes generated during decommissioning will be minimized to the extent practicable.

The licensee committed to surveying all material leaving the restricted area to ensure that radioactive material is not inadvertently released from the WCNS. In addition, all radioactive material storage areas will be contained inside posted restricted areas according to existing Cornell procedures and consistent with 10 CFR Part 20.

The licensee, in its May 12, 2005 response to an RAI, revised Section 2.3.1.1.3.1 of the DP to include a commitment to ensure that any equipment, materials, instrumentation, and tools used or encountered during decommissioning would be surveyed and free released only if they exhibited less than minimum detectable activity, consistent with the survey methodology chosen. The licensee committed to developing a survey procedure with free-release criteria.

In an additional RAI response, dated February 13, 2006, the licensee added this commitment to the end of the May 13, 2005, revised Section 2.3.1.1.3.1 of the DP in the form of the following revision:

> The survey methodologies employed will conform to the following guidance documents:
>
> - Information Notice No. 88-22, "Disposal of Sludge from Onsite Sewage Treatment Facilities at Nuclear Power Stations (Ref. 23)"
> - Information Notice No. 85-92, "Surveys of Waste Before Disposal from Nuclear Reactor Facilities (Ref. 24)"
> - IE Circular No. 81-07, "Control of Radioactively Contaminated Material (Ref. 25)"

3.2.2.1.4 Conclusions

The appropriate criterion is that no licensed radioactive material may be disposed of as clean waste. It is the licensee's responsibility to ensure that this criterion is met. The licensee proposed to develop a procedure for the disposal of clean waste and has committed to conform to the appropriate guidance. The staff find this plan acceptable, and NRC inspections will verify that appropriate instruments, processes, and approved procedures are used during decommissioning.

3.2.2.2 Health Physics Program

The DP notes that Cornell has procedures in place that will be implemented during the WCNS Decommissioning Project. If additional HP procedures are required at some point in the work to support decommissioning, they will be developed and approved in accordance with Cornell HP policies and procedures.

Cornell senior management has committed to being readily accessible to ensure timely resolution of difficulties that may be encountered. The RSO, while organizationally independent of the Decommissioning Project staff, has direct access to the WCNS Director on a daily basis and has full authority to act to protect workers and the public from the effects of radiation. Conduct of the WCNS Decommissioning Project HP program will be evaluated according to Cornell policy.

3.2.2.2.1 Radiation Exposure

The WCNS DP evaluated potential sources of radiation or contamination exposure based on process knowledge; radiological survey data; surveys performed during characterization; previous and current job coverage surveys; or daily, weekly, and monthly routine surveys.

The licensee concluded that worker exposure to significant external deep-dose radiation fields is considered unlikely during this project because of the nature of the contaminants and/or the work precautions and techniques 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.

Furthermore, Cornell concluded that exposure of the public to external or internal radiation from this Decommissioning Project is not considered credible because of the confinement provided by the facility and the access control provided for the facility and the surrounding area surrounding.

3.2.2.2.2 Surveys and Monitoring

Radiation surveys and monitoring will be performed by the licensee in accordance with the existing radiation protection program and as necessary to support work activities in areas where there is potential for exposure to radiation or radioactive materials. As noted in the DP, Cornell's existing program will be augmented as necessary using plans and procedures provided by the decommissioning contractor.

The WCNS DP addresses airborne effluent monitoring, radiation surveys, and personnel monitoring. As such, airborne effluent monitoring would be performed during the decommissioning effort where a temporary barrier with an exhaust system is in use, and the ventilation system exhaust points from the temporary barrier will be sampled continuously downstream of the high-efficiency particulate air (HEPA) filtration system.

Radiation surveys during decommissioning will be conducted in accordance with approved HP procedure(s). The purposes of these surveys will be to protect the health and safety of workers; protect the health and safety of the general public; and demonstrate compliance with applicable license, Federal, and State requirements, as well as DP commitments. The HP staff will verify the validity of posted radiological warning signs during the conduct of these surveys. Surveys will be conducted in accordance with procedures utilizing survey instrumentation and equipment suitable for the nature and range of hazards anticipated. Equipment and instrumentation will be calibrated and, where applicable, operationally tested before use in accordance with procedural requirements. Routine surveys will be conducted at a specified frequency to ensure that contamination and radiation levels in unrestricted areas do not exceed license, Federal, State, or site limits. The HP staff will also perform surveys during decommissioning whenever work activities create a potential to impact radiological conditions.

In the DP, Cornell addressed personnel monitoring, both internal and external. Prospective external exposure evaluations will be performed before initiating decommissioning activities and whenever changes in conditions warrant. Visitors to the WCNS will be monitored in accordance with requirements specified in Cornell HP procedures and according to the radiological hazards of areas to be entered.

The licensee committed to conducting internal monitoring in accordance with its approved procedures. This prospective internal exposure evaluation will be evaluated on an annual basis, at a minimum, or whenever significant changes in planned work warrant it. A comprehensive air sampling program will be conducted at the WCNS to evaluate worker exposures regardless of whether internal monitoring is specified. The results of this air sampling program will be utilized to ensure validity of specified internal monitoring requirements for decommissioning personnel. If, at any time during the decommissioning, hazards that may not be readily detected by the preceding measures are encountered, special measures or bioassay, as appropriate, will be instituted to ensure the adequate surveillance of worker internal exposure. Cornell committed to

monitoring if the prospective dose evaluation shows that an individual(s) dose is likely to exceed 10 percent of the applicable limits, and for individuals entering a high or very high radiation area.

3.2.2.2.3 Exposure Control

Restricted areas are defined by the licensee on the basis of the known or suspected hazard potential from radiation sources that have been defined from measurement or inferred from process knowledge. The licensee's DP notes that exposure to an individual entering such an area may be from any combination of the following:

- direct radiation
- surface contamination (fixed and removable)
- airborne radioactivity

Each of these potential exposures is discussed in the next three sections.

3.2.2.2.4 Control of Exposure to Direct Radiation

The types of exposure controls that will be implemented during decommissioning will take into account the current state of technology and the economics of improvements in relation to the benefits. Control of potential sources of direct radiation exposure to Cornell employees, contracted workers, and the public as a result of decommissioning activities will be achieved through the use of administrative, engineering, physical, and other controls.

Cornell proposed that administrative controls will consist of, but are not limited to, the following:

- administrative dose limits that are lower than regulatory limits
- training
- RWPs and associated radiological surveys

Physical and engineering controls may also be used, such as radiological warning rope/ribbon, in combination with radiological warning tape and lockable doors/gates, as well as information signs, flashing lights, or other applicable restrictions/barriers.

3.2.2.2.5 Control of Exposure to Surface Contamination

The licensee will control exposure to individuals from surfaces contaminated with radioactive material either by prior decontamination or by using protective equipment for personnel to minimize or limit exposure to the surface material. Contamination control measures that will be employed include, as appropriate, the following:

- Worker training will incorporate methods and techniques for the control of radioactive materials, as well as proper use and donning/doffing of protective clothing.

- Procedures will incorporate HP controls to minimize the spread of contamination during work.

- Radiological surveys will be scheduled and conducted by HP staff.

- Containment devices such as designed barriers, containers, and plastic bags will be used to prevent the spread of radioactive material.

- Physical decontamination of WCNS areas or items will occur.

- Physical barriers such as Herculite sheeting, strippable paint, and tacky mat step-off pads will limit the spread of contamination.

- Signs, physical area boundaries, and barricades will be present.

- Clean step-off pads will be at the entrance point to contaminated areas.

- Personnel entries into radiologically contaminated areas will require the use of protective clothing that is appropriate for the radiological conditions as outlined in the RWP.

3.2.2.2.6 Control of Exposure to Airborne Radioactivity

Cornell proposes to use engineering controls as the primary means to mitigate the airborne radiological hazard at the source by controlling the concentrations of airborne radioactive material. There may be, however, circumstances in which engineering controls are not practical or may not be sufficient to prevent airborne concentrations in excess of those that constitute an airborne radioactivity area. In circumstances in which worker access is required, respiratory protective equipment will be utilized to limit internal exposures. Any situation in which 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, the decision to allow access will be accompanied by the performance of representative measurements of airborne radioactivity to assess worker intake. The results of derived air concentration-hour tracking and air sample results for intake will be documented in accordance with appropriate regulations. Workers will provide nasal smears for HP evaluation following the use of respiratory protective equipment for radiological purposes, as necessary.

