SAFETY EVALUATION RELATED TO THE DECOMMISSIONING

OF THE LESLIE C. WILBUR NUCLEAR REACTOR FACILITY

AT WORCESTER POLYTECHNIC INSTITUTE (WPI)

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Enclosure 2

ABSTRACT

This safety evaluation summarizes the findings of a technical review conducted by the U.S. Nuclear Regulatory Commission (NRC), Office of Federal and State Materials and Environmental Management Programs. This review was conducted in response to a license amendment application filed by Worcester Polytechnic Institute (WPI or licensee) for approval of the Decommissioning Plan (DP) for the Leslie C. Wilbur Nuclear Reactor Facility (LCWNRF). The LCWNRF is located on the campus of WPI in Worcester, Massachusetts, approximately 40 miles west of Boston. On the basis of this review, the NRC concludes that WPI can safety dismantle the research and test reactor and dispose of the component parts in accordance with its DP, as amended, and the NRC's rules and regulations.

1.0 INTRODUCTION

In an application dated September 30, 2009, WPI submitted a DP to the NRC for approval for its LCWNRF located on the campus of WPI in Worcester, Massachusetts. The DP and supporting documents for the LCWNRF are located in ADAMS at ML092880231. WPI is working closely with the U.S. Department of Energy, the Idaho National Laboratory and NAC International, Inc. to facilitate and schedule the removal of reactor fuel from the facility before WPI's overall dismantling and decommissioning begins. WPI submitted its combined Quality Procedure and Quality Assurance (QA) document (ML092160598) in relation to WPI's nuclear fuel removal process on July 21, 2009. NRC reviewed and approved WPI's QA program for fuel removal on August 19, 2009 (ML092310471).

On September 21, 2009, WPI submitted its nuclear materials Transportation Plan (TP) in support of the removal of fuel. The NRC staff reviewed the WPI TP, concluded that the WPI TP for a one time shipment provided reasonable assurance that the requirements in 10 CFR 73.67(g) would continue to be met, and found the WPI TP acceptable by a letter dated February 18, 2010 (ML1003500702). WPI plans to ship the fuel to another research and test reactor licensed by the NRC.

The decommissioning, as described in the WPI DP 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). The licensee will perform a Final Status Survey (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 of License Amendment Request by the Worcester Polytechnic Institute for Approval of the Decommissioning Plan for the Leslie C. Wilbur Nuclear Reactor Facility in Worcester, Massachusetts and Opportunity to Request a Hearing" was published in the *Federal Register* on March 8, 2010 (75 FR 10519-10524).

2.0 BACKGROUND

2.1 Regulatory Basis

The regulatory requirements for the contents of DP's for research and test reactors are contained in 10 CFR 50.82(b)(4). 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 decommissioning activities (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 QA provisions, physical security plan provisions, emergency plan and technical specifications (TS) in place during decommissioning (see Sections 3.5, 4.0, 5.0, and 6.0 below).

The NRC conducted its review of the DP submitted by the WPI 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 Reactor License Termination Plans," Revision 1, issued April 2003. Furthermore, the staff established a license condition in accordance with the requirement of 10 CFR 50.82(b)(5) that the approved DP will be a supplement to the safety analysis report or equivalent.

The requirements following the approval of the DP 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 performed 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, "Radiological Criteria for License Termination."

2.2 Site and Facility Description and Operating History

The LCWNRF was made possible by a grant of $150,000 from the U.S. Atomic Energy Commission in June 1958. The LCWNRF reactor was constructed by the General Electric Company as a standard 1-kW (thermal) open-pool training reactor, and first achieved criticality on December 18, 1959. The reactor license was upgraded to 10-kW (thermal) in 1967, and the LCWNRF reactor first achieved 10-kW operation on January 31, 1968.

The LCWNRF reactor license was renewed in 1982, which extended the operating license for 20 years. In 1989, the reactor was converted from High Enriched Uranium (HEU) fuel (93% U-235) to Low-Enriched Uranium (LEU) fuel (19.75% U-235). No modifications were made to the reactor other than the fuel itself. In February 1992, a new solid-state-based control panel replaced the original vacuum-tube-based control panel. The control rod drive motors and position sensors were also upgraded at that time.

The primary use of the LCWNRF reactor was in support of WPI Nuclear Engineering-based laboratory activities and student projects. The reactor provided undergraduate and graduate students, under close supervision of qualified personnel, with reactor operating experience and experimental practice in the fields of nuclear engineering, metallurgy, chemistry, and physics.

The LCWNRF is located in the Washburn Shops and Stoddard Laboratories Building, an academic facility on the WPI campus about one mile from the center of Worcester, Massachusetts. That building is located at the top of a small hill, surrounded by other academic buildings. The nearest dormitories are located more than 500 feet away in various compass directions.

2.3 Scope of the Decommissioning Project

The DP provides the following information associated with the WPI LCWNRF Reactor Decommissioning Project (WPI-RDP):

- A summary of the present radiological condition of the LCWNRF and site environs.
- A description of the planned approach to be employed.
- Descriptions of the methods that will be utilized to ensure protection of the health and safety of the workers and to protect the environment and the public from radiological hazards.
- A description of the physical security and material accountability controls that will be in place during the various project phases.
- A description of radioactive waste management and disposal.
- A cost estimate for decommissioning the LCWNRF and a discussion of the source of funding for these activities.
- A decommissioning project schedule.
- A description of the applicable quality assurance program.
- A description of the training program to be established for personnel performing work in support of the LCWNRF Decommissioning Project.
- An environmental report concerning the expected impact of performing the activities involved in the LCWNRF Decommissioning Project.

