SUMMARY OF CHANGES

Revisions to the Decommissioning Plan will be tracked when revisions are issued. Changed sections will be identified by special demarcation in the margin and the revision number will be identified in the header of the modified pages. A summary description of each revision is noted in the following table.

Revision Number	Date	Description of Change
0	February 6, 2012	Initial Issue
1	May 31, 2012	The following pages were modified under Revision 1: Pages i-iv – Summary of Changes and Table of Contents Page 28 – Lowered the DCGL for Eu-152 to a value less than the EPA/NRC MOU consultation Trigger value. Page 43 – Added section to discuss DOT Function Specific Training for personnel involved with packaging and shipping radioactive materials. Page 47 – Added note to describe removal of Ra-226 as a radionuclide of concern. Page 48 – Provided additional detail of environmental monitoring program. Page 50 – Added column to Table 3-2 to list typical scan MDCs for instruments listed. Data obtained from BMRC Characterization data. Page 56 – Provided additional detail and clarification on potential radwaste packaging requirements for irradiated hardware. Page 59 – Provided additional detail on minimizing fire risk during D&D operations. Page 60 – Changes on page 59 changed layout of page. Page 61 – Refers reader to addition of Appendix D, FSS Plan. Page 65 – Added Student's t-test to list of statistical analyses available to use on FSS data. Page 71 – Added Student's t-test to list of statistical analyses available to use on FSS data. Appendix D – BMRC Final Status Survey Plan

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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.

2.2.3.2 Release Criteria for Soils

Characterization data indicates that there has been minimal impact to subsurface soils from operation of the reactor. Soils remaining in place will be shown to meet an annual TEDE of 25 mrem/yr by demonstrating the average volumetric activity is less than the NRC screening values as found in Appendix B of NUREG-1757, *Consolidated Decommissioning Guidance* and presented in Table 2-2. The Eu-152 screening value is greater than the EPA and NRC Memorandum of Understanding (MOU) consultation trigger of 7.0 pCi/g. Therefore, the Eu-152 value has been reduced to the value contained in Table 1, *Consultation Triggers for Residential and Commercial/Industrial Soil Contamination*, of the EPA/NRC MOU. The screening values are listed in picocuries per gram (pCi/g) of material.

Table 2-2 NRC License Termination Screening Levels for Surface Soils

Radionuclide	NRC Screening Value (pCi/g)
Ag-108m	8.2*
Am-241	2.1
C-14	12
Co-60	3.8
Cs-137	11
Eu-152	6.9**
Eu-154	8
H-3	110
Ni-63	2,100
Pu-238	2.5
Pu-239/240	2.3
Ra-226	0.7
Sr-90	1.7

*See Section 2.2.3.4 for derivation of Ag-108m screening value.
**Value selected that is less than EPA MOU Consultation Trigger Value.

2.2.3.3 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

subcontractors in accordance with the requirements of 10 CFR 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 pervious training and qualification 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, but is not limited to the following subjects:

- 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 19 and 20
- NRC license conditions and limitations
- Reporting requirements for workers
- Biological effects of radiation
- Radiation control zone procedures
- Radiation Work Permits (RWP)

A written exam will be required to demonstrate proficiency with the radiation worker training topics. 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

Persons who have documented equivalent radiation worker training from another site or employer within the previous twelve (12) months may be waived from taking the training but must take the written and practical factors examinations. Radiation Worker training will be refreshed on an annual basis or at the discretion of the RSO.

2.5.3 Function Specific DOT Training for Radioactive Material Shipments

In accordance with 49 CFR 172.704, *Training Requirements*, personnel involved in any aspect of packaging, labeling, marking, and/or shipping radioactive materials shall have documented training specifically applicable to the function the person performs.

3.0 PROTECTION OF WORKERS AND THE PUBLIC

3.1 Radiation Protection

The RPM, under the direct supervision of the RSO, will administer the Health Physics Program (also referred to as the Radiation Protection Program) specifically developed for the BMRC Decommissioning as described in Section 3.1.2. The DOC will supplement the radiation protection program with detailed plans and procedures specific to the radionuclides listed in Table 3-1. The RSO, the RPM and Decommissioning Health Physics (HP) Staff will be responsible for implementing ALARA principles; providing radiation worker training; establishing administrative-level occupational and public dose limits; monitoring personnel for occupational exposures; controlling exposures; providing and maintaining radiation monitoring equipment; performing radiation surveys and monitoring; and maintaining records and generating reports as necessary to comply with regulatory and licensing requirements.