Monitoring for the intake of radioactive material is required by 10 CFR 20.1502(b) (Ref. 26) if the intake is likely to exceed 10 percent of the 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. Air sampling will be performed in areas where airborne radioactivity is present or likely.

The prospective estimates of worker intakes and air concentrations used to establish monitoring requirements will be based on consideration of the following:

- the quantity of material(s) handled
- the annual limit on intake for the nuclides of interest
- the release fraction for the radioactive material(s) based upon its physical form and use
- the type of confinement used for the material(s) being handled
- other factors that may be applicable

The licensee's respiratory protection program will include direction for use of equipment certified by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA). This program will be reviewed and approved in accordance with

the HP program to ensure adherence to the requirements of 10 CFR Part 20. The Cornell industrial hygienist may be consulted to advise the decommissioning contractor on issues about air quality and the use of respiratory protection. The Director of Environmental Health and Safety has supervisory control over the industrial hygienist position.

Respiratory protection, if warranted, will be provided using NIOSH/MSHA-approved air purifying respirators. These respirators 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.

3.2.2.2.7 Radiation Monitoring Equipment

The licensee committed to using radiation survey equipment and instrumentation suitable to permit detection and assessment of radiological hazards to workers and the public to ensure the validity of measurements taken during remediation and final release surveys. The selection of equipment and instrumentation to be used 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 WCNS.

A sufficient inventory and variety of instrumentation will be maintained onsite by the licensee to facilitate effective measurement of radiological conditions and control of worker exposure consistent with ALARA and to evaluate suitability of materials for the release of materials for unrestricted use. The licensee will employ radiation monitoring equipment capable of measuring the expected range of dose rates and radioactivity concentrations to be encountered during remediation and decontamination activities, including the minimum values required for release or materials for unrestricted release. The licensee committed that the radiation monitoring equipment will be calibrated at manufacturer-prescribed intervals (if frequency is shorter than annual), annually, or before use, employing standards traceable to the National Institute of Standards and Technology (NIST), and that the calibration information will be clearly marked on the instrument. Survey instruments and equipment will be operationally tested daily when in use. A specific listing of survey instruments expected to be used on this project is provided in Table 3-1 of the DP."

3.2.2.3 Dose Estimates

The total projected occupational exposure to complete the decommissioning of the WCNS is estimated to be 18.34 person-rem. This estimate was taken from NUREG/CR-1756, "Technology, Safety, and Cost of Decommissioning Reference Nuclear Research and Test Reactors," issued March 1982 (Ref. 27). The estimate in this document was developed for a reference research reactor (i.e., a 1000 kW TRIGA reactor).

The licensee provided this estimate for planning purposes. Detailed exposure estimates and exposure controls will be developed during detailed planning of the decommissioning activities. Area dose rates used for this estimate are based on process knowledge and current survey maps (where available).

The dose estimate to members of the public as a result of decommissioning activities is estimated to be negligible. This is because site perimeter controls will restrict members of the public from the area where decommissioning activities are taking place. This is consistent with the estimate given for the reference research reactor in NUREG-0586, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," issued 1988 (Ref. 28). The dose to the public during DECON 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 man-rem)."

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

3.2.2.4 Radioactive Waste Management

3.2.2.4.1 Fuel Removal

As stated in the DP, the TRIGA reactor's fuel was shipped to Idaho Falls, Idaho, arriving on November 20, 2003. The ZPR fuel was returned to the Department of Energy in April 2000.

3.2.2.4.2 Radioactive Waste Processing

The licensee's waste management program includes provisions for waste minimization or volume reduction, radioactive and hazardous waste segregation, waste characterization, neutralization, stabilization, solidification, and packaging.

The licensee's decommissioning of the WCNS will result in the generation of solid and liquid low-level radioactive waste (LLRW), mixed waste, and hazardous waste. Limited soil remediation is anticipated, which will result in solid radioactive waste. This waste will be handled (processed and packaged), stored, and disposed of in accordance with Federal, State, and local requirements.

3.2.2.4.3 Radioactive Waste Disposal

The licensee stated that LLRW will be processed and packaged for disposal at a licensed low-level waste site such as the Envirocare of Utah site or the Barnwell, South Carolina site. The volume of LLRW is estimated at 4700 cubic feet. Mixed low-level waste will be prepared for shipment to offsite commercial processing and disposal facilities such as Envirocare of Utah.

The DP notes that 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste, Subpart D—Technical Requirements for Land Disposal Facilities," (Ref. 29) establishes minimum radioactive waste classification, characterization, and labeling requirements. These requirements will be satisfied through the implementation of project packaging and characterization procedures. Section 2.2.2 of the DP notes that estimates of the radioactivity inventory may be determined 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. Direct measurements, however, are generally more reliable and will be used during actual removal and/or dismantlement of components.

Project waste management personnel will be trained/qualified in accordance with Cornell's internal procedures/plans to assure conformance to applicable 10 CFR Part 61 requirements. Audits and surveillance will be conducted in accordance with the project-specific QA plan based on ASME-NQA-1 and the requirements of 10 CFR Part 71.

Radioactive wastes will be packaged and transported in accordance with 10 CFR Part 71. Cornell is licensed by the NRC to receive, possess, use, and transfer licensed byproduct and source materials. These regulatory requirements will be met through the implementation of Cornell-approved packaging and shipping procedures. Training will be provided for waste management personnel to assure conformance to applicable 10 CFR Part 71 requirements.

The licensee committed to comply with 10 CFR 20.2006, "Transfer for Disposal and Manifests," (Ref. 30) which establishes requirements for controlling transfers of LLRW intended for disposal at a land disposal facility; establishes a manifest tracking system; supplements requirements concerning transfers and recordkeeping; and requires generator certification that transported materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transport. These requirements will be met through the implementation of Decommissioning Project and Cornell packaging and shipping procedures with the oversight of the decommissioning contractor and Cornell QA staff.

Cornell stated that radiological and mixed wastes will be disposed of at disposal sites in accordance with the applicable disposal site's 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 analyses, evaluations and profiles, transportation plans, and waste stream volume forecasts. Waste characterization, waste designation, waste traceability, waste segregation, waste packaging, waste minimization, and QA and training requirements for the designated disposal sites will be incorporated in implementing procedures to assure conformance to disposal site requirements.

Radioactive waste will be staged in designated controlled areas in accordance with the requirements of 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," (Ref. 31) and 10 CFR Part 20. Mixed wastes will be staged in designated controlled areas in accordance with Environmental Protection Agency requirements under Title 40, "Protection of Environment," (Ref. 32) of the CFR, 10 CFR Parts 19 and 20, and local and State permits. Measures will be implemented through plans and procedures to control the spread of contamination; to limit radiation levels; and to prevent unauthorized access, unauthorized material removal, tampering, and weather damage. The designated controlled areas will be approved by RWPs and/or hazardous work permits. A hazardous work permit will be used when controls are imposed to protect against nonradiological hazards. The Cornell Associate Director of Laboratory and Radiation Safety is responsible for hazardous work permit approval. The Director of Environmental Health and Safety has supervisory control over the Cornell Associate Director of Laboratory and Radiation Safety.

Radioactive and mixed waste material will be packaged for shipment in accordance with Titles 10 CFR, "Energy" (Ref. 33), 49, "Transportation" (Ref. 34), and 40, "Protection of Environment," of the CFR and the designated disposal site criteria and placed in permitted interim storage (staged) until shipped. The quantity of waste packages staged for shipment will

be a function of waste generation and packaging rate, shipment preparation rate, shipment rate, and disposal site acceptance rate. To meet this objective, shipments will be scheduled throughout the life of the project to designated treatment, storage, and disposal facilities.

3.2.2.5 Conclusions

The staff reviewed the licensee's HP program, the estimate of potential radiological doses attributable to decommissioning operations, and the program that will be implemented to support waste management operations.