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,” issued February 1996, as well as additional guidance from NUREG-1757, Volume 1, Rev. 2, “Consolidated Decommissioning Guidance-Decommissioning Process for Materials Licensees,” and NUREG-1757, Volume 2, Rev. 1, “Consolidated Decommissioning Guidance-Characterization, Survey, and Determination of Radiological Criteria,” issued September 2006.

3.0 EVALUATION

The licensee has safely conducted licensed operations involving the use of radioactive materials since the LCWNRF became operational in 1959. As such, the operational, security, QA, waste management, and radiological programs required under the referenced license 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 LCWNRF.

The NRC staff has reviewed the licensee's proposed actions to decontaminate, dismantle, and dispose of component parts of the LCWNRF, and to perform a 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 Facility License No. R-61 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 perform the FSS of the facility.

3.1 Decommissioning Alternative

The licensee's stated objective for decommissioning the LCWNRF is the regulatory release of the LCWNRF for unrestricted use. The DECON option is the decommissioning alternative chosen by the licensee to permit termination of the reactor license 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 processed, as necessary. The licensee will perform an FSS to demonstrate that the LCWNRF 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 license terminated.

3.1.1 Conclusions

The NRC staff has concluded that the choice of DECON and associated proposed plans meets the provisions of 10 CFR 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

WPI is committed to, and retains ultimate responsibility for, full compliance with its existing NRC reactor license and applicable regulatory requirements during decommissioning. WPI states that it will follow its policies and goals to ensure high standards of performance in accomplishing the decommissioning tasks.

WPI intends to utilize experienced and qualified consultants and contractors to perform the physical decommissioning work. WPI will select the contractors after NRC's approval of the DP. The Reactor Director (from the Office of the Vice President for Finance and Operations) and the WPI Radiation Safety Officer (RSO), with assistance of the Radiation Health and Safety Committee (RHSC) will monitor performance of the consultants and contractors to ensure that the decommissioning work is being performed safely and according to Federal, State and local regulatory requirements (i.e., NRC, U.S. Environmental Protection Agency, U.S. Department of Transportation, etc.).

Consistent with WPI policy, the RHSC has certain responsibilities to review and approve policies, procedures, programs and facilities pursuant to the safe use of materials and radiation-producing equipment. The RHSC's jurisdiction will extend to all decommissioning activities dealing with radioactive material and radiological controls. The RSO and the RHSC will approve consultant and contractor plans, policies and procedures used during the decommissioning as described in the DP.

The planned organization for the WPI LCWNRF Reactor Decommissioning Project is shown in Figure 2.4 of the DP. Individuals performing the functions may vary over the project duration; however, the specified functions will be maintained. Consultants, contractors and subcontractors performing work under this DP will be required to comply with applicable WPI policies, procedures and regulatory commitments.

3.2.1.1 WPI Reactor Director

The WPI Reactor Director functions include:

- Controlling and maintaining safety during decommissioning activities and protection of the environment.
- Reporting of performance.
- Approving minor changes to the DP and procedures (which do not change the original intent and do not involve an un-reviewed safety question).
- Overseeing and coordinating WPI functional groups, contractors, and consultants.
- Ensuring that the conduct of decommissioning activities complies with applicable regulations and is in accordance with the WPI license.

3.2.1.2 WPI Radiation Safety Office

The WPI RSO shall be responsible for providing radiological support in the decommissioning of the LCWNRF. This function ensures that the activities involving potential radiological exposure are conducted in compliance with the applicable license, Federal and State regulations, and WPI standard operating procedures. The position includes responsibility for maintaining the surveillance and monitoring program, and for Health Physics (HP) radiological protection procedures.

The RSO will have oversight of all Decontamination and Decommissioning (D&D) operations. The scope of his oversight will include all D&D operations that involve work with systems or materials that have a radiological component.

The RSO is responsible for ensuring that:

- 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:

- Implement any actions necessary to ensure that radiological controls are implemented and followed.
- Immediately stop or modify radiological work determined to be unsafe.

3.2.1.3 Decommissioning Consultant

WPI may elect to use a decommissioning consultant to assist WPI with the management of the decommissioning. The consultant would provide project management and day-to-day oversight of the contractors, as well as provide WPI with technical expertise needed for the project.

WPI management, with assistance from its Decommissioning Consultant, will select qualified contractors to perform the physical decommissioning of the LCWNRF. In addition to planning and implementing the physical decommissioning activities, the contractors (which may include the Decommissioning Consultant's organization) will provide required HP support, radiation surveys, and waste packaging, processing, and shipping. Contractors will be selected after WPI's receipt from NRC of the license amendment authorizing decommissioning.

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. 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,” and American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1, “Quality Assurance Requirements for Nuclear Facility Applications,” issued in 2001. One of the applicable criteria that must be included is a QA approved suppliers list.

The contractor should be prepared to provide qualified personnel and programs, including but not limited to the following areas of expertise, as applicable to their roles and responsibilities:

- Project management
- Health Physics
- Radiological engineering with Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) survey experience
- Radioactive waste management
- Industrial and occupational safety
- Civil and mechanical engineering
- Quality assurance
- Construction supervision
- Project controls
- Decontamination and waste handling
- Radiological safety engineering
- Worker training and qualification

3.2.1.4 Conclusion

The NRC concludes that the licensee has provided reasonable assurance that organizational structures needed to safely decommission the LCWNRF, including the reactor, are in place. In addition, the licensee has committed to ensuring the WPI RSO, with assistance of the RHSC 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 LCWNRF 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 As Low As Reasonably Achievable 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 ultimate responsibility for assuring radiation protection and maintaining exposures ALARA during decommissioning remain with the WPI Reactor Director and RSO. A documented ALARA evaluation will be required for specific work evolutions if it is likely that the dose is exceeded by 5% of the applicable dose limits.