Table 3-1 BMRC Radionuclides of Concern as determined in the Site Characterization Report

Radionuclide	Half Life (yr)	Emission	Area(s) of Interest
Ag-108m	4.38E+02	β, γ	Soil; Tank Water; SSCs
Am-241	4.32E+02	α, γ	Tank sediment
C-14	5.73E+03	β	Laboratory areas
Co-60	5.27E+00	β, γ	Soil; SSCs; Bioshield
Cs-137	3.01E+01	β, γ*	Soil; SSCs; Bioshield
Eu-152	1.36E+01	β, γ	Soil; SSCs; Bioshield
Eu-154	8.59E+00	β, γ	Soil; SSCs; Bioshield
H-3	1.23E+01	β	Soil; Bioshield and Tank Water
Ni-63	1.00E+02	β	Soil; SSCs; Bioshield
Pu-238	8.78E+01	α, γ	Tank sediment
Pu-239	2.41E+04	α, γ	Tank sediment
Pu-240	6.60E+03	α, γ	Tank sediment
Ra-226**	1.60E+03	α, γ	Discrete source
Sr-90	2.88E+01	β	SSCs; Ventilation systems; Soil

* γ emission from Ba-137m progeny.

**The Ra-226 source was removed from the building during the pre-decommissioning cleanout. Ra-226 was not detected in waste tank sludge analyses nor was it detected in a 10CFR61 waste classification analysis performed to determine radionuclides for shipping manifests during the pre-decommissioning cleanout. Therefore, this radionuclide has been removed from future consideration as a radionuclide of concern at the BMRC.

3.1.1 Ensuring ALARA Radiation Exposures

The DOC will prepare an RP and ALARA Plan that will incorporate provisions for minimizing occupational and public radiation exposures. This Plan will describe specific administrative and engineering controls that will be put in place during specific D&D project activities. Examples of administrative and engineering controls include limiting access to certain areas, mock-up training, use of remote-handling devices, temporary shielding, containment structures, portable HEPA filtered ventilation, and specialized protective equipment and respiratory protection.

3.1.2 Health Physics Program

The project Health Physics Program will be implemented under the authority of the RSO with the assistance of the DOC RPM. The Health Physics Program will satisfy the following commitments that should be 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 20 and ALARA.
- Monitor personnel internal and external exposure in accordance with 10 CFR 20 requirements.

3.1.2.1 Project Health Physics Program - General

UB has procedures in place that will be implemented during the BMRC Decommissioning Project. Specifically, the current radiation monitoring procedures for public exposure that document compliance with 10CFR20 limits will be implemented. The monitoring program utilizes environmental TLDs to monitor radiation exposure to the public at public boundaries. The program also monitors air and liquid effluents in accordance with the BMRC Technical Specification. A timely ALARA review of the monitoring program results should be conducted to ensure public exposure is ALARA. Additional Health Physics procedures may be required and will be developed and approved in accordance with UB policy.

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, is a direct report 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.

Decommissioning HP staff will select instrumentation that is sensitive to the minimum detection limits for the particular task being performed, but also with sufficient range to ensure that the full spectrum of anticipated conditions for a task or survey can be met by the instrumentation in use.

Consumable supplies will conform to manufacturer and/or regulatory recommendation to ensure that measurements meet desired sensitivity and are valid for the intended purpose.

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

Survey instruments will be stored in a common location under the control of BMRC Decommissioning HP Staff. A program to identify and remove from service inoperable or out-of-calibration instruments or equipment as described in HP procedures will be adhered to throughout the BMRC Decommissioning Project. Survey instruments, counting equipment, air samplers, air monitors and personnel contamination monitors will be calibrated at license-required intervals, manufacturer-prescribed intervals (if shorter frequency) or prior to use against standards that are traceable to the National Institute of Science and Technology (NIST) in accordance with approved calibration laboratory procedures, HP procedures, or vendor technical manuals. Survey instruments will be operationally checked daily when in use. Counting equipment operability will be verified daily when in use. The personnel contamination monitors are operationally tested on a daily basis when work is being performed.