Cornell has committed to implementing its existing radiation protection and contamination control programs in support of decommissioning the WCNS. The NRC has confidence that these mature programs will achieve their intended purposes because they have been successfully implemented by the licensee in support of reactor operations. Furthermore, based on review of the waste management, ALARA, personnel monitoring, radiation protection/instrumentation, and respiratory protection programs, the NRC concludes that these programs are adequate to safely support decommissioning operations at the WCNS and are therefore acceptable.

Based on its review of the WCNS DP and the reference research reactor in NUREG/CR-1756, the staff concludes that the licensee's estimates for occupational and public doses during decommissioning activities are reasonable. The staff also finds that the estimates of occupational dose may be revised as additional characterization data are developed. As such, the licensee has provided reasonable assurances that decommissioning operations will be conducted safely and within the allowable radiation dose limits specified in 10 CFR Part 20.

Based on the review of the licensee's program and the licensee's experience in safely managing radioactive waste generated during normal operations, the staff concludes that the licensee's proposed radioactive waste management program that will be implemented to support decommissioning operations is adequate and, therefore, acceptable.

3.2.3 Training Program

The licensee has committed to provide individuals (employees, contractors, and visitors) who require access to the work areas or a radiologically restricted area with the necessary training to levels that are commensurate with the potential hazards to which they may be exposed. Radiation protection training will be provided to personnel who will be performing remediation work in radiological areas or handling radioactive materials in accordance with the requirements specified in 10 CFR Part 19. The training will ensure that Decommissioning Project personnel have sufficient knowledge to perform work activities in accordance with the requirements of the radiation protection program and accomplish ALARA goals and objectives. The stated principal 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.

The licensee committed to maintain records of training that will generally include trainees' names, dates of training, type of training, test results, authorization for protective equipment use, and the instructor's name. As such, the staff finds that the radiation protection training provides the necessary information for workers to implement sound radiation protection practices. The

following training program elements applicable to remediation activities covered in the WCNS DP were reviewed by the NRC staff.

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 the following:

- project orientation/access control
- introduction to radiation protection
- QA
- industrial safety
- emergency procedures

Radiation Worker Training

Radiation worker training will be required for all individuals directly associated with the WCNS Decommissioning Project, 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, investigational levels, keeping doses at ALARA levels)
- contamination limits and controls
- management and control of radioactive waste

Respiratory Protection Training

The licensee committed to provide personnel whose work assignments require the use of respiratory protection devices with 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; NRC Regulatory Guide 8.15, “Acceptable Programs for Respiratory Protection,” Revision 1, issued October 1999 (Ref. 35); NUREG-0041, “Manual of Respiratory Protection Against Airborne Radioactive Materials,” Revision 1, issued January 2001 (Ref. 36); and 29 CFR 1910.134, “Respiratory Protection” (Ref. 37). 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.

General Industrial Safety Program

The DP specifies that industrial safety and industrial hygiene personnel, along with project management, will be responsible for ensuring that the project meets all occupational health and safety requirements. The primary functional responsibility is to ensure compliance with the Occupational Safety and Health Administration (OSHA) regulations of 1973. Specific responsibilities include conducting an industrial training program to instruct employees in general safe work practices, reviewing Decommissioning Project procedures to verify adequate coverage of industrial safety and industrial hygiene concerns and requirements, performing periodic inspections of work areas and activities to identify and correct any unsafe conditions and work practices, providing industrial hygiene services as required, and advising Decommissioning Project management on industrial safety matters and on the results of periodic safety inspections.

All personnel working on the WCNS Decommissioning Project will receive health and safety training to recognize and understand the potential risks associated with the work at the WCNS. The health and safety training implemented at the WCNS will ensure compliance with the requirements of the NRC, EPA, and OSHA in Titles 10, 40, and 29, "Labor," (Ref. 38) of the CFR, respectively. Workers and regular visitors will be familiarized with plans, procedures, and operation of equipment to conduct work activities safely.

3.2.3.1 Conclusions

Based on the review of the licensee's training program as described in the DP, the staff concludes that the licensee's training program is acceptable. The licensee also recognized that specific training would be required to reflect the unique hazards associated with decommissioning operations. While the NRC does not regulate nonradiological hazards as specified in the Atomic Energy Act, the licensee is aware that personnel involved with decommissioning activities are subject to training requirements administered by other Federal, State, and local government agencies and has committed to provide training commensurate with the potential hazards to which individuals may be exposed.

3.2.4 Radiological Accident Analyses

The staff evaluated potential radiological accidents that could occur during the decommissioning of the WCNS. These accidents were mainly associated with the reactor pool and are reported in the Duratek Inc. report, DRTK-CALC-WARD-001, "Radiological Accident Analysis for Decommissioning Ward Center," Revision 0, issued June 2003 (Ref. 39). The primary postulated types of accidents related to decommissioning activities included the following:

- the inadvertent release of radioactive materials caused by dropping a waste shipping liner containing activated hardware as it is moved from the reactor pool to a transportation cask

- the inadvertent release of radioactive materials caused by dropping a demineralizer resin column

- the airborne release of radioactive materials caused by a fire in an area used to stage dry solid waste for shipping

- the airborne release of radioactive materials caused by a fire in a block of activated graphite material

The radiological consequences for the types of accidents related to decommissioning activities were significantly less than that for the types of accidents postulated for an operating research reactor. Because the reactor fuel has been removed from the reactor vessels, and the radiological source term significantly reduced, the radiological consequences postulated for the TRIGA reactor and ZPR, while operational, are bounding. In addition, the licensee noted that other engineered controls that would be in place during decommissioning operations would further prevent or mitigate postulated accidents that could potentially occur during decommissioning operations.

The staff reviewed the results of calculated radiological doses to members of the public assuming a source to receptor distance of 100 meters from the WCNS. The staff finds that it is reasonable to conclude that offsite radiological consequences, as reported in the DP, would be well below the NRC dose limits for individual members of the public (100 mrem/yr).

3.2.4.1 Conclusions

Based upon information contained in the DP, the staff finds that the postulated accidents as reported by the licensee adequately reflect the types of potential accidents that could reasonably be expected to occur during decommissioning operations. In addition, since the reactor fuel has been removed from the reactor and shipped off site, the radiological consequences that could result during decommissioning are far less than those types of accidents that formed the licensing basis for the TRIGA reactor and ZPR during operations. Furthermore, the licensee will be required by a license condition to perform reviews in accordance with 10 CFR 50.59 before removal of significant safety controls (e.g., fire suppression systems) during decommissioning operations. As such, the staff finds that, given the likelihood and low radiological consequences to workers and members of the public attributable to potential accidents that could reasonably occur, there is reasonable assurance that decommissioning operations can be performed while maintaining the health and safety of the public and protection of the environment.

3.3 Decommissioning Activities

3.3.1 Radiological Status of the Facility

3.3.1.1 General

Routine radiological surveys conducted during reactor operations show that the radiation levels and contamination levels measured at the WCNS have consistently been low. A characterization survey completed in February 2003, and summarized in Appendix A to the DP, confirmed that only minor quantities of residual radioactivity or radioactive contamination are present. In addition, the overview of the characterization survey data in Appendix A to the DP provides an indication of the WCNS decommissioning areas where residual activity was detected. The information indicates that the radioactive portions of the facility are primarily confined to the reactor internals and reactor pool.

3.3.1.2 Radionuclides

The licensee provided a listing of radionuclides known to be present, or possibly present in detectable levels within the WCNS. The list of expected radionuclides is provided in Table 2-2 of the DP.

3.3.1.3 Principal Radioactive Components

The licensee provided information on principal radioactive components based upon process knowledge and direct measurements. The most highly radioactive components to be handled and processed during decommissioning of the WCNS that may exceed 5 R/h at the surface are the following:

- control rods estimated at about 400 mR/h at 6 inches
- hot thimbles estimated at about 20 R/h
- hydraulic rabbit (aluminum) about 25 feet long estimated at about 6 R/h

3.3.1.4 Conclusions

The staff has reviewed the activities identified by the licensee for the principal radioactive components. 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 in order to justify the classification of areas that were not accessible before the removal of material from the pool is complete and the pool is drained, the licensee will submit reports of all characterization surveys performed that were not part of the license amendment application. These surveys should include the pool and any potential leakage pathways, the radiological condition of the reactor pool water prior to disposal, and activities and contamination of beam ports and thermal column, sanitary sewer lines, soil beneath the reactor building, and ground water. A license condition is included to assure that the characterization reports are provided to the NRC.