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 kept ALARA. The methods include the use of Radiological Work Permits (RWPs), protective equipment, radioactive material handling techniques, and work practices as described in the WPI DP. Work will be performed in accordance with NRC regulations and the DP, and implemented in accordance with approved written procedures.

A RWP will be used for the administrative access control of personnel to areas that have radiological hazards. Work techniques will be specified in such a manner that the exposure for all personnel, individually and collectively, are maintained ALARA. RWPs will not replace work procedures, but will supplement procedures.

Whenever there is a potential for generating airborne radioactivity, the use of engineering controls such as HEPA filtered vacuums will be the first choice with respect to controlling the hazard. Where engineering controls are not practical or may not be sufficient to prevent airborne radioactivity concentrations, respiratory protective equipment will be utilized to limit internal exposures. Any situation when workers are required to access an area with airborne radioactivity exceeding 0.1 Derived Air Concentration (DAC), WPI will document DAC-hour tracking and air sample results for intake in accordance with appropriate regulations and procedures.

The WPI-RDP's HP program will establish radioactive material controls to ensure that inadvertent releases of licensed radioactive materials to unrestricted areas are avoided. The HP program will also ensure personnel are not inadvertently exposed to licensed radioactive materials. It will also minimize the volume of radioactive wastes generated during the decommissioning.

3.2.2.1.3 Control and Storage of Radioactive Materials

The WPI-RDP radiation protection program will establish radioactive material controls that ensure the following:

- Prevention of inadvertent radioactive waste material release to uncontrolled areas.
- Prevention of personnel exposure to licensed radioactive decommissioning waste materials.
- Minimization of the amount of radioactive waste material generated during decommissioning.

3.2.2.2 GENERAL INDUSTRIAL SAFETY PROGRAM

While the NRC does not directly regulate or license nonradiological activities, except as they would affect radiological health and safety, an agreement exists between the Federal Occupational Safety and Health Administration (OSHA) and the NRC concerning nonradiological activities. WPI has committed to compliance with all applicable occupational health and safety requirements, primarily the Occupational Safety and Health Act of 1973. Compliance will be ensured through training programs, procedures, and inspections. Health and Safety Training for reactor decommissioning will be compliant with NRC (10 CFR), EPA (40

CFR), and OSHA (29 CFR) regulations. Based upon these commitments, NRC staff has reasonable assurance to conclude that the licensee is aware of and responsible for controlling any nonradiological hazards or releases that ensue from decommissioning activities.

3.2.2.4 Conclusions

Based on the descriptions of the WPI ALARA and Health Physics Programs, NRC staff concludes that the decommissioning Radiation Protection Program is acceptable. The ALARA policy provides for documented ALARA evaluations when 5% of the applicable dose limits are exceeded, and methods for occupational exposure reduction are provided through the use of RWPs and the use of protective equipment and handling techniques. The dose estimates provided are reasonable and give adequate assurance that decommissioning can be safely completed within the allowable dose limits specified in 10 CFR Part 20. An estimate of total cumulative and individual maximum dose equivalents to radiation workers was provided. While it was stated that WPI expects any public dose to be negligible, a commitment to environmental monitoring was also provided to ensure that there is no release of radioactive material or increased radiation levels in uncontrolled areas.

WPI has also committed to performing all work in accordance with NRC regulations, the DP, and approved written procedures. NRC inspections during decommissioning will further verify that approved processes and instrumentation are used.

3.2.3 Radiological Accident Analyses

WPI is relying on the existing operational accident analysis to bound and exceed the consequences of any radiological accident that could credibly occur during decommissioning and, therefore, did not provide a new accident analysis. This assumption is based on WPI's plans to remove all reactor fuel prior to decommissioning and the expectation that radioactivity remaining after fuel removal will be much lower and mostly in a non-dispersible form (i.e., less than 60 mCi, and mostly activated metals).

3.2.3.1 Conclusions

NRC staff concludes that, with the fuel removed prior to decommissioning, there is a decreased risk of accidents with radiological consequences to workers and members of the public. There is reasonable assurance that decommissioning can be performed under the existing accident analysis 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

WPI stated that routine radiological surveys conducted during reactor operations showed the radiation levels and contamination levels measured at the LCWNRF have consistently been low and limited in extent. Radiological measurements performed in the summer of 2008 confirmed that only minor quantities of residual radioactivity or radioactive contamination are present and the radioactive portions of the facility are primarily confined to the reactor internals and reactor pool. WPI will perform a detailed characterization of radionuclide mixtures and concentrations at the time of actual removal and dismantlement.

3.3.1.3 Principal Radioactive Components

The majority of the residual radioactivity at the facility contained in structures, systems, and components, is found in a single item: an activated stainless-steel regulating blade (as discussed in section 1.2.2 of the DP). Other than the exposure rate emanating from the regulating blade (125 mR/hr at 13 centimeters, through water), radiation exposure rates at the reactor facility were found to be very low and limited to portions of the reactor core box and grid, the reactor core end of the beam port, and the reactor side of the graphite thermal column interior, which were slightly neutron activated. Maximum radiation levels on these non-regulating blade components were found to be in the range of 1 to 3 mR/hr on contact. Radiation and radioactive contamination was not detected outside of the reactor pool or experimental facilities in the biological shield.

