STATE UNIVERSITY OF NEW YORK AT BUFFALO

BUFFALO MATERIALS RESEARCH CENTER

DOCKET NO. 50-57

AMENDMENT TO FACILITY LICENSE

Amendment No. 27
Facility License No. R-77

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

   A. The license amendment application filed by the State University of New York at Buffalo (the licensee), dated February 17, 2012 (ML120540187), as supplemented by letters dated June 20, 2012 (ML121870132), September 21, 2012 (ML122780454), and October 15, 2012 (ML12297A237), is in compliance with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the regulations of the Commission as stated in 10 CFR Chapter I;

   B. The facility will be maintained in conformity with the applications, the provisions of the Act, and the rules and regulations of the Commission;

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

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

2. Accordingly, Facility License No. R-77 is amended by (i) replacing Technical Specifications Amendment No. 26 in Appendix A with Technical Specifications Amendment No. 27, which is enclosed; and (ii) amending paragraph 2. C. 2. to read as follows:

2. C. 2. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 27, are hereby incorporated in the license. The licensee shall maintain the facility in accordance with the Technical Specifications as amended.

3. This license amendment is effective on the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Andrew Persinko, Deputy Director
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure: Appendix A Technical Specifications Amendment No. 27

Date of Issuance: November 6, 2012

SAFETY EVALUATION REPORT BY OFFICE OF FEDERAL AND STATE MATERIALS

AND ENVIRONMENTAL MANAGEMENT PROGRAMS

RELATED TO THE DECOMMISSIONING PLAN AND AMENDMENT NO. 27 FOR THE

UNIVERSITY AT BUFFALO MATERIALS RESEARCH CENTER REACTOR

FACILITY LICENSE R-77

DOCKET NO. 50-57

1.0 Introduction

By letter dated February 17, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML120540187), as supplemented by letters dated June 20, 2012 (ADAMS Accession No. ML121870132), September 21, 2012 (ADAMS Accession No. ML122780454), and October 15, 2012 (ADAMS Accession No. ML12297A237), the State University of New York at Buffalo (UB or the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC or the Commission) to approve a license amendment and a decommissioning plan (DP) completed by its design and oversight contractor (DOC) Enercon Services, Inc. (Enercon), for the Buffalo Materials Research Center (BMRC) Reactor located on the University's South Campus. Licensing activities related to decommissioning activities at the BMRC facility are limited to the AMF Atomics Materials Research and Test Reactor Facility, NRC Docket No. 50-57, Facility License No. R-77.

The February DP submittal included a historical site assessment, and a proposed amendment to the license technical specifications (TS). The June submittal included a revision to the proposed DP and a proposed final status survey plan (FSSP). The September submittal revised the FSSP. The October submittal revised the proposed TS amendment.

As described in the DP, the option chosen for decommissioning is the decontamination (DECON A) option, which will consist of the removal of licensed radioactive equipment and material from the site, and complete decontamination and demolition of the facility to meet the unrestricted release criteria provided in Section 20.1402, "Radiological Criteria for Unrestricted Use," of Title 10 of the *Code of Federal Regulations* (10 CFR). According to the FSSP, the licensee will perform a final status survey (FSS) to verify and document that, after completing the decommissioning, the relevant 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 entitled, "License Amendment Request From The State University of New York, University of Buffalo Reactor Facility," was published in the *Federal Register* on May 10, 2012 (77 FR 27487). In accordance with 10 CFR 20.1405, the notice solicited comments from individuals and local and State governments in the vicinity of the site, as well as any Federally-

recognized Indian tribe that could be affected by the decommissioning. Further, in accordance with 10 CFR 50.82(b)(5), the notice informed interested persons of the Commission's intent to approve the plan by amendment, subject to such conditions and limitations as the Commission deems appropriate and necessary, if the plan demonstrates that decommissioning will be performed in accordance with the Commission regulations and will not be inimical to the common defense and security or to the health and safety of the public No comments from the public, Federally-recognized Indian tribes, local governments, or the State of New York were received.

The staff has reviewed and approves the proposed license amendment and DP. This Safety Evaluation Report (SER) summarizes the staff's safety review of the licensee's proposed license amendment and DP.

2.0 Regulatory Basis

Section 50.82(b)(4) of the Commission's regulations contains the regulatory requirements for the contents of DPs for research and test reactors. This regulation requires that the proposed DP include the following items:

• The choice of the alternative for decommissioning with a description of activities involved (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 3.7 below);

• A description of the planned FSS (see section 3.10 below);

• An updated cost estimate for the chosen alternative for decommissioning, a comparison of that estimate with present funds set aside for decommissioning, and a plan for assuring the availability of adequate funds to complete decommissioning (see section 3.14 below); and

• A description of quality assurance (QA) provisions, physical security plan provisions, and technical specifications (TS) in place during decommissioning (see sections 3.4, 3.12, and 3.11 below).

The NRC conducted its review of the DP submitted by the University 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. 10 CFR 50.82(b)(5) states that, if the NRC finds that these criteria are met, after notice to interested persons it will approve, by amendment, the DP, subject to such conditions and limitations as the Commission deems appropriate and necessary. The DP will be included as a supplement to the safety analysis report or equivalent, and specified in the license technical specifications.

Section 50.82(b)(6) provides the requirement that follows the approval of a DP. This regulation states that the NRC will terminate the license if it determines that the decommissioning has been 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.”

3.0 Evaluation

3.1 Decommissioning Alternatives

The objective of the BMRC decommissioning activities is to remove licensed radioactive materials from the facility and surrounding soils in order to obtain NRC approval for release of the property for unrestricted use and to allow termination of the NRC license. The decommissioning pathway described in the DP is intended to meet the necessary requirements to achieve this objective.

The BMRC DP Section 2.1 considered four alternatives available to the licensee: (1) the No-Action alternative (SAFSTOR); (2) the entombment option (ENTOMB); (3) complete decontamination and structure demolition (DECON-A); and (4) complete decontamination and release of the structure (DECON-B).

The BMRC DP Section 2.1.3 states that DECON–A is the licensee’s preferred option for decommissioning. The BMRC facility records and current facility characterization indicate that minimal facility contamination exists from past reactor operations. The DECON-A alternative requires the site to be released and restored for unrestricted use. The reactor, the containment building, and the administration building under this option will be disassembled and the radioactive material removed to meet the release criteria. The BMRC facility is located in the center of a growing university and the land area could be reused for future construction; therefore, complete decontamination and demolition (D&D) of the BMRC facility, DECON-A, is the University’s preferred option. According to the licensee, this alternative poses minimal risk and impacts to the environment as described in the licensee’s Decommissioning Environmental Report (ER).

3.1.1 Conclusion

The NRC staff reviewed the licensee’s chosen method for decommissioning, DECON-A, and concludes that this choice satisfies the requirement of 10 CFR 50.82(b)(4)(i). This choice is acceptable because it provides for completion of decommissioning without significant delay (i.e., 15 months from DP approval to completion of the FSS).

3.2 Facility Radiological Status

3.2.1 Facility Description and Operating History

The BMRC reactor operated from March 24, 1961 until June 23, 1994. The BMRC reactor was a PULSTAR heterogeneous open-pool type water cooled reactor that used solid 6% enriched uranium dioxide fuel clad in zirconium-alloy similar to commercial nuclear power reactor fuel. The core was cooled by forced convection at higher power levels and by natural convection at lower power levels. The coolant is purified water and the reflector is water and/or graphite.

The core is immersed in a 13,000-gallon aluminum alloy lined pool surrounded by both high density and regular density concrete. Original design specifications used water to cool the core. The water exited the reactor at the pool bottom and was then pumped to a 5,000-gallon Nitrogen-16 (N-16) holdup tank for decay. The water then cycled through a heat exchanger connected to an external cooling tower located on the southeast side of the Administration Building (Laboratory Wing). The cooled water was then circulated back to the top of the pool.

All nuclear fuel has been removed from the site and shipped offsite. The reactor and its associated components remain in the pool in the normal operational configuration. Reactor components removed during repairs completed in 1991 were stored behind concrete block shielding on the Neutron Deck. These reactor components were removed during the pre-decommissioning cleanout and buried at the Energy Solutions Clive, UT facility.