3.1.2.5 Specific Health Physics Equipment and Instrumentation Use and Capabilities

Table 3-2 provides details of typical HP equipment and instrumentation planned for use in the BMRC Decommissioning Project. This list is neither inclusive nor exclusive. MDC equations for instruments used during the FSS are discussed in detail in the FSS Plan.

Table 3-2 Health Physics Instrumentation

Instrument	Detector Type	Radiation Detected	Calibration Source	Use	MDC Scan (Static) (dpm/100cm^2)
Ludlum Model 2221	Ludlum Model 43-68 Gas Proportional (126 cm^2 area)	Beta	Tc-99	Surface Static Measurements; Beta scan measurements	1539 (778)
Ludlum Model 2360	Ludlum Model 43-68 Gas Proportional (126 cm^2 area)	Alpha/Beta	Th-230/Tc-99	Alpha/Beta static measurements	1539 (778)
Ludlum Model 19	Internal NaI	Gamma	Cs-137	General area exposure rates	1 uR/hr
Ludlum Model 3030E	Ludlum Model 43-10-1 ZnS internal detector	Alpha/Beta	Th-230/Tc-99	Swipe/smear counting	Alpha – 16 Beta - 327

characterization data and activation analysis data for the reactor. Disposition pathways 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 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. After determination is made for disposal at N2S2, or another site, the Waste Management Plan is to be revised to incorporate the waste acceptance criteria for the disposal site.

Irradiated reactor hardware has been characterized by WMG with the results shown in Appendix A. As described in Section 4.0 of Appendix A, the irradiated hardware may exceed the definition of Low Specific Activity II (LSA-II), thus requiring the use of a DOT Type A shielded container such as a CNS 8-120A or equivalent. However, Section 4.0 of Appendix A also states that the results are identified as worst case components used as bounding conditions for decommissioning planning. More detailed surveys must be performed on individual items as they are removed to develop the specific shipping documentation and radiological profiles. Items may be loaded into a High Integrity Container (HIC) or liner prior to placement into an approved, shielded shipping container. Contaminated reactor system piping and hardware may be land disposed as LLRW. Pre-disposal volume reduction processing may be performed on site to facilitate loading or off site at a subcontracted processing facility.

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 a licensed land disposal facility. Concrete may also be eligible for processing using an option such as Tennessee's BSFR program. Mixed waste lead bricks will either be decontaminated and released, or processed for direct land disposal.

3.2.3.2 Liquid

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.

performed during decommissioning, the likelihood is low that a fire would start or that a fire could become intense enough to release radioactive material. The HASP will outline Hot Work protocols and a specific Hot Work Procedure shall be developed to ensure proper fire safety protocols are followed, including, but not limited to, the use fire retardant suits, fire watches, training, and documentation requirements.

During the pre-decommissioning cleanout project, approximately 38,800 lbs (267,000 lbs total waste) of combustible Dry Active Waste (DAW) was removed from the BMRC and shipped to a licensed facility in Tennessee. Additionally, paper documents from the time of operations were removed from the facility and stored in the EH&S building in preparation for the Interference Removal (Asbestos) Project.

The primary DAW generated during D&D would be personal protective equipment (i.e., disposable coveralls, gloves) and cleaning wipes. The DAW would have very low quantities of radioactive materials; therefore, the radioactivity is not high enough to result in a significant release to the environment in the case of a fire. Even though the risk of a serious fire event is low, a rigorous housekeeping campaign will be enforced during D&D. DAW generated during D&D will be collected and packaged to limit the volume of DAW available for consumption by fire and to lower the potential for a fire to consume additional waste collections. The EH&S Division of Fire and Life Safety of UB will perform routine fire loading inspections commensurate with decommissioning activities throughout the D&D process. The DOC and DC will also perform daily housekeeping tasks.

3.3.2 Spill Contaminated Water

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.

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.

3.3.3 Release of Airborne Contamination

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 bioshield is a wet process; therefore, 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.

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.

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.

3.3.4 Transportation Accidents

Various forms and quantities of radioactive waste will be shipped from the reactor during the D&D project. 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, adherence to NRC and DOT radioactive material packaging and transportation requirements is considered 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.