3.3.1.4 Conclusions

The NRC staff has reviewed the activities identified by the licensee for the principal radioactive components. The staff concludes that the licensee's estimates of the radiological conditions and radiation measurements are acceptable.

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 WPI. The objective of decommissioning the WPI reactor facility is to reduce residual contamination to levels that will result in a total effective dose equivalent (TEDE) to an average member of the critical group does not exceed 25 mrem/yr and ensures that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA) 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. 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.

The DCGLs for residual radioactive material contamination in surface soil (i.e., top 15 cm of soil) under or near the WPI reactor 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 2.3 in the DP 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 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.

If it is impractical or impossible to meet the release criteria, WPI will treat the location/item as radioactively contaminated and it will be disposed as low-level radioactive waste. Where there is measurable volumetric radioactivity above background, WPI plans to remove concrete as radioactive waste. However, if its removal will require extensive demolition of the Biological Shield or disturbance of the building's structural features, and structural concrete with measurable volumetric radioactivity needs to remain in place at license termination, the probabilistic RESRAD-BUILD 3.0 code, a site-specific modeling application adapted by Argonne National Laboratory (ANL) for NRC regulatory application for probabilistic dose analysis, will be used for deriving appropriate DCGLs.

The release criteria will be based upon use of the sum-of-fractions unity rule, based on relative concentrations of radionuclides on or in the material and their respective release criteria if more than one radionuclide is present. If additional screening values are required for nuclides not included in Table 2.2 or Table 2.3 in the DP, they will be calculated using the probabilistic RESRAD-BUILD 3.0 code for planning and assessing MARSSIM site surveys, with default values.

3.3.2.1 ALARA Analysis

In addition to requiring that licensees demonstrate 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 to remediate building surfaces or surface soil, consistent with regulatory guidance (Appendix D to NUREG-1757, Volume 1).

3.3.2.2 Conclusions

The NRC staff concludes the DCGLs for building and soil surface contamination 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. The decommissioning methodology described in the DP regarding volumetric radioactivity in building structures, the Biological Shield, etc. is acceptable to the staff. In addition, the staff agrees that consistent with guidance provided in NUREG-1757 additional measures to remove residual radioactivity of building and soil surface contamination to ALARA levels are not required.

3.3.3 Decommissioning Tasks

3.3.3.1 Phase One: Pre-Decommissioning Tasks and Activities

In preparation for decommissioning, non-reactor related equipment and materials located throughout the facility will be collected and surveyed. Radioactive materials will be segregated from clean materials. This work will include general cleanup of the facility, such as removal of non-contaminated equipment and materials (non-reactor related) situated throughout the LCWNRF. Such materials will be collected, surveyed, and appropriately dispositioned in accordance with established procedures. During these activities none of the reactor's structures, systems, or components will be dismantled or decontaminated. Around the same time, WPI is expected to return the used nuclear fuel to the Department of Energy (DOE).

3.3.3.2 Phase Two: Decommissioning Mobilization Activities

During this phase, training and qualification of workers and physical preparation of the facility for Phase Three decommissioning activities will take place. Training and qualification of workers will be conducted as described in Section 2.5 of the DP. Temporary electric power, lighting and other utilities will be installed as needed. Material handling equipment, such as ramps, gantry cranes, etc., will be installed as required to support the decommissioning work.

General radiological controls as described in the DP will be installed to support the decommissioning work. Contamination control boundaries and protective barriers, personnel contamination frisking stations and step-off pads, and facilities for workers to change into protective clothing will be set up. Portable air samplers, continuous air monitors, area radiation monitors, containment tents, and HEPA filtered ventilation units will be set up to support the decommissioning work. A HP counting room will be established for sample analysis to support radiation protection, waste management and FSS work. A secure radioactive material storage area will be set up, where waste material can be accumulated, packaged and prepared for shipment to the disposal facility. Additionally, a low-background area will be set up for conducting free-release surveys and secure storage of materials prior to release. Additional characterization of structures, systems, and components will be performed on those areas that could not be performed prior to the acceptance of the DP.

3.3.3.3 Phase Three: Decontamination and Dismantling Activities

The licensee committed to the dismantling of the reactor and associated systems in a safe manner and in accordance with ALARA principles, as well as the decontamination and survey of the entire WPI reactor facility. 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 by WPI as 13 tasks in the DP as follows:

Task 1: Remove Reactor Core Structure

The objective of this task is to remove the reactor core support structure from the pool. The major items include the reactor core box and grid, control blade drive shafts and drive

mechanisms, regulating blade, safety blades, ion chambers and associated instrumentation hardware, start-up counter assembly and guide tube assembly, sample irradiation, and reactor suspension posts.

The regulating blade contains the bulk of the reactor's radioactivity which will be removed first from the core. The control drive shafts and the attached blades will be lifted out of the core box by workers latching onto the blades with long-handled tools. The blades and shafts will be raised to the surface of the pool and decoupled. The control blades will be manually placed into steel waste container boxes. The control blade drive shafts will be manually cut by mechanical means (saws or shears), and sized to fit into the waste boxes.

The pool will be drained in a controlled manner using the existing liquid effluent discharge protocols. Pool water will be drained to temporary batch tanks, sampled, analyzed, treated (if necessary), and then released to the sanitary sewer system. As the water level is lowered, the radiation levels above the pool water will be continuously monitored to assure unexpectedly high sources of radiation are not exposed. Loose surface contamination levels on the exposed surface will be monitored to assure that no airborne contaminations are released.