3.3.2 Radiological Release Criteria

The staff reviewed the specific decommissioning cleanup criteria contained in the DP that reflect each of the potential or known radioactive contaminants of concern present at the WCNS. The objective of decommissioning the WCNS is to reduce residual contamination to levels that will not exceed 25 mrem/yr (above background) to the average member of the critical group for a period of 1000 years into the future (in accordance with 10 CFR 20.1402), thus allowing unrestricted release of the site.

The staff reviewed the methodology proposed by the licensee to determine the derived concentration guideline levels (DCGLs) needed to determine compliance with 10 CFR 20.1402. This review consisted of evaluating the methods proposed by the licensee against regulatory acceptance criteria contained in Appendix B to NUREG-1757, Volume 1.

For building surfaces and surface soil contamination, the licensee proposed to use acceptable license termination screening values (meeting the 10 CFR 20.1402 criteria) of common radionuclides provided in NUREG-1757, Volume 1. The screening values for total structure surface contamination are repeated from the DP in Table 3-1; guideline levels for removable

activity are 10 percent of the values in the table. These default screening levels have been conservatively evaluated by the NRC as satisfying the goal that estimated doses to facility occupants and the public during future facility use do not exceed 25 mrem annually. Default screening criteria are based on a conservative exposure scenario and pathway parameters and are generally regarded as providing a high level of confidence that the annual dose limits will not be exceeded.

The DCGLs for residual radioactive material contamination in surface soil (top 15 cm of soil) under or near the WCNS facility or sediments were proposed by the licensee from the tables of NRC default screening values (see NUREG-1757). These screening values for contaminants in soil are listed in Table 3-2 below and are based on assurance that estimated doses to facility occupants and the public during future facility use do not exceed 25 mrem annually. These default screening criteria are based on a conservative exposure scenarios and pathway parameters and are generally regarded as providing a high level of confidence that the annual dose limits specified in 10 CFR 20.1402 will not be exceeded.

Table 3-1 Acceptable License Termination Screening Values of Common Radionuclides for Structural Surfaces

Radionuclide	Symbol	Acceptable Screening Levels[1,2] for Unrestricted Release (dpm/100 cm^2)[3]
Hydrogen-3 (Tritium)	^{3}H	1.2×10^{8}
Carbon-14	^{14}C	3.7×10^{6}
Sodium-22	^{22}Na	9.5×10^{3}
Sulfur-35	^{35}S	1.3×10^{7}
Chlorine-36	^{36}Cl	5.0×10^{5}
Manganese-54	^{54}Mn	3.2×10^{4}
Iron-55	^{55}Fe	4.5×10^{6}
Cobalt-60	^{60}Co	7.1×10^{3}
Nickel-63	^{63}Ni	1.8×10^{6}
Strontium-90	^{90}Sr	8.7×10^{3}
Technetium-99	^{99}Tc	1.3×10^{6}
Iodine-129	^{129}I	3.5×10^{4}
Cesium-137	^{137}Cs	2.8×10^{4}
Iridium-192	^{192}Ir	7.4×10^{4}

1. Screening levels presented here are taken from "Supplemental Information on the Implementation of the Final Rule on Radiological Criteria for License Termination" (63 FR 222, 1998) (Ref. 40). The DP states that site-specific screening levels will be developed for the project in the manner described in that reference.

2. Screening levels are based on the assumption that the fraction of removable surface contamination is equal to 0.1. For cases in which the fraction of removable contamination is undetermined or higher than 0.1, users may assume for screening purposes that 100 percent of the surface contamination is removable, and therefore the screening levels should be decreased by a factor of 10. Users may calculate site-specific levels using available data on the fraction of removable contamination and the D&D code, version 2.

3. Units are disintegrations per minute (dpm) per 100 square centimeters (dpm/100 cm^2). One dpm is equivalent to 0.0167 Becquerel (Bq). Therefore, to convert to units of Bq/m^2, multiply each value by 1.67. The screening values represent surface concentrations of individual radionuclides that would be deemed in compliance with the 0.25 mSv/yr (25 mrem/yr) unrestricted release dose limit in 10 CFR 20.1402. For radionuclides in a mixture, the "sum of fractions" rule applies (see Appendix B to Part 20, Note 4).

Table 3-2 Acceptable License Termination Screening Values of Common Radionuclides for Surface Soil

Radionuclide	Symbol	Surface Screening Values[1,2]
Hydrogen-3 (Tritium)	^{3}H	$1.1x10^{2}$
Carbon-14	^{14}C	$1.2x10^{1}$
Sodium-22	^{22}Na	4.3
Sulfur-35	^{35}S	$2.7x10^{2}$
Chlorine-36	$^{36}C1$	$3.6x10^{-1}$
Calcium-45	^{45}Ca	$5.7x10^{1}$
Scandium-46	^{46}Sc	$1.5x10^{1}$
Manganese-54	^{54}Mn	$1.5x10^{1}$
Iron-55	^{55}Fe	$1.0x10^{4}$
Cobalt-57	^{57}Co	$1.5x10^{2}$
Cobalt-60	^{60}Co	3.8
Nickel-59	^{59}Ni	$5.5x10^{3}$
Nickel-63	^{63}Ni	$2.1x10^{3}$
Strontium-90	^{90}Sr	1.7
Niobium-94	^{94}Nb	5.8
Technetium-99	^{99}Tc	$1.9x10^{1}$
Iodine-129	^{129}I	$5.0x10^{-1}$
Cesium-134	^{134}Cs	5.7
Cesium-137	^{137}Cs	$1.1x10^{1}$
Europium-152	^{152}Eu	8.7
Europium-154	^{154}Eu	8.0
Iridium-192	^{192}Ir	$4.1x10^{1}$
Lead-210	^{210}Pb	$9.0x10^{-1}$
Radium-226	^{226}Ra	$7.0x10^{-1}$
Radium-226+C[3]	$^{226}Ra+C$	$6.0x10^{-1}$
Actinium-227	^{227}Ac	$5.0x10^{-1}$
Actinium-227+C	$^{227}Ac+C$	$5.0x10^{-1}$

Radionuclide	Symbol	Surface Screening Values[1,2]
Thorium-228	^{228}Th	4.7
Thorium-228+C	^{228}Th+C	4.7
Thorium-230	^{230}Th	1.8
Thorium-230+C	^{230}Th+C	6.0×10^{-1}
Thorium-232	^{232}Th	1.1
Thorium-232+C	^{232}Th+C	1.1
Protactinium-231	^{231}Pa	3.0×10^{-1}
Protactinium-231+C	^{231}Pa+C	3.0×10^{-1}
Uranium-234	^{234}U	1.3×10^{1}
Uranium-235	^{235}U	8.0
Uranium-235+C	^{235}U+C	2.9×10^{-1}
Uranium-238	^{238}U	1.4×10^{1}
Uranium-238+C	^{238}U+C	5.0×10^{-1}
Plutonium-238	^{238}Pu	2.5
Plutonium-239	^{239}Pu	2.3
Plutonium-241	^{241}Pu	7.2×10^{1}
Americium-241	^{241}Am	2.1
Curium-242	^{242}Cm	1.6×10^{2}
Curium-243	^{232}Cm	3.2

1. These values represent surficial surface soil concentrations of individual radionuclides that would be deemed in compliance with the 0.25 mSv/yr (25 mrem/yr) unrestricted release dose limit in 10 CFR 20.1402. For radionuclides in a mixture, the “sum of fractions” rule applies (see Appendix B to 10 CFR Part 20, Note 4).