Section 1.2 of the DP describes the BMRC Facility, which consists of the reactor described above, the Containment Building, which encloses the reactor and associated facilities related to use of the reactor, as well as the Administration Building, which contains offices, classrooms, and laboratories. The Administration Building is also referred to as the Laboratory Wing.

Containment Building

The reactor is housed in a tri-level Containment Building as shown in an artist's rendering of the interior of the original Containment Building in BMRC DP Figure 1-2. The three levels (from top to bottom) of the Containment Building include the Control Deck, the Gamma Deck, and the Neutron Deck. Plan views of the Control Deck, Gamma Deck, and Neutron Deck are shown on Figure 1-3, Figure 1-4, and Figure 1-5 of the BMRC DP respectively. The Containment Building was constructed of reinforced concrete in a right cylinder shape, approximately 75 feet in diameter and 52 feet high with walls that are two-foot thick reinforced concrete. The roof varies from four to nine inches in thickness and is supported by concrete beams. The walls and the foundation are constructed on bedrock.

Within the Containment Building are the following additional facilities:

- Hot Cell and Hot Cell Work Room (Room 105)
- Dry Chamber (Neutron Deck Level)
- Charpy Cell (Neutron Deck level) (Removed)
- Hot and Warm Chemistry Labs (Rooms 103, 104, and 108)
- Neutron Activation Analysis and Counting Lab (Room 109)
- Other Labs (Rooms 202, and 203)
- Electronics Shop (Room 200)

3.2.2 Current Radiological Status of the BMRC Facility

The BMRC DP included a Site Characterization Report, dated July 30, 2011, as Appendix B. The report described the current radiological status of the BMRC Facility to support development of the DP. The data collected in the report will assist in the development of radiation safety protocols, project dose estimates, estimation of expected radiological waste volumes, methodologies for removal and packaging of radiological waste, and disposal options for radiologically contaminated impacted materials during decommissioning activities. The data have also been incorporated into the decision making process for the development of the FSS data quality objectives described in NUREG-1575, Rev. 1, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (ADAMS Accession No. ML003761445).

The BMRC DP Section 2.2.2 states that Enercon developed the Site Characterization Plan to establish a measurement and sampling technical approach along with the project quality assurance requirements. The plan was reviewed and approved by the BMRC Operating Committee.

According to the Site Characterization Plan, the BMRC facility has been impacted from the operation of the research reactor, but the practices employed to minimize the spread of radioactive material were effective and therefore the impacts have been limited. As a result, a majority of the waste generated from the demolition of the BMRC facility is expected to be eligible for release. It should be possible to recycle and reuse the concrete as aggregate or dispose of the concrete as construction and demolition (C&D) waste in a local permitted landfill. These options reduce both the overall cost of decommissioning and the associated safety risk because: (1) the risk of a transportation accident is significantly reduced with local recycling versus interstate transportation for bulk survey for release (BSFR) or Class A Low-Level Radioactive Waste (LLRW) disposal; (2) there will be reduced cost of transportation to a local disposal facility versus distant LLRW landfills or processing facilities; (3) if the concrete is disposed of as C&D waste, the disposal rates are significantly lower than for BSFR waste or Class A LLRW.

Overall, the Site Characterization Report provides a detailed status of the radiological conditions at the BMRC. Characterization efforts were guided by a thorough historical site assessment (HSA) and characterization plan. Characterization activities included subsurface soil samples down to bedrock, fixed location alpha and beta measurements on building surfaces, waste tank samples, loose activity smears, smears for hard to detect radionuclides, bio-shield concrete samples, scan measurements on building surfaces, 10 CFR Part 61 distribution samples, and a gamma walkover survey. Analytical results from subsurface soil samples taken from areas adjacent to the reactor tank were less than the laboratory minimum detectable concentrations (MDCs) for contaminants of concern. In addition, indications of residual activity were not found outside of areas described in the HSA that the licensee expected to contain elevated levels of radioactive materials.

This information obtained from the site characterization effort provides sufficient data to demonstrate that it is unlikely that significant quantities of residual radioactivity have gone undetected in the BMRC. DP Table 2-1 provides an estimate of the types and quantities of radiologically impacted components and systems.

3.2.3 Release Criteria

This section provides the specific radiological criteria that will be applicable for unrestricted release of the site and termination of NRC license R-77.

DECON-A, the licensee's preferred method for decommissioning, includes the removal of activated and contaminated materials, equipment, and components. Because the BMRC facility will be demolished, the release criteria for the FSS will be for the soil and bedrock that remain on site. The licensee expects that the remaining soil and rock surfaces will satisfy the requirements of 10 CFR 20.1402 that the residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 millirem (mrem) per year, and that the residual radioactivity has been reduced to levels that are as low as reasonable achievable. The release criteria will be determined to have been met by demonstrating surface or volumetric activities meet their respective NRC screening values as found in Appendix B of NUREG-1757, "Consolidated Decommissioning Guidance," Vol. 1, Rev. 2 (ADAMS Accession No. ML063000243).

Release Criteria for Structures, Systems and Components

Section 2.2.3.1 of the DP states that Structures, Systems, and Components (SSCs) destined for reuse, recycling, or disposal as clean waste will be shown to be free of detectable surface contamination in accordance with the guidelines provided by the NRC in IE Circular No. 81-07, "Control of Radioactively Contaminated Material" (ADAMS Accession No. ML103420362). Monitoring for residual radioactivity will use instrumentation and techniques (background radiation levels, scan speed, counting times) necessary to detect activity no greater than 5,000 dpm/100cm^2 total and 1,000 dpm/100cm^2 removable beta/gamma contamination. All instruments shall be calibrated with radiation sources having an energy spectrum and instrument response consistent with the radionuclides being investigated. If alpha contamination is suspected, appropriate residual radioactivity measurements capable of detecting alpha activity no greater than 100 dpm/100cm^2 fixed and 20 dpm/100cm^2 removable will be used. Per IE Circular No. 81-07, the potential dose impacts to members of the public will be less than 5 mrem/yr to the maximally exposed individual which will meet the NRC release criteria of 25 mrem/yr. This release criterion is also described in NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors," and is known throughout the industry as the Regulatory Guide 1.86 release criterion.

Properly calibrated survey instrumentation with known efficiencies capable of measuring the radionuclide of concern will be used for release surveys. Removable contamination wipes may be measured in a liquid scintillation counter (LSC) or a wipe/filter counter such as the Ludlum Model No. 3030E or equivalent.

For surface tritium contamination, only removable contamination will be assessed because of the difficulties in measuring total tritium surface contamination directly (International Organization for Standardization, August 1, 1988, *Evaluation of Surface Contamination-Part 2: Tritium Surface Contamination*, ISO 7503-2). If a removable fraction of 10% is assumed, analysis for removable tritium must have a minimum detection limit no greater than 500 dpm/100cm^2 so that the total (fixed plus removable) required detection limit of 5,000 dpm/100cm^2 is not exceeded. Tritium wipes shall be measured in an LSC.

Release Criteria for Bedrock Surfaces

During decommissioning, the entire BMRC structure will be demolished and removed from the site. The bottom concrete slab of the Containment building, i.e., the Neutron Deck floor, was poured directly on the bedrock. After the building is demolished, only the bedrock will remain. The bedrock is not volumetrically contaminated; therefore, the FSS will employ survey methods utilized for building surfaces using the NRC screening values for building surfaces as found in Appendix B of NUREG-1757 and presented in DP Table 2-3. The bedrock will be prepared prior to the FSS by removing loose materials, i.e., concrete dust, pieces, and dirt. Release criteria for radionuclides not in DP Table 2-3 will be consistent with the Regulatory Guide 1.86 values stated in DP Section 2.2.3.1. The amount of loose radioactive materials shall not exceed 10% of the release criteria.

3.2.4 Conclusion

The NRC staff has reviewed the characterization performed by the licensee for the principal radioactive components. The NRC staff, based on its experience and engineering judgment, concludes that the characterization was performed in accordance with NRC guidance in NUREG-1757 and that the licensee's estimates of the radiological conditions and radiation measurements are acceptable.