Task 2: Remove Contents of Thermal Column

This task involves the removal of the thermal column, a horizontal, aluminum-lined penetration through the biological shield, which is filled with graphite blocks. The graphite blocks are stacked in alternating perpendicular rows; some of the blocks contain embedded stainless Helicoids to facilitate their removal using a threaded T-bar. The licensee stated that during their scoping surveys, radiation exposure rates from the graphite and Helicoids were found to be 0.01 and 0.2 mR/hr on contact, respectively. Smear samples taken on the graphite did not reveal loose graphite dust or radioactive surface contamination. The graphite blocks will be manually un-stacked and placed into waste containers staged nearby.

Task 3: Remove Reactor Pool Equipment

The objective of this task is to remove the remaining activated equipment from the reactor pool that includes the beam port extension, beam port shutter and shutter housing, core box locating rails, and spent fuel racks.

Engineering controls will be used as required to contain and collect any potentially contaminated debris. Such controls may include enclosing the top of the pool with tarpaulins and using HEPA-filtered ventilation to maintain inward air flow and the use of HEPA vacuums for collection of debris. The sequence of equipment removal will be determined by an ALARA evaluation, with the items with the highest exposure rates being removed first.

Task 4: Remove Reactor Pool Water Treatment System

The objective of this task is to disassemble and remove piping and equipment comprising the pool water treatment system. This system is external to the reactor pool, and is comprised of an ion exchange column, filter housing, pump, hold-up tank, and piping (metal and plastic, all less than two-inch in diameter). During this activity, catch basins, drop cloths, and HEPA vacuums will be used to control and capture any potentially contaminated debris.

Task 5: Remove Liners and Embedments from Biological Shield

The objective of this task is the removal of contaminated or activated portions of the liner from within the pool, thermal column, beam port and gutter drains; and removal of contaminated piping embedded within the biological shield.

The beam port liner embedded in the biological shield (and potentially activated concrete surrounding it) will be removed by over coring around the beam port liner, at a diameter of approximately 16-to-18 inches. A contractor specializing in concrete cutting and coring will be utilized for this operation. Concrete coring and cross cutting will necessitate the use of water for cooling and lubrication, and to prevent the generation of any potential airborne dust. Resulting slurry will be controlled, collected, and captured as a waste material. Berms, catch basins, and plastic drapes, as well as wet/dry HEPA vacuums, will be used to capture and collect the slurry. The resulting slurry will be allowed to congeal and further dried by mixing with cement, if required, and placed into waste containers.

WPI is planning to remove non-embedded or embedded pipe within the concrete biological shield that has been or potentially has been exposed to pool water or neutron irradiation, and dispose of it as radioactive waste. If these items are embedded in concrete, they will either be over cored or the surrounding concrete jack hammered to expose the items for removal.

If portions of embedded pipes or conduits cannot be removed due to safety or building structural concerns, and need to remain at license termination, they will be evaluated using "License Termination Screening Values for Building Surface Contamination" given in Table 2.2 of the DP.

In order to apply the screening values, the interior of the embedded items will be checked for both loose and fixed contamination at accessible openings. If an item needs to be left in place, the interior surfaces will be characterized for residual radioactivity by inserting small diameter sodium iodide (NaI) or Geiger Mueller (GM) detectors to quantify contamination levels. If loose contamination is determined to exceed 10% of the screening values, those interior surfaces will be decontaminated by scrubbing and flushing.

Task 6: Decontaminate Concrete Biological Shield

The objective of this task is to determine if activated or contaminated biological shield concrete is present and, if found, removed to meet release criteria. If any radioactive contamination is found, it will be removed by mechanical means, such as surface chipping, jack hammering, or hydraulic splitting. These removal techniques have a potential for creating loose or airborne dust. Accordingly, the licensee will use engineering controls to control, contain, and collect any potentially contaminated dust and debris. Such controls may include enclosing the top of the pool and other openings, use of HEPA-filtered ventilation for inward air flow, HEPA vacuum collection of debris, and water misting.

Task 7: Remove Liquid Effluent Discharge Equipment

The objective of this task is to gain access to the interior of the liquid effluent discharge equipment for the purpose of radiological characterization, to determine if remediation is required, and if necessary removing them as radioactive waste. Non-embedded pipes and the valve will be mechanically segmented and removed as assumed radioactive waste. If the

embedded portion of the pipe exceeds the screening values in Table 2.2 and the items require removal, they will be either over cored or the surrounding concrete jack hammered to expose the items for removal. Additionally, if radioactive contamination is found within the pipe, the first sewer manhole receiving discharges from this piping will also be decontaminated or removed as required.

Task 8: Remove Exhaust Ventilation Equipment

The objective of this task is the removal of ventilation ducts that could possibly contain internal contamination, and the evaluation of down-stream building ventilation equipment to determine if additional remediation is warranted. If the system's interior surfaces cannot be adequately decontaminated or accessed, or contamination levels cannot be properly quantified, the ventilation system will be assumed to be contaminated and will be removed as radioactive waste.

If radioactive contamination is found in the ventilation ducts, the discharge stack on the roof (and surrounding roofs) surfaces will also be checked for radioactive contamination and decontaminated or removed as required.

Task 9: Remove Remaining Equipment

The objective of this task is to survey, evaluate and/or remove any fixtures or equipment remaining within the LCWNRF, where surface contamination could have been missed or hidden in, under or behind equipment or fixtures.

Task 10: Decontaminate Building Interior Surfaces

The objective of this task is to provide added assurance that the facility is prepared to conduct the FSS. This task will principally involve taking radiological measurements to identify any contamination within the facility that may have been missed during prior tasks. If any remaining surface contamination is identified it will be remediated at this time.