2. Screening values are in units of picocuries per gram (pCi/g) equivalent to 0.25 mSv/yr (25 mrem/yr). To convert from pCi/g to units of Becquerel per kilogram (Bq/kg), divide each value by 0.027. These values were derived using D&D screening methodology (NUREG/CR-5512, “Residual Radioactive Contamination for Decommissioning,” Volume 3) (Ref. 41). They were derived based on selection of the 90th percentile of the output dose distribution for each specific radionuclide (or radionuclide with the specific decay chain). Behavioral parameters were set at “Standard Man” or at the mean of the distribution for an average human.

3. “Plus Chain” (+C) indicates a value for a radionuclide with its decay progeny present in equilibrium. The values are concentrations of the parent radionuclide but account for contributions from the complete

chain of progeny in equilibrium with the parent radionuclide (NUREG/CR-5512, Volumes 1 (Ref. 42), 2 (Ref. 43), and 3).

The licensee proposed to use the NRC D&D code with default values if additional screening values are required for radionuclides not listed in Tables 3-1 and 3-2.

3.3.2.1 ALARA Analysis

In addition to demonstrating compliance with the 25 mrem/yr dose standard, 10 CFR 20.1402 also specifies that residual radioactivity be reduced to ALARA levels. The licensee has determined that an ALARA analysis is not needed since it elected to use the generic screening thresholds as the basis for determining the site DCGLs, consistent with regulatory guidance (Appendix D to NUREG-1757, Volume 1).

3.3.2.2 Conclusions

The staff concluded that the DCGLs proposed by the licensee based on the referenced generic screening thresholds are sufficient to demonstrate compliance with 10 CFR 20.1402 and are therefore acceptable. In addition, the staff agrees that additional measures to remove residual radioactivity to ALARA levels are not required, consistent with guidance provided in NUREG-1757.

3.3.3 Decommissioning Tasks

3.3.3.1 Characterization Surveys

The staff reviewed Table 1-3 in the DP that summarizes the results of the characterization survey performed by the licensee and identifies areas containing residual activity. Appendix A to the DP provides a summary of the characterization results. The surveyed areas were divided into 20 survey packages. The licensee reported that approximately 10,000 measurements and/or samples were collected during characterization.

3.3.3.2 Dismantlement and Decontamination of the Facility

The licensee committed to the dismantling of the reactors and associated systems in a safe manner and in accordance with ALARA principles, as well as the decontamination and survey of the entire WCNS. The general dismantling and decontamination activities are discussed in the following sections. The licensee may not follow the sequence presented for ALARA, safety, accessibility, or scheduling reasons.

An overview of the dismantling sequence of equipment, components, systems, and structures for the Decommissioning Project is provided in the DP as follows:

- Group 1—equipment that does not have induced radioactivity but which may have surface contamination (e.g., TRIGA reactor systems, ZPR systems, beam port, thermal column, and lab areas)

- Group 2—core components and other components that have induced radioactivity, including pool concrete that has been activated (e.g., reflector, control rods, pneumatic transfer rabbits, and activated concrete)

- Group 3—reactor support systems (e.g., coolant system, purge system, and floor drains)

- Group 4—equipment, tools, and systems that become contaminated during decommissioning operations (e.g., ventilation system, confinement barrier, contaminated tools, and equipment)

The control rods in the TRIGA pool are expected to have the highest dose rates from 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. Additional shielding will be provided for worker protection if necessary.

After pool components and contaminated and activated equipment and parts have been removed, plastic contamination control barriers may be utilized to contain materials generated during bioshield removal. Depending on the demolition methods used, there will be concrete dust or concrete debris generated during the demolition. During the demolition the airborne and surface activity levels will be monitored to determine if contamination control barriers are needed.

The TRIGA bioshield structure will also be removed and may involve an initial surface decontamination prior to removal of the structure, depending on the surface activity levels found after the pool is drained. To minimize resuspension of dust, a localized HEPA vacuum system may be used in the area where concrete is being demolished. The embedded piping that passes from the pool to the heat exchanger and the demineralizer system will be removed during the pool structure demolition.

Post-remediation surveys of the remaining building floor concrete may include concrete and soil/rock/shale coring sampling and analysis. As the removal of activated material proceeds, the radioactive material will be packaged for shipment and disposal.

Two potential radiological safety concerns during performance of this task were identified by the licensee, namely, external exposure from the activated components in the pool and inhalation of airborne material. To mitigate the radiological consequences attributable to these tasks, the licensee committed to monitor the work area for airborne radioactivity and radiation levels during periods of occupancy, and to determine sudden changes in the radiological conditions.

The water treatment system will be removed, which includes the L-1 mixed bed deionizer and the L-2 carbon filter, along with associated pipes, valves, and instrumentation. The pool water cooling system will also be removed, which includes a heat exchanger that utilizes campus-supplied chilled water, two pumps, and associated piping valves and controls. The water treatment system is housed in the reactor equipment room. The cooling system is mounted in the reactor bay on the exterior wall of the reactor equipment room.

The hoods in the isotope handling room and the ZPR laboratories will be removed. All parts of the pneumatic transfer system will be removed with the exception of supplied air and electrical controls.

The ZPR is no longer operational, and significant progress has been made in preparing the facility for release for unrestricted use. The two cleanup filters and the demineralizer associated with the ZPR will be removed. It is anticipated that the remaining equipment can be surveyed and left in place.

The heating, ventilation, and air conditioning system will be left in place except that all filters will be removed.

3.3.3.2.1 Reactor Containment Structure

The licensee proposed the following decommissioning tasks for the reactor containment structure:

- All contaminated equipment will be removed, and all other equipment will be surveyed and left in place.

- Reactor complex ventilation system filters will be removed, and the remaining system will be surveyed and left in place.

- 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.

- The building roof exhaust pipe will be surveyed and left in place.

- The WCNS 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 Pool

The licensee proposed the following decommissioning tasks for the reactor pool:

- Reactor components and activated pool hardware will be removed in hardware liners for disposal as LLRW. A cask will be brought in and loaded with the hardware liners and shipped to the Barnwell, South Carolina, LLRW facility for disposal. The removal of these items can take place either with the pool filled or drained.

- When no longer useful as a radiological shield, the reactor pool water will be surveyed and discharged.

- The dismantling of the reactor support structure and pool will proceed with an initial cleaning of the pool floor and walls. If appropriate, a coating may be applied to “fix” the contamination.

- The thermal column will be removed.

- The beam port extension tubes will be removed.

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

- Potentially activated pool concrete will be removed down to the floor level. Portions of the concrete may be released as uncontaminated. The remainder will be handled as potentially radioactive material or as radioactive material.

- Surface and coring samples of the pool concrete floor in the vicinity of the reactor core will be performed to determine the extent of the activated concrete.

- Activated concrete with activity concentrations in excess of release criteria will be disposed of as radioactive waste.

- The remaining tasks include removal of residual surface contamination in the rooms and performance of the FSS. The packaged waste will be shipped to a licensed processing or disposal facility.

3.3.3.2.3 Remaining Rooms, Structure, and Equipment

The reactor-associated equipment, materials, instrumentation, and tools may be free released if surveyed and shown not to be radioactive or to have total or removable contamination in excess of the minimum detectable activities associated with the survey methodology (see Section 3.2.2.1.3 of this report). Items that cannot be free released will be handled using one of three methods described below:

(1) The items may be shipped directly for disposal as radioactive waste at a licensed facility.
(2) The items may be shipped for processing at a licensed facility.
(3) The items may be shipped to another licensed facility for storage or use.

In each case the term “licensed facility” refers to a facility holding the appropriate radioactive material disposal, processing, storage, or use license appropriate to the class of waste involved.

Reactor-associated equipment, materials, and tools include demineralizer process equipment, heat exchanger equipment, contaminated hoods, and process equipment associated with the beam ports and equipment in the gamma cell that will be dispositioned as LLRW.

Contaminated room surfaces will be decontaminated to levels commensurate with unrestricted release.

3.3.3.3 Final Survey and Report

Following decontamination and remediation activities of the WCNS, an FSS will be performed by the licensee covering the entire WCNS facility. A final radiation survey, executed according to the approved FSS plan, will document that the licensee’s decommissioning efforts meet the release criteria.