The NRC staff also concludes that the release criteria 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. Chapter 9 of the Decommissioning Plan specifies DP change criteria. This chapter asserts that the licensee may make minor changes to the DP that do not affect the safety of workers or the public or result in environmental impacts. The NRC staff has compared these criteria to those listed in Appendix 2 to NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans," Rev. 1, and Appendix 17 to NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," Part 2, "Standard Review Plan and Acceptance Criteria," and has determined that the DP change criteria are consistent with NRC guidance. Therefore, the NRC staff concludes that the change criteria in chapter 9 of the DP are acceptable to ensure that NRC approval is required under the appropriate circumstances, such as the development of alternate release criteria.

Additionally, the licensee's proposed screening values were compared to the trigger levels in the Memorandum of Understanding between the EPA and the NRC, reproduced in NUREG 1757, Appendix H, "Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites." The licensee's proposed screening values are at or below the relevant

consultation trigger values for industrial/commercial land use and therefore are considered appropriate.

3.3 Decommissioning Tasks

3.3.1 Scope of the Decommissioning Project

The BMRC DP Section 2.3 states that prior to approval of the DP by the NRC, several activities are scheduled to be conducted to prepare the reactor facility for decommissioning. Preparation of the facility and the removal of non-reactor structures, systems, and components can advance the overall decommissioning schedule.

3.3.1.1 Identified Preparatory Actions

The preparatory actions identified by the DP are:

- Pre-decommissioning cleanout of miscellaneous loose materials and equipment that were sent to a licensed radioactive materials processor.
- Isolation and removal of inactive systems
- Removal of hazardous waste and asbestos containing material (ACM)
- Facility preparation for decommissioning including the installation of temporary power, portable lighting, temporary ventilation systems, and air monitoring systems needed to support decommissioning activities.

3.3.1.2 Tasks and Activities for BMRC Decommissioning

According to the DP, decommissioning will initially focus on the items that have the greatest potential to be radioactively impacted. Planned activities, and their approximate order, are:

- Removal of the operating platform
- Removal of reactor components (e.g., the core frame, plenum, core blades and shrouds, thermal column frame, and sleeve for the fission chamber)
- Dewater the reactor tank
- Removal of activated portions of the reactor tank liner
- Removal of reactor bio-shield, dry cell, and hot cell
- Removal of heating, ventilation, and air conditioning system and other impacted systems
- Waste systems removal
- Demolition of containment building

- Demolition of administration building
- Remediation of soils and bedrock, if necessary

3.3.2 Schedule

According to the DP, the project duration, from DP approval to completion of the FSS, is approximately 15 months. However, changes to the schedule may be made at the UB's discretion to respond to resource management, availability of a radioactive waste burial site, interference with ongoing UB activities, as low as is reasonably achievable (ALARA) radiation exposure considerations, and/or temporary on-site radioactive waste storage operations. This current project schedule is consistent with other recently completed university research reactor decommissioning projects.

3.3.3 Conclusion

The NRC staff reviewed the DP with respect to decommissioning tasks and concludes that the manner in which the licensee proposes to complete each of the decommissioning tasks is acceptable, including its Final Status Survey Plans, which were developed in accordance with the standards in NUREG 1575; NUREG-1537, Part 1, Appendix 17.1, Section A; and NUREG-1757, Volume 2, Chapter 4.

3.4 Decommissioning Organization and Responsibilities

According to the DP, the University is committed to, and retains ultimate responsibility for, full compliance with the existing NRC reactor license and all applicable regulatory requirements during decommissioning. The decommissioning of the BMRC facility is under the supervision of the University's Environment, Health and Safety (EH&S) Department, which will supervise decommissioning, radiation safety, and industrial safety. Personnel in EH&S who operated the BMRC before shutdown held the positions of Director, Operations Manager, Reactor Engineer, and the Radiation Safety Officer (RSO). The University has appointed a project manager to oversee the decommissioning process.

The following key licensee organizations and positions are described in section 2.4 of the DP:

University Project Manager (UBPM)

The UBPM is responsible for:

- Selecting a Demolition Contractor (DC) in accordance with UB procurement guidelines.
- Overseeing the Design and Oversight Contractor (DOC) and DC performance relative to the terms of their contract.
- Overseeing the DOC and DC performance relative to plans and procedures.

Minimum qualifications and experience requirements for the UBPM are:

- A bachelor's degree in Architecture, Civil, Electrical, Mechanical or Structural Engineering or related field and five (5) years of construction experience, which include one year of construction supervisory experience; or,

- Nine years of progressively responsible construction experience, which include one year of construction supervisory experience; or,

- Any equivalent combination of experience, training and/or education approved by the UB Human Resources department.

BMRC Director

The BMRC Director has management responsibility and technical oversight for facility operations and radiation safety programs. The BMRC Director is responsible for:

- Ensuring that decommissioning activities are performed in compliance with applicable regulations and license conditions.

- Approving plans and procedures required for decommissioning

- Reviewing and submitting to the Reactor Decommissioning Safety Committee (RDSC) needed changes and subsequent plans and procedures that do not change the original intent of the DP or result in an unreviewed safety question.

- Communicating with the NRC, New York State Agencies, and UB Administration.

Minimum qualifications and experience requirements for the BMRC Director are:

- Advanced degree (MS or PhD) in Nuclear Engineering or related discipline or equivalent experience and five (5) years experience in nuclear reactor operations and/or decommissioning.

- Familiarity with NRC License R-77, the Decommissioning Plan, the BMRC Radiation Protection Program, and applicable Federal and state regulations.

- Trained at the level required by the UB Radiation Protection (RP) Program to be in possession of radioactive materials of the types known to be present at the licensed reactor site.

Radiation Safety Officer (RSO)

The UB RSO is responsible for monitoring and overseeing radiological safety at the BMRC facility. The RSO has the responsibility and authority to stop any plan or activity that has the potential to result in an unacceptable radiological hazard. The RSO shall:

- Supervise the implementation of the UB radiation safety program by DOC radiation safety staff.
- Review and approve radiation safety procedures.
- Review and approve radiation work permits.

Minimum required qualifications and experience requirements for the RSO are:

- Advanced degrees (MS or PhD) and/or certification in Health Physics with 10 years experience in radiation safety and health physics.
- Familiarity with NRC License R-77, NYS Radioactive Materials Licenses, the Decommissioning Plan, the BMRC Radiation Protection Program, and applicable Federal and state regulations.

Reactor Decommissioning Safety Committee (RDSC)

The function, responsibilities, and makeup of the RDSC are defined in the DP and Technical Specifications. Those responsibilities include:

- Approval of plans required for decommissioning.
- Review and approval of proposed changes to the facility, procedures, Technical Specifications and DP.
- Determination of whether a proposed change to the DP would constitute an unreviewed safety question or a change in the Technical Specifications as required by 10 CFR 50.59, and review and approval of required safety analysis.

Design and Oversight Contractor

The DOC is responsible for the direct field management of the BMRC decommissioning and assisting the UB in the administration of the industrial and radiological safety programs. The duties assigned to the DOC project manager (PM) include, but are not limited to, the following:

- Manage the safe and regulatory compliant implementation of the UB DP and FSS.
- Assist the UBPM in overseeing the DC performance relative to subsequent plans and procedures.

- Develop and implement a Radiation Safety program compliant with 10 CFR 20.
- Develop and implement an OSHA compliant Health and Safety Program.
- Review and approve work plans and procedures necessary for the safe and compliant decommissioning of the BMRC.
- Assist the UB in acquiring applicable permits for radiological waste disposal and transportation.

The DOC will assign a PM with the following minimum required qualifications and experience:

- B.S. Degree and 10 years combined experience in decommissioning, project management, and radiation safety with at least five (5) of the years specific to nuclear reactor decommissioning.
- Experience in the decommissioning of university research and test reactors.
- Familiarity with applicable Federal and state regulations, MARSSIM and NRC decommissioning guidance.

Demolition Contractor

The DC reports directly to the DOC Project Manager for implementation of the DP, but is contracted directly to the University.

The DC is assigned the following responsibilities:

- Development and safe implementation of work plans and procedures for the demolition of the BMRC.
- Compliance with the BMRC DP.
- Compliance with the BMRC Decommissioning Radiation Safety program.
- Compliance with the BMRC Decommissioning Health and Safety Program.

The qualifications and experience for the DOC and DC are discussed in Section 3.6.