Task 11: Prepare Waste Packages for Transportation and Disposal

This task involves the final disposition of the radioactive wastes generated during the decommissioning. Containers of waste materials will be staged and prepared for shipment at the conclusion of the D&D activities as described in section 3.2 of the DP.

Task 12: Demobilize and Prepare Reactor Rooms for Final Status Survey

This task involves the preparation of the WPI facility for the FSS. Tools and equipment used during the decommissioning will be surveyed, decontaminated if necessary, and removed from the facility. Final housekeeping will be performed to remove debris, dust or protruding objects from surfaces, which would otherwise interfere with the final survey.

Task 13: Perform License Termination Activities

This task involves the preparation of an FSS Plan as described below and in section 4.0 of the DP. The final report will also be prepared and submitted to the NRC with a request for termination of the R-61 license.

3.3.3.3.1 Conclusions

The staff concludes that the manner in which the licensee proposed to complete each of the decommissioning tasks is acceptable.

3.3.4 Proposed Final Radiation Survey Plan

3.3.4.1 Description of Final Status Survey Plan

WPI plans to develop a FSS Plan based on guidance from NUREG-1757, Volume 2 and NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual," issued August 2000. The plan will be developed after decommissioning contracts are awarded, and will be submitted to the NRC in accordance with "Method 1" from NUREG-1757, Volume 2, Chapter 4. Specifically, the criteria for Method 1 are as follows:

> The licensee or responsible party may submit the information contained in Sections 4.1-4.3 of this volume of this NUREG as part of the DP, along with a commitment to use the MARSSIM approach in developing the final radiological survey. The information discussed in Section 4.4 would then be submitted by the licensee or responsible party at the completion of remediation or when the licensee or responsible party has completed developing the design of the final radiological survey for the site. The final status survey report (FSSR) (Section 4.5) will be submitted after the licensee or responsible party has performed the final radiological survey.

WPI has committed to using the MARSSIM approach in developing the final radiological survey and has indicated that the FSS planning process will include the development of Data Quality Objectives, the designation of survey units within each area classification, the review of contaminants the establishment of DCGLs, and the selection of appropriate survey instrumentation.

3.3.4.2 Review and Approval of Final Status Survey Plan

Once the design of the final radiological survey has been completed, WPI has committed to submit information to the NRC on FSS Design. The following information will be provided in the FSS Plan:

- 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 will indicate compass orientation.

- 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 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 concentration levels in units that are comparable to the DCGL and, if data is 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.

3.3.4.2.1 Means for Ensuring that all Equipment, Systems, Structures and Site are Included in the Survey Plan

WPI has indicated that any items left in the reactor facility after remediation will be radiologically surveyed prior to removal to ensure that licensed radioactive materials are not inadvertently removed from the facility. A systematic approach will be used to ensure that every item or structural component is evaluated for release prior to the FSS; this will be accomplished by using the MARSSIM 3 class approach to survey coverage.

3.3.4.2.2 Means for Ensuring that Sufficient Data is Included to Achieve Statistical Goals

The WPI FSS Plan will be developed using the guidance in NUREG-1757, Volume 2 and NUREG-1575. These documents will be used to ensure that NRC-recommended statistical goals are satisfied.

3.3.4.3 Proposed Final Radiation Survey Plan Conclusions

NRC staff finds the information presented on the forthcoming Final Status Survey Plan to be acceptable. WPI has committed to submit a FSS Plan to the NRC in accordance with "Method 1" from NUREG-1757, Volume 2, Chapter 4. Accordingly, the NRC expects to receive and approve the FSS Plan at the completion of remediation or when the licensee or responsible party has completed developing the design of the final radiological survey.

3.3.4.4 Background Survey Results

WPI does not plan to subtract background radiation from direct surface contamination measurements as naturally occurring radiation may be present in construction materials. WPI does plan to account for background when gamma exposure measurements are taken. NRC staff finds this handling of background levels to be acceptable, and including background in surface contamination measurements will result in a more conservative contamination estimate.

3.3.4.5 Final Release Criteria - Residual Radiation and Contamination Levels

Final release criteria were previously discussed in Section 2.7 (Facility Release Criteria) of the DP. WPI intends to decommission the facility to unrestricted release limits as specified in 10 CFR 20.1402. Generic screening values presented in Tables H.1 and H.2 of NUREG-1757, Volume 2 will be used as building and soil surface contamination limits. WPI intends to remove as radioactive waste, all concrete that is contaminated above background. In the event that concrete removal might diminish the structural integrity of the building that houses the reactor room (which WPI intends to keep intact), the probabilistic RESRAD-BUILD 3.0 code will be used to derive appropriate DCGLs.

3.3.4.5.1 Conclusion

NRC staff concludes that the proposed DCGLs for building and soil surface contamination are acceptable and sufficient to demonstrate compliance with 10 CFR 20.1402. The proposed methodology to develop volumetric DCGLs for building structures, the biological shield, or structural concrete is acceptable to the staff.

3.3.4.6 Measurements for Demonstrating Compliance with Release Criteria

3.3.4.6.1. Instrumentation - Type, Specifications and Operating Conditions

A list of typical health physics equipment and instrumentation was provided in the DP. WPI will use instrumentation that is sensitive to the isotopes of concern and that will be capable of measuring levels below the respective DCGLs. WPI has indicated that instrumentation sensitivities will be determined following MARSSIM guidance and that instruments will be calibrated to NIST traceable sources and standards.