Once all decontamination has been performed and verified through final radiation surveys, a final release report will be developed by the licensee. The licensee will record in this report the decontamination and remediation activities performed and document the final radiological status

of the WCNS facility and associated grounds. This final report will be used by the licensee in part as the basis of the application for license termination.

3.3.3.4 Conclusions

The staff concludes that the manner in which the licensee proposed to complete each of the decommissioning tasks is acceptable. A license condition is included to assure that the FSS plan is provided to the NRC for review before performing the survey.

3.3.4 Schedule

The project schedule is presented in Figure 2-3 of the DP. The scheduled time from regulatory approval of the DP to the request for release of the site for unrestricted use is estimated to be 15 months. The licensee proposed that changes to the schedule may be made at its discretion. Those changes may be as a result of resource allocation, availability of a radioactive waste burial site, interference with ongoing Cornell activities, ALARA considerations, further characterization measurements, and/or temporary onsite radioactive waste storage operations.

3.3.4.1 Conclusions

Based on a review of the licensee's proposed decommissioning schedule and understanding contingency, the staff concludes that the licensee's proposed decommissioning timeline is acceptable.

3.3.5 Proposed Final Status Survey Plan

The licensee provided a plan for the development, review, and approval of the FSS plan in Section 4.0 of the DP. The licensee's stated objective for the FSS is to ensure that the facility meets the unrestricted release criteria as specified in 10 CFR 20.1402.

3.3.5.1 General Survey Approach

The outline for the proposed FSS plan prepared by the licensee is intended to provide information to the NRC for determining the adequacy of the licensee's understanding of the proposed FSS approach, commitments, and objectives needed to ultimately demonstrate compliance with the radiological criteria for license termination.

The licensee's proposed FSS plan was prepared in accordance with the guidelines and recommendations presented in the MARSSIM. The DP reiterates the MARSSIM process that emphasizes the use of data quality objectives and data quality assessment, along with a QA and quality control (QC) program. The graded-approach concept of the MARSSIM will be followed by the licensee to assure that survey efforts are maximized in those areas having the greatest potential for residual contamination or the highest potential for adverse impacts of residual contamination. The licensee also intends to use the COMPASS computer code to facilitate the FSS survey planning and data assessment process.

The licensee will use trained and qualified HP technicians to conduct radiological surveys in accordance with the survey procedures. In addition, a senior-level member of the HP staff other

than the individual that performed the survey will review radiological surveys and sample results. The RSO will also review FSS data.

The licensee committed to implement actions to prevent recontamination through administrative and physical access controls of surveyed radiologically clean areas. Control of surveyed areas will be accomplished administratively by written instruction contained in the final survey plan and by training of project personnel. Control of surveyed areas may be accomplished physically by placing rope barriers, locking doors where able, placing signs to notify personnel regarding the condition of an area, and other means.

3.3.5.2 Instrumentation

The licensee stated that instrumentation used during the FSS (and equipment and materials survey) will be selected based upon the need to ensure that site residual radioactivity levels will not exceed the release criteria. In order to achieve this goal, instrumentation sensitive to the isotopes of concern and capable of measuring levels below the guideline values for those isotopes will be selected. The licensee proposed to use the instrumentation listed in Table 3-1 of the DP. Instrumentation sensitivities were determined following the guidance of NUREG-1507, “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions,” issued June 1997 (Ref. 44), using nominal literature values for background, response, and site conditions. Refinements to these detection sensitivity estimates will be made as necessary on the basis of actual instrument response and background data gathered during site survey activities. Instrumentation used in the surveys will be calibrated against sources and standards that are NIST-traceable and representative of the isotopes encountered at the WCNS. When used, instruments will be operationally tested daily or before each use, whichever is less frequent. Instruments will not be used in conditions that are not in conformance with manufacturer recommendations.

While the staff found the description of the instrumentation adequate, the licensee has not provided sufficient information pertaining to the methods that would be used to account for the effects of surface conditions through the use of a “source efficiency” factor. The staff underscores the importance of accounting for the instrumentation source efficiencies based on the various materials of construction that will be encountered during decommissioning because this information will be needed to support the staff's review of the FSS report and to terminate the referenced licenses. The staff expects that a commitment from the licensee to implement a specific method (e.g., from International Organization for Standardization (ISO) 7503-1, "Evaluation of Surface Contamination: Beta Emitters and Alpha Emitters," First Edition, issued August 1998 (Ref. 45) shall be made in the FSS plan that they are required to submit to the NRC by a license condition added with this amendment.

3.3.5.3 Data Quality Objectives

The licensee’s stated data quality objectives are to permit demonstration at the 95-percent confidence level that the criteria are met. Decision errors selected by the licensee are limited to 5 percent for both Type I (α) and Type II (β) errors.

3.3.5.4 Overview of Final Status Survey Plan

The licensee stated that the FSS plan included sufficient information to allow the NRC to determine that the design of the FSS is adequate to demonstrate compliance with the radiological criteria for license termination. The staff reviewed the following information:

- a brief overview describing the FSS design
- a description and map or drawing of impacted areas of the site, area, or building classified by residual radioactivity levels (Class 1, Class 2, or Class 3) and divided into survey units, with an explanation of the basis for division into survey units (maps have compass headings indicated)
- a description of the background reference areas and materials, if they will be used, and a justification for their selection
- a summary of the statistical tests that will be used to evaluate the survey results, including the elevated measurement comparison, if Class 1 survey units are present, a justification for any test methods not included in the MARSSIM, and the values for the decision errors with a justification for values greater than 0.05
- a description of scanning instruments, methods, calibration, operational checks, coverage, and sensitivity for each media and radionuclide
- for in situ sample measurements made by field instruments, a description of the instruments, calibration, operational checks, sensitivity, and sampling methods, with a demonstration that the instruments and methods have adequate sensitivity
- a description of the analytical instruments for measuring samples in the laboratory, including the calibration, sensitivity, and methodology for evaluation, with a demonstration that the instruments and methods have adequate sensitivity
- a description of how the samples to be analyzed in the laboratory will be collected, controlled, and handled
- a description of the FSS investigation levels and how they were determined
- a summary of any significant additional residual radioactivity that was not accounted for during site characterization
- a summary of direct measurement results and/or soil concentration levels in units that are comparable to the DCGL and whether the data are used to estimate or update the survey unit
- a summary of the direct measurements or sample data used to both evaluate the success of remediation and to estimate the survey unit variance

Based on information contained in the DP, the staff finds that the licensee has provided an adequate overview of the process that will be used to conduct the FSS. In addition, the licensee

is expected to provide survey data results, number and type of measurements, basic statistical quantities, and statistical test results and overall conclusions as discussed in NUREG-1757 in the FSS report that will be submitted to support license termination. Because the licensee provided this level of detail in a revision to the DP and because a License Condition is being added to the TRIGA reactor and the ZPR licenses, Facility License No. R-80 and Facility License No. R-89 respectively, which states that the licensee will submit the completed FSS plan for review before performing the FSS, the staff finds that the FSS plan overview is adequate.

3.3.5.5 Change Control

The staff reviewed the WCNS DP to determine whether sufficient criteria were listed that would establish the types of changes to equipment, structures, system components, and procedures that would be permissible without prior NRC approval. It is not clear from the applicability statement of 10 CFR 50.59(b) that the regulation applies to a license that has been amended to remove authorization to possess fuel. The staff has added License Conditions to the licenses for the TRIGA reactor and the ZPR, Facility License No. R-80 and Facility License No. R-89 respectively. That license condition reads as follows:

> 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.

These license conditions are based on Appendix 2 to NUREG-1700.

The staff concludes that this license condition assures that the licensee will have an adequate process to facilitate changes needed to implement the decommissioning and the FSS in a manner that reasonably assures the safety of workers and the public, protects the environment, and facilitates the timely decommissioning of the WCNS.

3.3.5.6 Conclusions

The staff has reviewed and finds the licensee's DP concerning the planning of the FSS acceptable.