3.4.1 Conclusion

The NRC staff has reviewed the licensee's DP with respect to the proposed decommissioning organization and responsibilities. The NRC staff concludes that this information satisfies the requirement of 10 CFR 50.82(b)(4)(v) regarding quality assurance provisions because the licensee has provided reasonable assurance that organizational structures needed to safely decommission the BMRC are in place. In addition, the licensee has committed to ensuring that the RDSC will properly oversee all decommissioning activities conducted by the DOC and DC,

including the review and approval of changes to the facility and of decommissioning-related plans and procedures. The NRC staff finds that the project management structure for the decommissioning of the BMRC 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.

3.5 Training Program

General Site Training

According to DP Section 2.5, a general training program will be designed and implemented by the DOC and approved by UB to provide orientation to project personnel and meet the requirements of 10 CFR 19, “Notices, Instructions, and Reports to Workers: Inspection and Investigations.” General site training will be required for personnel assigned on a regular basis to the Decontamination and Decommissioning (D&D) project. General site training will include but is not limited to:

- Project orientation, security, and access control – such as BMRC Operating Procedure # 56; BMRC Unescorted Access Training for Non-BMRC Personnel
- Introduction to radiation protection
- Quality assurance
- Industrial safety
- Emergency procedures
- Packaging and transport of radioactive materials
- Additional training as required (e.g., Radiation Worker Training, Hazardous Waste Operations and Emergency Response Training, Respirator Training, Confined Space Entry Training, Lockout/Tagout Training, etc.)

For specific tasks that require state licensing or other special qualifications, the qualifications will be reviewed by the DOC. If additional radiation safety training is required, it will be provided by the site RSO.

Radiation Worker Training

According to the DP, the reactor D&D operations will be managed by the DOC and performed by the DC. As such, the DOC will be responsible for the radiation worker training of BMRC decommissioning contractors and subcontractors in accordance with the requirements of 10 CFR Part 19 with the final approval of qualifications by the RSO. The Decommissioning Radiation Protection Manager (RPM) will be responsible for on-site radiation safety training of workers and verifying qualifications as approved by the RSO. The DOC's radiation safety training program will be administered by the RPM who will approve, along with the RSO, training materials and qualification of workers. The RSO will provide dose monitoring badges such as thermoluminescent dosimeters (TLD).

The minimum radiation safety training provided to any worker will include the following:

- Principles of radiation protection
- Radiation monitoring techniques
- Radiation monitoring instrumentation
- Emergency procedures
- Radiation hazards and controls
- Concepts of radiation and contamination
- Provisions of 10 CFR Parts 19 and 20
- NRC license conditions and limitations
- Reporting requirements for workers
- Biological effects of radiation
- Radiation control zone procedures
- Radiation Work Permits (RWP)

Radiation worker training will also include a practical factors demonstration and evaluation. This evaluation will include a review of the following:

- Proper procedures for donning and removing protective clothing and equipment.
- The ability of the worker to read and interpret self-reading and/or electronic dosimeters (if used).
- Proper procedures for entering and exiting a controlled area, including proper frisking techniques

Radiation Worker training will be refreshed on an annual basis or at the discretion of the RSO.

3.5.1 Conclusion

Based on its review of the licensee's training program as described in the DP, the staff has determined that the proposed licensee training program is consistent with the NRC guidance for training for decommissioning research reactors provided in Appendix 17 to NUREG-1537, Part 2. Therefore, the NRC 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 non-radiological hazards as specified by the Atomic Energy Act, the licensee is aware that personnel involved with decommissioning project 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.

3.6 Decommissioning Contractors

According to DP Section 2.6, the DOC selected by the licensee, Enercon, is a qualified DOC for the design and oversight of the BMRC decommissioning because of Enercon's prior experience in university research and test reactor decommissioning.

The DP also states that, in addition to the DOC, the UB will select a qualified DC to perform the physical demolition of the BMRC. The selected DC will manage the physical aspects of its portion of the decommissioning work including QA, health physics, safety, waste processing, and waste packaging and shipping. However, the University will continue to maintain overall responsibility for health and safety, compliance with regulations, and applicable license conditions.

In selecting the DC, the University will prepare a request for proposal, which will define the qualifications and experience necessary for prospective DCs and subcontractors. Prior history and performance of the prospective contractor on non-power reactor or similar decommissioning projects will be used to help the University select a qualified DC to perform the facility D&D.

The contractor qualifications and experience requirements include the following:

- At least 5 years prior experience in radiological site decontamination.
- Specific experience in the decontamination and demolition of test reactors, power reactors, and/or materials licensed sites.
- DC submittals of project descriptions, references, and other supporting information prior to contract award.
- Specific DC project management documentation in the areas of work plan development, training, QA, work management, reactor dismantlement and decontamination, waste packaging, waste shipping, work documentation, and supporting the preparation of the final decommissioning project report. The minimum expectation of the UB for a DC is verification of company experience in these tasks, proof of financial viability, and bonding capacity.

The UB will require the selected DC to support the project with an experienced Superintendent, supervisors, and Work Planner(s) with at least five years prior experience in radiological site decontamination and demolition with preference in test reactors in a college campus setting. Specific individual experience will be required in the areas of work plan development, training, QA, work management, reactor dismantlement and decontamination, waste packaging, waste shipping, work documentation, and supporting the preparation of the final decommissioning project report. The minimum expectation of the UB for a DC is verification of personnel experience in these tasks plus a commitment to provide experienced personnel for the duration of the project.

3.6.1. Conclusion

The NRC staff has reviewed the criteria the licensee used to select the DOC and will use to select the DC. The selection criteria cover all skill areas necessary for successful decommissioning project management and performance. Therefore, the NRC staff concludes there is reasonable assurance that the licensee has selected a DOC and will select DC contractors with adequate qualifications.

3.7 Radiation Protection

3.7.1 ALARA Program

The BMRC DP in Section 3.1 states that the DOC will supplement the BMRC radiation protection program with detailed plans and procedures specific to the radionuclides of concern as determined in the Site Characterization Report in order to minimize occupational and public radiation exposures. The DOC will prepare a radiation protection and ALARA Plan. This Plan will describe specific administrative and engineering controls that will be implemented during specific D&D project activities. Examples of administrative and engineering controls include limiting access to certain areas, use of mock-up training, use of remote-handling devices, use of temporary shielding, use of containment structures, use of portable HEPA filtered ventilation, and use of specialized protective equipment and respiratory protection.

3.7.2 Health Physics Program

According to the DP, the project's Health Physics (HP) Program will be implemented under the authority of the UB RSO with the assistance of the DOC RPM. The HP Program will satisfy the following commitments established by the Radiation Protection Program:

- Implement the procedures defined in the Radiation Protection and ALARA Plan.
- Ensure radiological safety of the public, occupationally-exposed personnel, and the environment.
- Monitor radiation levels and radioactive materials.
- Control the distribution and release of radioactive materials.
- Maintain potential exposures to the public and occupational radiation exposure to individual within administrative limits and the regulatory limits of 10 CFR Part 20 and ALARA.
- Monitor personnel internal and external exposure in accordance with 10 CFR Part 20 requirements.

UB has HP procedures in place that will be implemented during the BMRC Decommissioning Project. Additional HP procedures may be required and will be developed and approved in accordance with UB policy and procedure.

UB senior management is readily accessible to ensure timely resolution of difficulties that may need to be addressed prior to regularly scheduled meetings. The RSO, while organizationally independent of the project staff, reports directly to the BMRC Director. He also has full authority to act in all aspects of protection of workers and the public from the effects of radiation. Conduct of the BMRC Decommissioning Project HP program will be evaluated according to UB policy.

Contractor personnel will be used during the BMRC Decommissioning Project and will be required, at the discretion of the RSO, to attend and complete appropriate radiation safety courses; provide required exposure history information; read and sign an applicable RWP and comply with instructions; and follow special instructions given by the HP staff.

3.7.3 Occupational & Public Dose Estimates

The BMRC DP in Section 3.1.3 estimates the total occupational exposure to complete the BMRC Decommissioning Project to be 6.7 person-rem. This dose estimate for decommissioning of the reactor was prepared using the individual work activity durations and work crew sizes, based upon the results of the characterization results to date and based upon recent experience in performing similar activities at the University of Washington and at the University of Arizona, combined with the DOC's experience at numerous other sites. Using these individual work activity durations, and work crew sizes and characterizations results, a dose estimate was generated for each activity. The doses from each activity were categorized and are provided by those categories in BMRC DP Table 3-3, Project Dose Estimates.