4.0 PROPOSED FINAL STATUS SURVEY PLAN

The following sections describe the methodology and QA requirements to be implemented during the FSS. The DOC is responsible for the planning and implementation of the FSS. Appendix D contains the BMRC FSS Plan to be implemented.

4.1 Survey and Sampling Approach

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 expected condition of the area post remediation will be exposed subsurface soils and bedrock. The non-porous bedrock, being similar to a concrete structure, will be surveyed using survey methodologies for surface release of concrete and the results compared to the NRC surface screening values. Prior to the FSS on bedrock material, the loose dirt and debris is to be removed to ensure there is no interference with the survey measurements. The BMRC Site Characterization report (ENERCON 2011) 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. There will be no BMRC buildings or structures that will require a FSS.

The FSS will be developed following the guidance provided in NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC 2000) to demonstrate compliance with the release criteria provided in 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 will be performed in accordance with an 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 NYS will be contained within the FSS Plan which will direct surveys or sampling efforts required to demonstrate compliance with such criteria.

The FSS may include surface gamma surveys using sodium-iodide (NaI) gamma scintillation detectors and gas flow proportional detectors. Surface soil samples will be collected using either a random-start grid pattern or randomly generated locations as appropriate commensurate to the classification of the survey area. Soil samples will be analyzed for contaminants of concern using standard analytical methods

4.4.3 Bedrock

The Neutron Deck of the BMRC was poured directly on the bedrock with no leveling material (e.g., gravel or sand) utilized between the bedrock and concrete. The bedrock, described in Section 8.0, is non-porous and similar to a concrete slab. Radiological impacts to the bedrock are expected to be limited to the surface and after the concrete is removed from the bedrock, loose material such as soil and concrete dust will be removed prior to the FSS.

4.4.4 Bedrock Surface Scans

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 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.

4.5 Data Evaluation

Data evaluation is 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, Student's t-test, and Wilcoxon Rank-Sum (WRS) test may be implemented as appropriate 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 DCGL, the Sign test will be used. If background is a significant fraction of the DCGL the WRS test will be used. It is anticipated that the sign test will be the only statistical test applied to the collected data because of the small fraction of the DCGL that background radionuclides will contribute.

9.0 CHANGES TO THE DECOMMISSIONING PLAN

Following NRC review and approval of the DP, the DP will be incorporated as an amendment to license R-77. Minor changes to the DP that do not change the original intent of the DP and which do not involve an unreviewed safety question may be approved by the Operating Committee, a sub-group of the RDSC, as defined in the BMRC Technical Specifications and this section. The licensee may make changes to the DP without prior NRC approval provided the proposed changes do not:

i. Require Commission approval pursuant to 10 CFR 50.59;
ii. Use a statistical test other than the Sign test, Student's t-test, or WRS test for evaluation of the FSS;
iii. Increase the radioactivity level, relative to the applicable derived concentration guideline level, at which an investigation occurs;
iv. Reduce the coverage requirements for scan measurements;
v. Decrease an area classification (i.e., impacted to unimpacted; Class 1 to Class 2; Class 2 to Class 3; or Class 1 to Class 3);
vi. Increase the Type I decision error;
vii. Increase the DCGLs and related MDCs (for both scan and fixed measurement methods); or
viii. Result in significant environmental impacts not previously reviewed.

If a significant change to the DP is required, the BMRC RDSC will apply the criteria identified in 10 CFR 50.59 (March 2001) as it applies to non-power reactors in decommissioning. Guidance on implementing the requirements 10 CFR 50.59 is provided in the following documents:

- NRC Regulatory Guide 1.187 Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments
- Nuclear Energy Institute (NEI) Guidance NEI 96-07, Guidelines for 10 CFR 50.59 Implementation, Revision 1, September 2000
- NRC Inspection Guidance (Part 9900)

If the RDSC determines that the change is significant and could pose a significant increase in potential worker, public, or environmental impacts, NRC approval will be obtained prior to implementing the change.

Changes to the DP are to be listed in the Summary of Changes table at the beginning of this DP with special demarcations in the margins next to the revised text. A report of changes made to the DP without NRC approval is to be maintained for review by the NRC during routine decommissioning inspections. Records of all changes to the DP are maintained until license termination.

APPENDIX D – BMRC FINAL STATUS SURVEY PLAN