3.4 Estimated Cost

The licensee stated that dismantlement and decommissioning of the WCNS will be accomplished without dismantlement of the building. The detailed estimated cost to decommission the WCNS licensed areas is presented in Table 1-4 of the DP. The estimate includes itemized costs for manpower and equipment resources, radioactive waste disposal, performance of FSSs for buildings and structures, and removal of these released buildings. The licensee estimated that the project will cost up to $3,603,086 in 2003 dollars. The detailed estimated cost to decommission the WCNS is presented in the decommissioning cost estimate for the WCNS at Cornell University (Ref. 46). The licensee stated that it is committed to providing the funding for decommissioning the WCNS.

3.4.1 Conclusions

The staff has reviewed the licensee's decommissioning cost estimate. The staff finds that the cost estimate provided in Table 1-4 of the DP is consistent with the scope of work covering dismantlement and decommissioning of the WCNS. The staff concludes that the licensee is committed to providing adequate funding for decommissioning the WCNS.

3.5 Quality Assurance

Cornell will develop a quality assurance project plan (QAPP) to incorporate the applicable portions of Appendix B to 10 CFR Part 50 and 10 CFR Part 71, Subpart H. In addition, the QAPP will use 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. The licensee plans to use American National Standards Institute/American Society for Quality Control (ANSI/ASQC) E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," issued 1994 (Ref. 47), and Appendix K to the MARSSIM to provide guidance in quality systems and the collection and evaluation of environmental data, and for developing a QAPP. All changes to the plan will be governed by measures commensurate with those applied to the original issue.

The DP states that an extensive QA program will be implemented throughout the WCNS decommissioning effort to assure that work does not endanger public safety and to assure the safety of the decommissioning staff. The QA efforts during the WCNS decommissioning period will include the following:

- performing QA functions for procurement
- qualifying suppliers
- auditing project activities

- monitoring worker performance for compliance with work procedures
- verifying compliance of radioactive shipments with appropriate procedures and regulations
- performing dimensional, visual, or nondestructive examinations or other required inspection services to assure compliance with work plans
- maintaining auditable files

3.5.1 Quality Assurance Responsibilities

As stated in the DP, the QA organizations of Cornell University and the decommissioning contractor have the responsibility, authority, and organizational freedom to do as follows:

- 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
- verify the implementation of solutions

Cornell, as the reactor license holder, has the ultimate responsibility for the implementation of the QA plan for the WCNS, both by Cornell and its decommissioning contractor(s). Cornell will verify compliance through periodic audits.

3.5.2 Quality Requirements for Instrumentation

The licensee committed to the following in its DP.

3.5.2.1 Calibration

Field instruments and associated detectors will be calibrated on a semiannual basis using NIST-traceable sources. Appropriate calibration equipment and laboratory instruments will be calibrated on an annual basis.

Calibration labels showing instrument identification number, calibration date, and calibration due date will be attached to all field and laboratory instrumentation.

3.5.2.2 Response Testing

All instrumentation will be inspected and source checked daily before use to verify calibration status and proper operation. Control-check and/or source-check criteria will be established before the initial use of the instruments.

3.5.2.3 Maintenance

Limited maintenance, such as changing batteries or changing mylar windows, high-voltage cables, etc., may be performed on site by qualified personnel. Following the change of essential components for maintenance, limited calibration may be performed on site by qualified personnel.

3.5.2.4 Recordkeeping

Calibration and maintenance records, or copies of these records, will be maintained on site where they will be available for review. The results of the daily instrument functional checks will be recorded on separate log sheets for each instrument and maintained on site.

3.5.3 Sampling and Analysis Quality Control

The licensee committed to the following in its DP.

3.5.3.1 Data Collection

Direct surface beta measurements, removable contamination measurements, gamma exposure rates, soil sampling, and any specialized measurements will be performed to provide data required to meet the requirements of 10 CFR 20.1402, as well as the guidance provided in the MARSSIM) and in NUREG-1757.

3.5.3.2 Sample Quality Control

QC samples will be obtained for a minimum of 10 percent of all samples collected for radionuclide-specific analysis. QC samples for direct measurements and smears are not required. The QC samples will be a combination of split, duplicate, blank, and/or spiked samples.

3.5.3.3 Data Identification

Direct surface beta measurements, removable contamination samples, exposure rates, and any specialized measurements will be identified as to location, type of measurement, specific instrument and probe used, sample time and date (as appropriate), and name of the person collecting the data.

Soil samples will be identified with a unique sample number, sample location, depth of sample, sample time and date as appropriate, and the name of the person collecting the sample.

3.5.3.4 Sample Chain-of-Custody

Sample chain-of-custody will be initiated for those samples sent off site for analysis or transferred to another organization for analysis. A sample chain-of-custody record will be generated to document the sample identification and sample transfer; it will accompany the sample during shipping to the new custodian of the sample.

3.5.3.5 Sample Analysis

Vendor laboratories will be on a QA approved suppliers list for the decommissioning contractor or Cornell University for the type of analytical services being provided. Cornell has the ultimate responsibility for ensuring that decommissioning sample analysis specifications and laboratory capabilities meet data quality requirements.

3.5.3.6 Sample Documentation

Sample identification information, sample chain-of-custody records, sample analysis results, and vendor laboratory qualification records, or copies of these records, will be maintained on site where they will be available for review.

3.5.4 Recordkeeping

The licensee will establish measures to control the issuance of documents and changes to documents that prescribe activities affecting quality, such as procedures, drawings, and specifications. These measures shall ensure that documents and changes to documents are reviewed for adequacy, approved for release by authorized personnel, and distributed to and implemented at the location where the prescribed activity is performed.

3.5.4.1 Procedure Control

Procedures will be controlled to ensure that current copies are provided to personnel performing the prescribed activities. Procedures will be independently reviewed by a qualified person and will be approved by a management member of the organization responsible for the prescribed activity. Significant changes to procedures will be reviewed and approved in the same manner as the original.

3.5.4.2 Radioactive Shipment Package Documents

All documents related to a specific shipping package for radioactive material will be controlled by appropriate procedures. All significant changes to such documents will be similarly controlled.

3.5.4.3 Final Survey Documents

All documents related to the FSS will be controlled by appropriate procedures. All significant changes to such documents will be similarly controlled. This documentation would normally include a survey plan, survey packages, survey results, and a survey report.

3.5.5 Handling, Storage, and Shipping

Cornell will use approved procedures to control the handling, storage, and shipping of radioactive materials. Areas will be provided in the reactor complex for the storage of radioactive material to ensure physical protection and control of the stored material. The handling, storage, and shipment of radioactive material will be controlled through the following requirements:

- Procedures will be provided for handling, storage, and shipping operations.

- Established safety requirements concerning the handling, storage, and shipping of packages for radioactive material will be followed.

- Shipments will not be made unless all tests, certifications, acceptances, and final inspections have been completed.

Shipping and packaging documents for radioactive material will be consistent with pertinent regulatory requirements.

3.5.6 Quality Assurance Records

In the DP, the licensee stated that sufficient records will be maintained to furnish evidence of activities important to safe decommissioning as required by code, standard, and specification or project procedures. Records will be identifiable, available, and retrievable. The 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 regarding the potential for impact on quality and radiation exposure to the workers and the public.

Typical records would include the following:

- proposed DP

- procedures

- reports

- personnel qualification records

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

- dismantlement records

- inspection, surveillance, audit, and assessment records

The DP lists the records that have a potential for impacting quality and radiation exposure to the workers and the public.

3.5.7 Audits

The licensee will perform audits to verify compliance with appropriate requirements of the QAPP and to determine the effectiveness of the plan. The audits will be performed in accordance with written procedures or checklists by trained and qualified personnel not having direct responsibility in the areas being audited.

The DP states that reports of the results of each audit will be prepared. These reports will include a description of the area audited, identification of the individual responsible for implementing the audited provisions and performing the audit, and identification of discrepant areas. The audit report will be distributed to the appropriate level of management and to those individuals responsible for implementing audited provisions.

Cornell commits to resolve any discrepancies identified by audits. These measures will include notification of the manager responsible for the discrepancy and verification of satisfactory resolution. Discrepancies will be resolved by the manager responsible for the discrepancy. Higher levels of management will resolve disputed discrepancies. Followup action, including a re-audit of deficient areas, will be taken as indicated.