The BMRC DP states that the dose estimates are provided for planning purposes only. Detailed exposure estimates and exposure controls will be developed in accordance with the requirements of the ALARA program during detailed planning of the decommissioning activities.

According to the DP, the primary doses expected to be received by BMRC D&D project workers will be from external exposure to activated metals and concrete, with little dose expected from internal exposure. External exposure will be monitored using whole-body and extremity TLDs, and electronic dosimeters. External exposures can be kept ALARA due to the availability of long reach tools, remote handling equipment, and the building's overhead crane. Additionally, there is plenty of floor space in the BMRC to maintain safe distances and to use shielding as necessary to keep exposures ALARA. Air sampling will be performed to assess the potential for airborne contaminants and internal doses will be monitored if they are expected to exceed 10% of the annual dose limits specified in 10 CFR Part 20. However, the committed effective dose equivalent (CEDE), the sum of the external and internal doses, is expected to be equal to the Deep Dose Equivalent (DDE).

Finally, the DP states that the dose estimate to members of the public as a result of BMRC decommissioning activities is estimated to be negligible. This is because the area immediately surrounding the facility is under the control of the UB and because the BMRC is not within a high foot-traffic area of the UB South Campus. UB students, faculty and staff will be kept at a safe distance from the BMRC during decommissioning activities using temporary construction fencing. The licensee will be required to conduct appropriate radiological monitoring to ensure that NRC public dose limits are not exceeded and that public doses are ALARA.

3.7.4 Conclusion

The NRC staff has reviewed the licensee's commitments to decommissioning ALARA and health physics programs and the licensee's estimate of the potential dose from the BMRC decommissioning activities. The NRC staff concludes that, because the radiation protection controls committed to by the licensee will maintain doses within the 10 CFR Part 20 limits and be ALARA, these commitments are adequate to protect occupational and public health and safety. Therefore, these commitments satisfy the requirement of 10 CFR 50.82(b)(4)(ii).

3.8 Radioactive Waste Management

The BMRC DP Section 3.2 describes the proposed program to manage and control the management and disposition of solid, liquid and gaseous radioactive waste for the decommissioning project. According to the DP, the decommissioning project will require the handling of a relatively large volume of radioactive materials to reduce the residual levels of radioactivity to levels that allow for license termination and the release of the site for unrestricted use. Materials that are not decontaminated and/or released will be managed as radioactive waste.

The BMRC DP states that radioactive waste includes neutron-activated materials, contaminated materials remaining in the containment building, tools, and disposable equipment and supplies that become contaminated during dismantling activities. Waste disposal costs are directly related to the activity, volume, and weight of the materials requiring disposal. Strategies will be implemented for minimizing waste including: source reduction, reuse, decontamination, volume reduction, and waste stream segregation.

The BMRC DP Section 3.2 states that the DOC will be required to develop and implement a Waste Management Plan for the BMRC Decommissioning project. The Waste Management Plan will include detailed guidance for the characterization, sampling, classification, segregation, handling, packaging, manifesting, transporting and disposal of waste generated by the decommissioning. The Plan will be submitted to the RSO and BMRC Director for review and approval prior to the start of any decommissioning work on site that has the potential to generate radioactive waste.

The licensee states in BMRC DP Section 3.2 that waste volumes will be minimized through the application of industry-proven methodologies to ensure the segregations of contaminated and non-contaminated materials. These methodologies will include the establishment of radiological controls consistent with the Health Physics Program and the implementation of good contamination control practices. Segregation categories may include: uncontaminated waste acceptable for land disposal or reuse, uncontaminated C&D wastes suitable for land disposal or recycle, Class A LLRW, and Class B activated components. Additionally, mixed wastes and non-radiological hazardous waste, if encountered, will be segregated from LLRW. The licensee states in BMRC DP Section 3.2 that based on the site characterization and Activation Analysis of the reactor components, Class C radioactive waste is not present at the BMRC.

The BMRC DP Section 3.2 states that except for Class B waste, disposal facility options for contaminated or activated materials currently available to BMRC include land disposal at the Energy Solutions facility in Clive, Utah; and mixed waste treatment by Energy Solutions or another qualified service provider, with subsequent disposal at Energy Solutions. A Bulk Survey for Release (BSFR) and disposal procedure that is specially-permitted in Tennessee is also an option for lightly contaminated materials, especially building materials.

The BMRC DP Section 3.2 states that currently, there is no commercial Class B disposal option available for the Old Control Blades. The UB is working with the Nevada National Security Site (N2S2) to determine if a nexus exists between BMRC operations and the Federal government in order to establish this as a disposal option. The UB shall properly manage the Class B waste until a disposal option is obtained.

The licensee states in BMRC DP Section 3.2 that transportation of radioactive waste will be performed in accordance with applicable NRC and U.S. Department of Transportation (DOT) regulations and the Waste Management Plan. Radioactive waste and material will be shipped either by truck, or by a combination of truck and rail. Shipments will be planned in a practical and efficient manner. Personnel with appropriate training and experience will be used to ensure the shipments comply with the BMRC license, applicable regulations, and the receiving site's license. Packages, packaging, and labeling for radioactive materials and waste shipment will meet applicable regulations and requirements. Personnel involved in the packaging, preparation for shipment, and transportation of licensed material will be required to have training in accordance with 49 CFR Part 172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans," Subpart H, "Training." The RSO, or designee, shall certify all radioactive waste manifests.

3.8.1 Fuel Removal

The BMRC DP Section 3.2.1 states that there is no longer any reactor fuel, used or unused, at the BMRC. The BMRC reactor was permanently shutdown in June of 1994. The licensee states that unused fuel was transferred to North Carolina State University in 1998, and used fuel was returned to the DOE at the Idaho National Engineering and Environmental Laboratory in 2005.

3.8.2 Radioactive Waste Processing

The BMRC DP Section 3.2.2 states that decommissioning of the BMRC reactor will result in the generation of solid and liquid LLRW, mixed waste, and hazardous waste. Solid radioactive wastes include neutron-activated materials, materials with surface or volumetric residual radioactive materials, and soil. Liquid LLRW includes the water in the reactor pool, waste systems, and the associated piping as well as contaminated water generated during remediation activities. The DP does not contain provisions for gaseous radioactive waste because the reactor has been defueled and has been shut down for over 16 years; therefore, the licensee states that radioactive gases present during operations have long since decayed.

The licensee states that handling, staging, and shipping of packaged radioactive waste will be performed in accordance with 10 CFR 20.2006, "Transfer for Disposal and Manifests"; the DOT hazardous materials regulations; disposal site waste acceptance criteria; and BMRC licenses and permits. Onsite radioactive waste processing will include waste minimization, volume reduction, segregation, characterization, neutralization, stabilization, solidification, and packaging. Wastes may be shipped to a licensed processing facility for survey and release or decontamination and release, or may be disposed of directly at a licensed facility. Each shipment of radioactive waste will be accompanied by a shipment manifest as specified in Appendix G to 10 CFR Part 20, "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests." Radioactive waste generated from BMRC decommissioning activities will be manifest in a manner consistent with its waste classification.

3.8.3 Radioactive Waste Disposal

3.8.3.1 Solid

The BMRC DP Section 3.2.3 states that solid waste generation will primarily be the direct result of the decontamination and dismantlement of the BMRC reactor components, activated and contaminated systems, and structures. The licensee states that the bulk of the radioactive waste is Class A with approximately 2 cubic feet of Class B waste and no Class C wastes based on site characterization data and activation analysis data for the reactor. Disposition paths for solid radioactive wastes include decontamination and free release, BSFR, and direct landfill disposal. Wherever possible, volume reduction strategies will be explored to reduce waste disposal handling, exposure, and cost; including offsite processing for volume reduction if appropriate.