3.3.4.6.2 Measurement Methodology for Conduct of Surveys

WPI has indicated that the FSS Plan will include several steps, based upon MARSSIM guidance, to calculate the number of measurements and samples required to demonstrate that the facility meets the criteria for unrestricted release. These steps include:

- Classify survey units
- Specify the decision error
- Determine the DCGLs
- Calculate the relative shift (COMPASS software may be utilized)
- Obtain the number of samples per survey unit (COMPASS may be utilized)
- Estimate the sample grid spacing
- Perform evaluation for small areas with elevated radioactivity
- Determine if the number of samples is reasonable.

Survey units will be determined and classified per the MARSSIM Class 1, Class 2, and Class 3 designations. The FSS Plan and survey work packages will include discussions of historical characterization and in-process survey information to support survey unit classifications.

WPI has committed to decision Type I and Type II decision errors of 0.05 (5%). The Type I error is the probability of determining that a result is above a criterion when it is actually not (a false positive), and the Type II error is the probability of determining that a result is below a criterion when it is actually above it (a false negative).

Gross activity DCGLs and elevated measurement comparison DCGL values ($DCGL_{EMC}$) will be developed during the planning stage for the FSS. As previously discussed, WPI is planning to utilize generic building and soil surface contamination limits, as presented in NUREG-1757, Volume 2.

WPI plans to use MARSSIM guidance to develop the relative shift, determine the number of samples per survey unit, estimate the grid sampling, and to perform an evaluation of small areas of elevated radioactivity.

3.3.4.6.3 Scan Surveys

WPI plans to conduct beta scans of surfaces and structures and gamma scans of environs after remediation and prior to conducting sampling. Class 1 surfaces will be 100% scanned, Class 2 surfaces will be 50% scanned, and Class 3 surfaces will be 25% scanned. Scanning action levels will be determined, based on guidance in NUREG-1507, and areas exceeding action levels will be investigated/sampled/re-surveyed and remediated if necessary. Scanning will be repeated if remediation is performed.

3.3.4.6.4 Soil Sampling

WPI has indicated that, “While soil sampling is not anticipated, if soil samples are later determined to be necessary, they will be obtained to a depth of 15 cm; samples will be packaged and uniquely identified in accordance with chain-of-custody and site-specific procedures.”

3.3.4.6.5 Sample Analysis

WPI has stated that samples will be transferred to radio-analytical laboratories for analyses in accordance with documented laboratory-specific standard methods. Laboratory instrumentation will have a minimum detection level of 50% of DCGL $_w$ (or $DCGL_{EMC}$) values for all primary contaminants.

3.3.4.6.6 Investigation Levels

According to the WPI DP, “radiation levels identified by scans that indicate potential residual radioactive contamination above background will be investigated to identify the source, level and extent of such residual activity,” and “areas that contain residual radioactivity concentrations of individual radionuclides, or sum-of-ratio concentrations above respective guideline values, will be remediated, reclassified (as necessary) and resurveyed.”

3.3.4.6.7 Conclusions for Measurements for Demonstrating Compliance with Release Criteria

NRC staff has determined that WPI’s methods for measurements for demonstrating compliance with release criteria and are acceptable and follow appropriate NRC guidance from NUREG-1575 (MARSSIM) and NUREG-1757.

3.3.5 Schedule

The project schedule is presented in Figure 2.3 in the DP. The duration of actual D&D work is expected to be less than 12 months, but the scheduled time from regulatory approval of the DP to the request for release of the site for unrestricted use is estimated to be 24 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 University activities, ALARA considerations, further characterization measurements, and/or temporary onsite radioactive waste storage operations.

3.3.5.1 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.

3.4 Estimated Cost

The detailed estimated cost to decommission the LCWNRF licensed areas is presented in Table 1.2 of the DP. The estimate includes itemized costs for manpower and equipment resources, radioactive waste disposal, performance of the FSSs for buildings and structures, and removal of these released buildings. A WPI letter of financial commitment to provide the funding for decommissioning of the LCWNRF is presented in Appendix A of the DP.

3.4.1 Conclusions

The staff has reviewed the licensee's decommissioning cost estimate. The staff finds that the cost estimate provided in Table 1.2 in the DP is consistent with the scope of work covering dismantlement and decommissioning of the LCWNRF. The staff concludes that the licensee is committed to providing adequate funding for decommissioning the LCWNRF.

3.5 Quality Assurance

3.5.1 Methods To Be Employed For Reviewing, Analyzing, and Auditing Data

3.5.1.1 Laboratory/Radiological Measurements Quality Assurance

WPI has indicated that sample collection, analysis, and the associated documentation will adhere to written procedures and meet NRC guidance, as well as comply with recognized industry recommendations and good practices. Laboratories selected to analyze decommissioning samples will be approved by WPI and listed on the contractor's QA Approved Suppliers List.

The WPI DP also specifies that contractors must implement a QA plan that is compliant with 10 CFR Part 71, "Packaging and Transportation of Radioactive Material," Subpart H, "Quality Assurance,", and applicable criteria from 10 CFR 50, Appendix B, and ASME NQA-1. WPI plans to assess the effectiveness of the QA program either through direct audits performed by WPI's Reactor Director, RSO, or Decommissioning Consultant, or by the acceptance of audits performed by other organizations.

3.5.1.2 Supervisory and Management Review of Results

WPI has indicated that reviews of health physics surveys and sample results will be performed by senior-level Health Physicists, other than the individual that performed the survey. FSS data will also be independently reviewed by the Decommissioning Consultant.