3.5.8 Quality Assurance of Laboratory/Radiological Measurements

During decommissioning survey activities, the licensee will collect many direct and indirect measurements and sample media specimens, measured and analyzed for radiological contaminants. The results of these surveys will be used to evaluate the suitability of the material or item for release for unrestricted use, as well as whether decontamination of structures, components, and the surrounding site have achieved the desired result. Sample collection, analysis, and the associated documentation will adhere to written procedures and meet the guidance of the NRC, as well as comply with recognized industry recommendations and good practices. Outside (i.e., non-Cornell) laboratories selected to analyze WCNS decommissioning samples will be approved by Cornell and listed on the QA approved suppliers list.

Organizations that perform radiological monitoring measurements recognize the need to establish QA programs to assure that radiological monitoring measurements are valid. These programs are established (1) to readily identify deficiencies in the sampling and measurement processes to those individuals responsible for such activities so that prompt corrective action can be taken, and (2) to routinely monitor the survey and laboratory measurement results to assure that results and conclusions are valid.

3.5.9 Conclusions

The licensee committed to develop a QAPP for activities leading up to the FSS, such as remediation, transportation of licensed material, and performance of the FSS. The licensee has provided reasonable assurance that it understands the elements of the QAPP.

The information presented in the DP provides reasonable assurance to the staff that an FSS QA program constructed according to the stated requirements will adequately address the necessary quality functions associated with decommissioning activities in accordance with 10 CFR 50.82(b)(4)(v).

4.0 PHYSICAL SECURITY

With approval of Amendment No. 13 to Facility License No. R-80, the licensee's authority to operate the TRIGA reactor and possess fuel is removed. With approval of Amendment No. 7 to Facility License No. R-89, the licensee's authority possess fuel is removed. The DP states that all radiation-restricted areas will be are secured from unauthorized entry of unauthorized personnel. During nonworking hours, all nuclear facility sensitive areas are locked. Cornell maintains routine, periodic police surveillance of the reactor site. Existing physical security and material control and accounting plans approved by the NRC as may be amended will continue to be implemented. These existing plans meet the requirements in NUREG-1537, Chapter 17.

4.1 Conclusions

Based on the review of the DP, the staff finds the licensee has acceptable access security control to prevent inadvertent exposure to workers and members of the public.

5.0 EMERGENCY PLAN

Cornell University has a reactor facility emergency plan for responding to emergencies at the reactor facility. The purpose of this plan is to minimize any emergency's effect on the public, personnel, the reactor facility, and the environment surrounding the facility. The removal of spent fuel from the site has considerably reduced the potential for significant release of radioactive material off site. Any airborne or liquid releases resulting from decommissioning activities would have a negligible impact off site. The most likely accident scenario is a contaminated and/or injured individual. This scenario is adequately addressed by the existing emergency plan. Training will be provided to key personnel to ensure their familiarity with the emergency plan and their expected responses.

5.1 Conclusions

The staff finds that the current reactor facility emergency plan is acceptable for responding to emergencies that may arise while decommissioning the WCNS.

6.0 TECHNICAL SPECIFICATIONS

Because the WCNS DP encompasses both the TRIGA reactor (Facility License No. R-80) and the ZPR (Facility License No. R-89), as well as the WCNS facility, there is a need to ensure that the TSs (Appendix A to each license) for each reactor have the same specifications concerning administrative controls. To that end, some changes to the TSs for both reactors were requested. Those changes were issued with Amendment No. 13 to Facility License No. R-80 for the TRIGA reactor and Amendment No. 7 to Facility License No. R-89 for the ZPR.

6.1 Conclusions

With the issuance of Amendment No. 13 to Facility License No. R-80 for the TRIGA reactor and Amendment No. 7 to Facility License No. R-89 for the ZPR, appropriate changes have been made to support the WCNS DP and the safe decommissioning of both licenses and the WCNS.

7.0 ADDITIONAL LICENSE CONDITIONS

The regulations in 10 CFR 50.82(b)(5) state in part that the licensee's DP will be approved by a license amendment subject to such conditions and limitations as the NRC 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 license conditions to the referenced license in addition to the approval of the WCNS DP.

7.1 Additional Change Control Criteria to Support D&D Operations

The staff has added a License Condition to the licenses for the TRIGA reactor and the ZPR, Facility License No. R-80 and Facility License No. R-89 respectively, concerning change control criteria that provides the licensee guidance in evaluating whether changes expected to occur during decommissioning will require prior NRC approval (see the evaluation in Section 3.3.5.5 of this report). The use of these criteria will allow the licensee to make changes as decommissioning operations progress in a manner that will not adversely impact occupational, public, or environmental health.

8.0 ENVIRONMENTAL CONSIDERATIONS

Cornell has prepared an environmental report (Ref. 48) that addresses the decommissioning of the WCNS. The report details the potential environmental consequences of the decommissioning action. Various hazards associated with the Decommissioning Project are addressed, including radiological effluent, hazardous materials, transportation, and waste disposal.

Based on the staff's review of the potential environmental impacts attributable to the decommissioning of the WCNS, an environmental assessment was prepared and a finding of no significant impact was published in the *Federal Register* on May 31, 2006 (Ref. 49).

8.1 Conclusions

The staff finds that the environmental report sufficiently addresses the potential environmental impacts that may arise during the decommissioning of the WCNS. Based on these findings, the staff prepared an environmental assessment/finding of no significant impact in accordance with 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions" (Ref. 50).

9.0 OVERALL 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 licensee provided reasonable assurance that the dismantlement of the reactor and disposal of all significant reactor-related radioactive materials would be conducted safely and in accordance with applicable regulations and NRC guidance.

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

The staff concludes that the licensee provided acceptable organizational structure and control to decommission the WCNS while maintaining due regard for protecting the public, the environment, and workers from significant radiological risk. Furthermore, the staff concludes that the licensee's plan for 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 Cornell proposes to be acceptable because its scope covers all aspects of decommissioning activities that need to be performed safely. The industrial safety program and procedural and equipment controls are consistent with such programs at decommissioning reactors, and they are therefore acceptable. The staff concludes that the accident analyses show potential radiological consequences to be 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 WCNS reactor facility and has proposed acceptable release criteria for the facility. The licensee has acceptably described the tasks, the sequence of activities, and the schedule needed to decommission the WCNS. The staff also concludes that the licensee has provided an acceptable description of its planned final radiation survey as required by 10 CFR 50.82(b)(4)(iii). Furthermore, the staff has approved the change control criteria that will allow certain changes to the manner in which the FSS is implemented that will not require prior NRC approval.

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 option and has an acceptable plan for assuring the availability of adequate funds for the completion of decommissioning.

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, does not 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 NRC 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.

Based on these conclusions, the staff has amended NRC Facility License No. R-80 and R-89, approving the DP for the WCNS, including the TRIGA reactor and ZPR, located at Cornell University.

ABBREVIATIONS

ALARA	as low ss reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
Bq	becquerel
CFR	*Code of Federal Regulations*
cm	centimeter
COMPASS	COMPASS Computer Code Version 1.0.0 development sponsored by the NRC
Cornell	Cornell University
D&D	decontamination and decommissioning
DCGL	derived concentration guideline levels
DECON	decontamination decommissioning option
DP	Decommissioning Plan
dpm	disintegrations per minute
FSS	final status survey
g	gram
h	hour
HEPA	high efficiency particulate air (filter)
HP	health physics
ISO	International Organization for Standardization
kW	kilowatt
LLRW	low-level radioactive waste
m	meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mm	millimeter
mR	milliroentgen
mrem	millirem
MSHA	U.S. Mine Safety and Health Administration
mSv	millisievert
MW	megawatt
n	neutron
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NQA	nuclear quality assurance
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
pCi	picocurie
PM	project manager
POL	possession-only license
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
R	Roentgen
RAI	request for additional information
RSO	radiation safety officer
RWP	radiation work permit
s	second

SS	
TRIGA	training reactor and isotopes production, General Atomics
TS	technical specification
WCNS	Ward Center for Nuclear Studies
yr	year
ZPR	zero power reactor

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