The BMRC DP Section 3.2.3 states that Class B Mixed Waste consists of the Old Control Blades made of nickel plated permalloy which is an alloy consisting of silver, indium and cadmium. Disposal sites licensed to accepted Class B waste are not available to the BMRC at the time this DP was developed. The UB and DOC are initiating the process with the N2S2 to determine if the Class B waste can be accepted for disposal. The licensee will properly manage Class B waste until a disposal option is determined. After determination is made for disposal at N2S2, or another site, the Waste Management Plan will be revised to incorporate the waste acceptance criteria for the disposal site. NRC staff notes since the BMRC DP was submitted, Waste Control Specialists LLC (WCS) Texas Compact Facility in Andrews, Texas has been licensed to accept Class B waste from out of compact states.

Irradiated reactor hardware may require size reduction to facilitate loading. Depending on the dose rate exhibited by irradiated hardware, it will be shipped either in a shielded Type A container, or it will be loaded into a High Integrity Container (HIC) or liner then placed in an approved, shielded shipping container (Type A or B as dictated by the waste characterization) for transport and subsequent disposal. Contaminated reactor system piping and hardware may be land disposed as LLRW. Pre-disposal volume reduction processing may be performed off site at a subcontracted processing facility if it is determined to be cost effective.

Activated or contaminated concrete removed in large sections may be packaged as Low Specific Activity (LSA) material in approved shipping containers for direct shipment to the licensed land disposal facility operated by Energy Solutions at Clive, Utah. Concrete may also be eligible for processing using an option such as the BSFR program offered in Tennessee, or potentially N2S2.

Mixed waste lead bricks will either be decontaminated and released, or processed to allow for direct land disposal.

3.8.3.2 Liquid

The licensee states in BMRC DP Section 3.2.3 that decommissioning the BMRC reactor involves radioactively contaminated water primarily in the form of low-level radioactively contaminated water in the reactor pool and associated piping. Additional contaminated water may be generated during decommissioning operations (e.g. concrete cutting). These waters will be disposed by discharge to the public sewer system operated by the City of Buffalo; assuming the discharged liquid can be shown to meet the requirements for sewage disposal established

by the BMRC license.

According to the DP, pre-discharge treatment may include the use of existing or temporary filtration units or demineralizers, coupled with tanks to store processed water prior to discharge. After it has been verified that the stored processed water meets the allowable discharge limits, the water may be released. In addition to testing the stored water after treatment, effluent monitoring instrumentation may be used to monitor discharges of liquid effluent as required, and to demonstrate compliance with applicable regulations. Contaminated filter media will be disposed as LLRW, after onsite treatment to meet LLRW disposal facility waste acceptance criteria.

According to the DP, in the event that discharge to the sanitary sewer or onsite treatment is not feasible, the waters may be treated offsite. There are several licensed radioactive waste processors that provide specialized services for volume-reducing or treating radioactive liquid waste, including demineralization, direct incineration, ground application, evaporation, and survey and release. BMRC may elect, or find it necessary, to transfer all or some of the liquid radioactive waste from decommissioning to a licensed waste processor based upon onsite treatment effectiveness, discharge permit limits, stakeholder input, or cost.

3.8.4 Industrial Safety Program

The BMRC DP Section 3.2.4 states that industrial safety and hygiene personnel, such as Certified Safety Professionals or Certified Industrial Hygienists, along with project management personnel, will be responsible for ensuring that the D&D project complies with applicable Federal safety requirements and general safe work practices. These personnel will be provided by the DOC, but will report to the UB EH&S department. The BMRC DP Section 3.2.4 states that the DOC will prepare a site specific Health and Safety Plan (HASP) to document safety requirements and accident response procedures.

The BMRC DP Section 3.2.4 states that all personnel working on the D&D project will receive health and safety training in order to recognize and understand potential hazards and risks. Training requirements for subcontractors will be determined by the Decommissioning Safety Manager based on the specific task the subcontractor is performing.

The BMRC DP Section 3.2.4 commits the DOC to the development of a HASP that will be reviewed and approved by the UB EH&S Department. The HASP will direct site activities necessary for ensuring that the reactor D&D project meets occupational safety and health requirements for protection of project personnel. The functional responsibility of the HASP will be to ensure compliance with the Occupational Safety and Health Act of 1973 (OSHA). New York adopts Federal OSHA standards by reference and enforces OSHA standards contained within 29 CFR Part 1910 and 29 CFR Part 1926 for General Industry and Construction Industry, respectively. The DOC assists the UB in oversight of the site HASP.

The BMRC DP Section 3.2.4 states that the HASP will include the following:

- Hazards assessment
- General site safety procedures
- A requirement for a daily site safety meeting
- Site inspection procedures
- Emergency response procedures
- Emergency contact telephone numbers
- Material Safety Data Sheets for hazardous materials present on-site
- Training requirements for specific activities such as permit-required confined space entry or hot work
- Local emergency medical information

3.8.5 Conclusion

The NRC staff reviewed the licensee's proposed decommissioning waste management program and determined that it is consistent with the NRC guidance on research reactor decommissioning waste management provided in Appendix 17 to NUREG-1537, Part 2. Additionally, the NRC staff determined that the licensee has demonstrated experience in safely managing radioactive waste generated during normal operations. Based on these reviews, the NRC staff concludes that the licensee's proposed decommissioning radioactive waste management program demonstrates a program sufficient to control, process, package and transport radiological waste, and is therefore acceptable. Additionally, the NRC staff review of the Industrial Safety Program indicates that it will ensure appropriate personnel protection consistent with OSHA requirements and is acceptable.

3.9 Radiological Accident Analyses

The BMRC DP Section 3.3 lists potential radiological accidents during reactor decommissioning that were evaluated by determining reactor components and areas that contain the highest radioactive material inventory. The proposed decommissioning activities and methods in which radioactive material could be released to the work area or environment were considered. Since all special nuclear material was removed before decommissioning, the majority of the accidents discussed in the current license are not applicable. The accident identification process was supplemented by reviewing experiences at other non-power reactor decommissioning projects. The following radiological accidents were considered in the DP to present the highest potential consequences:

- Fire

- Spill of liquid radioactive waste into the environment
- Release of airborne contamination to the environment
- Transportation accident

The accidental dropping of an activated reactor component was also considered as a potential accident. However, because the more highly activated components are located under water, the surface contamination on these parts would not be sufficiently high to release significant quantities of radioactive materials during such an incident. Such an incident would most likely result in additional unplanned external exposures. There are no, and will not be, fissile materials located on site that could result in a criticality incident.

3.9.1 Fire

The BMRC DP Section 3.3.1 concluded that the consequences of a fire during decommissioning of the reactor are not significantly different than the consequences of a fire during reactor operations. Most materials are metals, concrete, or similar non-combustible materials. Although some torch cutting operations may be performed during decommissioning, the likelihood is low that a fire would start or that a fire could become intense enough to release radioactive material.

Dry Active Waste (DAW) will be collected and packaged to limit the volume of DAW available for consumption by fire and lower the potential for a fire to consume additional waste collections. The UB will implement a routine fire loading inspection program during decommissioning activities. DAW would have very low quantities of radioactive materials; therefore, the radioactivity is not high enough to result in a significant release in the case of a fire.

3.9.2 Spill Contaminated Water

The BMRC DP in Section 3.3.2 concluded that the consequences of a spill during decommissioning of the reactor were considered and are not significantly different than the consequences of a spill during reactor operations. The spilling of contaminated water could occur during pool water pumping or liquid removal operations from the waste systems. Hoses could leak or break, resulting in an uncontrolled release. To mitigate the extent of such releases, processes involving contaminated liquids will only be operated with personnel present. Personnel will watch for leaks and spills and respond by shutting down the activity. This will not allow for additional water to leak from the system. In addition to the use of secondary containments or berms, a spill kit will be readily available to respond to any incidents.

According to the DP, as evidenced in prior reactor leaks, contaminated water does not infiltrate the subsurface soils or bedrock. Should radioactive liquids be spilled, the soils and/or building materials can be remediated with little to no impact to the public or the environment.

3.9.3 Release of Airborne Contamination

The BMRC DP Section 3.3.3 concluded that the consequences of an airborne contamination event during decommissioning of the reactor were considered and are not significantly different than the consequences of an airborne contamination event during reactor operations. An uncontrolled release of airborne radioactivity could occur during cutting and demolition activities involving contaminated or activated materials, such as removal and segmentation of reactor components, or removal of tank steel and concrete. The primary method of cutting the activated bio-shield is a wet process, thereby eliminating most if not all of the airborne hazard. Such activities may take place inside temporary containment structures equipped with local HEPA filter ventilation systems. Additionally, non-abrasive cutting methods, i.e., hydraulic shears, will be used where possible to limit abrasive dusts and/or activated metal fragments where feasible.