3.5.1.3 Methods to be Employed for Reviewing, Analyzing, and Auditing Data Conclusions

NRC staff concludes that the methods to be used for reviewing, analyzing, and auditing data and the oversight of the decommissioning program is adequate.

4.0 PHYSICAL SECURITY PLAN

The DP states that all radiation-restricted areas will be secured from unauthorized entry of unauthorized personnel. During nonworking hours, all nuclear facility sensitive areas are locked. WPI maintains routine, periodic police surveillance of the reactor site.

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. Existing physical security and material control and accounting plans approved by the NRC will continue to be implemented. These existing plans meet the requirements in NUREG-1537, Chapter 17.

5.0 EMERGENCY PLAN

WPI has a Reactor Facility Emergency Plan for responding to emergencies at the reactor facility. The purpose of the Emergency Plan is to minimize the effect of any emergency on the public, personnel, reactor facility and the environment surrounding the facility. Removal of spent fuel from the site will significantly reduce the potential for significant release of radioactive material off site. Any airborne or liquid releases due to decommissioning activities would have 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 Conclusion

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

6.0 TECHNICAL SPECIFICATIONS

The LCWNRF currently operates under technical specifications that are included as Appendix A of NRC License R-61. These technical specifications are in place to insure the safe operation of the reactor facility. However, most of the technical specifications do not apply to the reactor when it is not in operation. Other technical specifications that apply to non-operating conditions have been amended since reactor shutdown. If additional changes to the technical specifications are necessary prior to D&D operations, WPI will request that changes be approved by the NRC with a license amendment.

6.1 Conclusions

With the issuance of previous Amendments related to non-operating conditions for the GE reactor under Facility License No. R-61, appropriate changes have been made to support the WPI DP and the safe decommissioning of the LCWNRF.

7.0 ADDITIONAL LICENSE CONDITION

The regulation in 10 CFR 50.82(b)(5) states 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 LCWNRF DP.

7.1 Additional Change Control Criteria to Support D&D Operations

The staff has added a License Condition to the license for the WPI reactor, Facility License No. R-61, concerning change control criteria that provide the licensee with guidance for evaluating whether changes expected to occur during decommissioning will require prior NRC approval. The use of these criteria will allow the license to make changes as decommissioning operations progress in a manner that will not adversely impact occupational, public, or environmental health.

8.0 ENVIRONMENTAL CONSIDERATIONS

The Environmental Report (ER) was prepared in December 2005 and was submitted to the NRC along with the submittal of this Decommissioning Plan. The ER was prepared in accordance with the guidance provided in Chapter 6.0 of the NRC Office of Nuclear Material and Safety and Safeguards' (NMSS) NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs".

An assessment of potential environmental impacts was conducted based on the environmental report provided in Section 8 of the WPI decommissioning plan. During decommissioning activities, no contact will be made with aquatic or terrestrial environments. Also, current use of the property, a university campus will not change as a result of the decommissioning.

The following information was provided by the licensee:

Water Use and Quality – The decommissioning will require disposal of approximately 7,000 gallons of pool water via the public sewer system. Historically the pool water has not contained any detectable radioactivity, and the water will be filtered, sampled and analyzed for radioactivity before being batch released to assure 10 CFR Part 20 effluent limits are not exceeded.

Air Quality – Air quality within the reactor classroom will be monitored and sampled for airborne radioactivity to assure and verify that no emissions of radioactivity to the environment are possible. Use of internal combustion powered equipment, such as compressors or generators, that would generate emissions are not planned.

Waste – No hazardous or mixed wastes are expected to be generated. Radioactive wastes are estimated to be a small fraction of 10 CFR Part 60 Class upper limits. Wastes are planned to be disposed of at the EnergySolutions, LLC facility in Clive, Utah.

Human Health - No radiation exposure to the general public is expected via direct radiation or air and liquid effluents. There is a small risk of worker injury during performance of the decommissioning work, similar to that of construction work.

Transportation - Only one truck shipment is anticipated: to transport the radioactive waste to the disposal site.

Aesthetics - All decommissioning work will be limited to the interior of the reactor classroom. There will be no outdoor work performed. No outdoor storage of material or equipment is anticipated. No excessively noise producing dismantling techniques is anticipated.

Historical and Archeological - No structural or appearance changes will be made to the building. Decommissioning work is limited to one classroom within the building.

Environmental Justice - The decommissioning work will not involve contact with, or disruption of, any surrounding neighborhoods.

8.1 Conclusions

The staff finds that the Environmental Report sufficiently addresses the potential environmental impacts that may arise during the decommissioning of the LCWNRF. The staff also prepared an EA (ML102020428) in support of this amendment in accordance with requirements of 10 CFR Part 51. Based on the EA, the NRC concluded that a Finding of No Significant Impact (FONSI) was appropriate. The FONSI was published in the *Federal Register* on October 7, 2010 (75 FR 62151-62153).

The staff initiated section 106 of the National Historical Preservation Act of 1966 which affords the Massachusetts State Historic Preservation Officer (SHPO) an opportunity to comment on activities which may affect Historical Landmarks. It was determined by the SHPO that the decommissioning activities are unlikely to affect significant historic or archaeological resources. A copy of this response can be found in NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS) under ML110660209.

9.0 OVERALL CONCLUSIONS

Based on the NRC 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 LCWNRF 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 WPI 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)(iii).

The staff concludes that the licensee has adequately described the radiological status of the LCWNRF 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 LCWNRF. 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-61, approving the DP for the LCWNRF at the Worcester Polytechnic Institute.