According to the DP, temporary containment systems with local HEPA filter systems will likely vent to the BMRC rooms or tie into existing building ventilation. A failure in the HEPA filter system could result in the uncontrolled release of airborne radioactive materials. A Continuous Air Monitor will be used to monitor effluent air and will be set to alarm at 10% of the allowable effluent criteria. Operations inside the containment structure will immediately stop and an evaluation conducted to determine the nature of the alarm.

According to the DP, while the actual concentrations of airborne radioactive materials are unknown at this time, the scenario is similar to accident analyses contained in the current BMRC Technical Specifications. Safety management operations (standard engineering and administrative controls) are sufficient for protecting against such accidents.

3.9.4 Transportation Accidents

The BMRC DP Section 3.3.4 provides its assessment of transportation accident consequences. Various forms and quantities of radioactive waste will be shipped from the reactor during the D&D project. The BMRC DP states that the dose consequence from transportation accidents could be higher than the contamination accident scenarios described above because high-activity reactor components could be involved. As such, there is a potential for a moderate dose consequence of between 1 and 25 mrem for the public following a transportation accident. However, the licensee concludes that adherence to NRC and DOT radioactive material packaging and transportation requirements is a sufficient control measure for mitigating transportation-related incidents. The transportation accident risk is further reduced by using local disposition methods for the concrete (i.e., a local C&D landfill or recycling) that will minimize or eliminate the time spent on roadways by decommissioning debris shipments.

3.9.5 Conclusion

The NRC staff reviewed the postulated accidents identified in the BMRC DP and determined that they are reasonable and reflect the accidents that could be expected during decommissioning activities. Since the reactor fuel has been removed and shipped offsite, the radiological consequences of these postulated accidents are significantly less than those occurring during reactor operations. The licensee considered accidental exposures from fire, radiological spill of pool water or waste systems liquids, release of airborne radioactivity during cutting and demolition, failure of air filtration systems, dropping of activated reactor components,

and transportation accidents. The licensee concluded that the potential dose from transportation accidents could be higher than for the other postulated accidents, but that this potential will be reduced by recycling or by using local landfills. The NRC staff agrees with this conclusion. The NRC staff reviewed the postulated radiological accident scenarios and the DP's risk mitigation plans, and concludes that the DP's radiological accident analysis is complete and that the mitigation plans are sufficient to protect the public health and safety and are, therefore, acceptable.

3.10 Proposed Final Status Survey Plan

A Final Status Survey Plan dated June 20, 2012 and revised September 21, 2012, was submitted to the NRC for approval following submittal of the BMRC DP. The following sections describe the methodology and QA requirements to be implemented during the FSS. According to the DP, the DOC is responsible for the planning and implementation of the FSS.

3.10.1 Survey and Sampling Approach

The BMRC DP Section 4.1 states that the reactor and support facilities will be removed prior to site release. Consequently, the Final Status Survey (FSS) will include only the exposed soils and bedrock surfaces in areas covered by license R-77. The BMRC Site Characterization report (Appendix B of the DP) demonstrates that the subsurface soils are not volumetrically contaminated; therefore, the exposed subsurface soils will be surveyed to surface soil screening criteria to prove that the surface of these exposed soils were not contaminated during the building demolition process.

According to the DP, the FSS Plan follows the guidance provided in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)," to demonstrate compliance with the release criteria provided in the BMRC DP Section 2.2.3. The MARSSIM process emphasizes the use of data quality objectives (DQO), proper classification of survey areas (survey units), a statistically based survey and sampling plan, and an adequate quality assurance/quality control (QA/QC) program.

The FSS is to be performed in accordance with the BMRC FSS Plan by trained DOC technicians experienced in performing a MARSSIM FSS. The technicians will follow written procedures regarding surveys and sampling, sample collection and handling, chain-of-custody, and recordkeeping. The FSS Plan will define sampling locations, required analysis, and survey types. Any additional release criteria set forth by the UB or New York State will be contained within the FSS Plan which will direct surveys or sampling efforts required to demonstrate compliance with such criteria.

3.10.2 Identification and Classification of Survey Units

The BMRC DP Section 4.3 states that the FSSP will identify survey units that are classified based on contamination potential according to the methods described in the MARSSIM. In general, there are two overall classifications: non-impacted and impacted. Non-Impacted areas have no reasonable potential for residual contamination because there was no known impact from facility operations.

Based on the levels of residual radioactivity present, impacted areas are further divided into Class 1, Class 2 or Class 3 designations. Class 1 areas have the greatest potential for residual activity while Class 3 areas have the least potential for impacted areas. Each classification will typically be bounded by areas classified one step lower to provide a buffer zone around the higher class.

The size of a survey unit is directly affected by its classification. Section 4.6 of MARSSIM provides suggested sizes for survey units. However, as stated in MARSSIM, the suggested survey unit sizes were based on a finding of reasonable sample density and consistency with commonly used dose modeling codes. MARSSIM limits the size of a survey unit. The BMRC DP Table 4-1 summarizes MARSSIM recommendations for survey unit sizes based on their type and classification.

Following remediation and demolition of the BMRC buildings, there will be no structures remaining that will require FSS. Using the size restrictions in BMRC DP Table 4-1, the exposed bedrock may include only one Class 1 survey unit. The exposed subsurface soils surrounding the Class 1 survey unit will likely be designated as a single Class 2 survey unit to a maximum survey unit size of 10,000 square meters. The remaining surface soils will be designated as a Class 3 survey unit.

3.10.3 Data Collection

The BMRC DP Section 4.4 states that survey methods are applied differently depending on the data requirements of a survey area. For example, removable activity measurements provide little, if any, benefit when attempting to assess the radiological conditions in an excavation. Conversely, assessing a building surface via volumetric sampling would provide the necessary data, but at great costs of time and money. This section discusses the steps necessary to strike a reasonable balance between data needs and ease of survey performance based on the data needs of the survey area.

The bedrock surfaces, after cleaning, will be scanned using beta instrumentation such as a gas flow proportional detector. The coverage rates and speeds will be described in the FSS plan and subsequent report to ensure adequate Minimum Detectable Concentrations (MDCs) for hot spots and/or particles. Volumetric samples may be collected to verify residual radioactive materials are only on the surface of the bedrock.

3.10.4 Radiation Survey Instrumentation

The BMRC FSSP in Table 3-5, “FSS Instrumentation,” provides the proposed radiation instrumentation planned for use in final status surveys. BMRC FSSP Table 3-6 provides the FSS instrumentation MDC as specified by MARSSIM.

3.10.5 Data Assessment and Evaluation

The BMRC FSSP specifies that data evaluation will be performed on FSS results for individual survey units to determine whether the survey unit meets the release criteria. Appropriate tests will be used for the statistical evaluation of survey data. Tests such as the Sign test and Wilcoxon Rank-Sum (WRS) test will be implemented using unity rules, surrogate methodologies, or combinations of unity rules and surrogate methodologies, as described in the MARSSIM and NUREG-1505, Chapters 11 and 12.

If the contaminant is not in the background or constitutes a small fraction of the derived concentration guideline level (DCGL), the Sign test will be used. If background is a significant fraction of the DCGL, the WRS test will be used. The licensee anticipates that the Sign test will be the only statistical test applied to the collected data because of the predicted small fraction of the DCGL that background radionuclides will contribute.

3.10.6 Data Quality Objectives (DQO)

The BMRC DP Section 4.2 states that the object of the FSS is to demonstrate that the radiological conditions of the reactor site satisfy the decommissioning release criteria provided in BMRC DP Section 2.2.3. The DQO in the MARSSIM survey process will provide a 95% confidence level for the false negative (Type I error) in demonstrating that the site meets the criteria. Typically, the false positive (Type II error) will also be defined as a 95% confidence level, but may be modified to apply to a specific situation. Therefore, the Type I decision error will be 5-percent. The decision error rates are used in determining the required number of samples using the MARSSIM process that are necessary in each survey unit as well as the required minimum number of data points used for the final nonparametric statistical test performed to evaluate contaminant concentrations in the survey units against release criteria. The DQO will be fully described in the FSS Plan and will include limits on the sensitivities of survey and analytical methods.

According to the DP, the quality assurance program plan (QAPP) will incorporate standard regulatory and industry measures applicable to the FSS. The QAPP will be reviewed and approved by the UB Reactor Committee

The FSS report will be provided for NRC review and approval. The FSS report will provide a summary of the survey results and the overall conclusions to demonstrate that the BMRC site meets the radiological criteria for release. Information such as the number and type of measurements, basic statistical quantities, and statistical analysis results will be included in the report. The level of detail is to be adequate to clearly describe the FSS program and to certify the results.

The basic outline of the final report will be similar to the following:

1.0 Executive Summary

2.0 Introduction

- Purpose and Objective

- Project Background
- Decommissioning Activities

3.0 Final Status Survey methodology

- Release Criteria
- Classification and Sample size
- Types and Methods of Surveys
- Survey Instrumentation
- Final Status Survey Results
- Number of measurements taken
- Survey maps
- Sample concentrations
- Statistical evaluations, including power curves
- Judgmental and miscellaneous data sets
- Elevated measurement comparisons (if used)

4.0 Conclusions

5.0 References

3.10.7 Conclusion

The NRC staff has reviewed the licensee DP and FSSP with regard to the BMRC FSS and concludes that the licensee satisfies the requirement of 10 CFR 50.82(b)(4)(iii). The licensee's description of the FSS is adequate because the licensee commits to follow the NRC guidance in MARSSIM in the planning and conduct of final status surveys.

3.11 Technical Specifications

The proposed amendment consists of changes to the Facility Technical Specifications from possession only to a decommissioning license and eliminates specifications which are no longer needed. These changes were developed in preparation for decommissioning of the BMRC reactor.

3.11.1 Conclusion

The NRC staff reviewed the licensee's DP with respect to the description of technical specifications and concludes that this description satisfies the requirement of 10 CFR 50.82(b)(4)(v) regarding technical specifications. The staff also finds, regarding the BMRC technical specifications amendment application, that:

A. The application for an amendment to Facility Technical Specifications for the BMRC reactor, license No. R-77, filed by UB on February 17, 2012, as supplemented on June 20, 2012, September 21, 2012, and October 15, 2012, 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 maintained 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; and

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.

Therefore, the Commission issues Amendment No. 27 to Facility License No. R-77 for the BMRC reactor. The amendment consists of changes to the facility Technical Specifications in response to the application dated February 17, 2012, as supplemented on June 20, 2012, September 21, 2012, and October 15, 2012.

3.12 Physical Security Plan

In the BMRC DP Section 2.2, the licensee states that all nuclear fuel was removed from the facility in 2005. The license was subsequently amended to a possession only license, and so a 10 CFR Part 73 physical security plan is no longer required.

In Section 1.2 of the DP, the licensee states that, while the BMRC has a Special Nuclear Material License (SNM-273) for the possession of a Plutonium-Beryllium neutron source, this source has been transferred to the licensee's New York State Department of Health agreement state license. Subsequently, license SNM-273 was terminated by the NRC on June 27, 2011 (ADAMS Accession No. ML111790768), because the material quantities were below license requirements.

In Section 6 of the DP, the licensee states that a site security plan is maintained to comply with the 10 CFR Part 20 storage and control requirements, which are applicable to the residual radiological material remaining at the site. Licensed materials in storage are secured from unauthorized access or removal. Additionally, licensed materials not in storage will be under the control and constant surveillance of authorized personal.

3.12.1 Conclusion

The NRC staff reviewed the DP with respect to the licensee's proposed physical security plan provisions to be in place during decommissioning. The staff concludes that these provisions satisfy the requirement of 10 CFR 50.82(b)(4)(v) regarding physical security plan provisions because the licensee's commitment to facility security is consistent with regulations and is adequate for the protection of the material.

3.13 Emergency Plan

In Section 7.0 of the DP, UB states the following:

During decommissioning of the site, management of significant emergency incidents by the UB will be accomplished through implementation of a response framework as specified by the Federal Emergency Management Agency (FEMA) using the Incident Command System (ICS). The UB is committed to an All Hazard Emergency Management approach, which designates areas of responsibility and defines the administrative framework to respond to all emergency incidents.

Access to the facility is limited and daily monitoring of activities at the BMRC is conducted under the supervision of the UB and DOC project management team, minimizing the risk potential. The Site Security Plan, along with the UB police monitoring capabilities, maintains a safe environment and protects the surrounding community.

Utilization of the ICS, under FEMA guidelines, will provide a quick response, mitigating the incidents of concern at the BMRC. Unified command under the ICS format will afford the UB the opportunity to bring experts from multiple agencies together to mitigate impacts and allow for a smooth transition back to normal activities at the BMRC until decommissioning can proceed.

3.13.1 Conclusion

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

3.14 Estimated Cost

In DP Section 1.2, UB states the following:

The decommissioning cost estimate is approximately $8.9 million. The estimate includes the Demolition Contractor (DC), subcontractors, other direct costs, shipping and disposing of waste, and the final status survey. The cost estimate is subject to increases due to unforeseeable elements within the defined project scope. A contingency of 20% is included in the decommissioning cost estimate to ensure that sufficient funds are available to cover costs that may result from unanticipated conditions or unforeseeable elements in the project scope. Typically, these include factors such as waste disposal rates or increased waste volumes from undiscovered or uncharacterized areas. In addition, the time duration between the development of the DP and the inception of decommissioning activities can influence the costs associated with changes in the economy and regulatory requirements.

In accordance with 10 CFR 50.75(e)(1)(iv), UB is a state institution and as such will provide financial assurance with a statement of intent containing a cost estimate for decommissioning, indicating that funds will be obtained when necessary. The decommissioning of the BMRC is fully funded in the current UB Capital Budget that runs through June 2013.

3.14.1 Conclusion

The NRC staff has reviewed the licensee's decommissioning cost estimate and funding availability statement in its DP. The NRC staff concludes that the provision of this information satisfies the requirements of 10 CFR 50.82(b)(4)(iv) because the licensee has provided an updated cost estimate for the chosen alternative for decommissioning; the licensee has stated that there is full funding for this estimate in the current UB Capital Budget; and the licensee has provided a plan for assuring the availability of adequate funds by committing to provide a statement of intent pursuant to 10 CFR 50.75(e)(1)(iv).

4.0 ENVIRONMENTAL CONSIDERATION

The amendment associated with this DP involves changes in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or changes in inspection and surveillance requirements. The NRC staff has determined that this amendment involves no significant hazards consideration, no significant increase in the amounts, and no significant change in the types, of any effluents that may be released off site, and no significant increase in individual or cumulative occupational radiation exposure. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSION

The NRC staff has reviewed the licensee's proposed actions to decontaminate, dismantle, and dispose of component parts of the BMRC facility, 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 these levels, then the University of Buffalo's Facility License No. R-77 will be terminated.

Based on the NRC staff's review of the licensee's application for approval of decommissioning, the NRC 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 NRC 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 NRC staff concludes that the licensee provided acceptable organizational structure and control to decommission the BMRC facility while maintaining due regard for protecting the public, the environment, and workers from significant radiological risk. Furthermore, the NRC 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 NRC staff finds that the personnel training program that UB proposes is acceptable because its scope covers all aspects of the 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 NRC staff concludes that the accident analyses show potential radiological consequences to be well within acceptable limits.

The NRC 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 NRC staff concludes that the licensee has adequately described the radiological status of the BMRC 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 BMRC reactor. The NRC 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).

The NRC 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.

The NRC staff concludes that the licensee has provided, in accordance with 10 CFR 50.82(b)(4)(v), an acceptable description of the technical specifications, quality assurance provisions, and physical security plan provisions to be in place during decommissioning.

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

Pursuant to 10 CFR 50.82(b)(5), since the DP demonstrates that the decommissioning will be performed in accordance with Commission regulations and will not be inimical to the common defense and security or the health and safety of the public and since the appropriate notice has been previously provided to interested persons, the Commission approves the DP by amendment, subject to the change criteria specified in Chapter 9 of the DP.

Principal Contributors: Theodore B. Smith, FSME
Thomas Youngblood, FSME
Date: November 5, 2012