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October 8, 2021

NRC Docket No. 030-02278

Mr. Michael LaFranzo
Senior Health Physicist
U.S. Nuclear Regulatory Commission, Region III
Division of Nuclear Materials and Safety
2443 Warrenville Road, Suite 210
Lisle, IL 60532

Re: CURATORS OF THE UNIVERSITY OF MISSOURI – COLUMBIA
SECOND RESPONSE TO LETTER DATED AUGUST 12, 2021
TECHNICAL REVIEW OF PICKARD HALL DECOMMISSIONING PLAN IN ACCORDANCE WITH 10 CFR § 30.36(G) UNDER LICENSE NO. 24-00513-32 (MAIL CONTROL #596692)

Dear Mr. LaFranzo:

By letter dated August 16, 2021, you provided the University of Missouri with 27 requests for additional information ("RAIs") and requested responses within 60 days. Since that time, we discussed the University providing responses to the RAIs on a rolling basis. We also discussed that some of the responses would require additional data collection that could not be completed within 60 days.

Attached please find the second set of responses which covers the following RAIs from your August 16 letter:

Items 2, 8, 12, 22, 25, 26, 27.

Sincerely,

Cade J. Register
Radiation Safety Officer

Attachments:
MU Responses to RAIs 10-8-2021.pdf
RAI 2 – University of Missouri Decommissioning Funding Plan.pdf
RAI 2 – University of Missouri Pickard Hall Phase III Characterization Survey Report.pdf
RAI 2 – University of Missouri Pickard Hall Pre-Decommissioning Characterization Report.pdf
RAI 27 – Pickard1 RRB Report – Small Enclosure.pdf
RAI 27 – Pickard2 RRB Report – Large Enclosure.pdf
RAI 27 – Pickard3 RRB Report – Small Enclosure 4ACH.pdf
RAI 27 – Pickard4 RRB Report – Large Enclosure 4ACH.pdf

NRC RAI Number 2.

During the site visit, the licensee provided NRC information that the documents referenced and used for NRC Acceptance Review evaluation were incomplete. This is due to, in part, the large number of documents submitted to NRC over the course of this project. The NRC is requesting that the licensee provide a complete list of all documents that have been submitted to NRC that are relevant to the Decommissioning Plan. If the licensee is relying on documents that have not been submitted to NRC, we are requesting that all such documents be provided so they can be properly reviewed.

RESPONSE:

ADAMS Accession Number	**Document**
ML102800311, ML102800322, ML102800330, ML102800336, ML102800398, ML102800412, ML102800427, ML102800430, ML102800436, ML102800441, ML102800450, ML102800452, ML102800455, ML102800458, ML102800463, ML102800467, ML102800563	"Pickard Hall Characterization Survey Report," July 2010
Attached	"University of Missouri Pickard Hall Phase III Characterization Survey Report," October 17, 2011
Attached	"University of Missouri Pickard Hall Pre-Decommissioning Characterization Report", December 11, 2020
ML20344A404	"University of Missouri Pickard Hall Pre-Decommissioning Soil Data Report", November 30, 2020
ML18298A298	PHDP Radiation Safety Manual
DP Appendix	"Pickard Hall Derived Concentration Guideline Levels for Soils," January 31, 2021
DP Appendix	"Pickard Hall Derived Concentration Guideline Levels for Structural Surfaces," January 31, 2021
DP Appendix	Wind Rose Diagrams
Attached	University of Missouri – Columbia Decommissioning Funding Plan

References:

"ANL/EAD-4 User's Manual for RESRAD-ONSITE Code Version 7.2," Environmental Assessment Division Argonne National Laboratory, September 14, 2017
"Air Monitoring Modeling of Radioactive Releases During Proposed PFP Complex Demolition Activities", Pacific Northwest Laboratory, January 2011
"Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil and Building Structures," ANLIEVSITM-14/4, Argonne National Laboratory September 2015
"Extraction of Radium from American Pitchblende Ores," Chemical News July 19, 1918
"Handbook of Health Physics and Radiological Health," 3rd Edition, 1998
"LaCrosse Open Air Demolition Limits", EnergySolutions, December 2015
"Methods For Estimating Fugitive Air Emissions Of Radionuclides From Diffuse Sources at DOE Facilities", US EPA September 3, 2004
"Open Air Demolition of Facilities Highly Contaminated with Plutonium", US DOE May 2007
"Technical Basis for Radiological Limits for Structure/Building Open Air Demolition," ZionSolutions March 2011
"The Environmental Transport of Radium and Plutonium: A Review," Institute for Energy and Environmental Research, June 23, 2006
"Decommissioning Health Physics: A Handbook for MARSSIM Users," Second Edition, Abelquist
ANL/EAD/03-1 "User's Manual for RESRAD-BUILD Version 3," June 2003
ANSI/HPS N13.12-2013, "Surface and Volumetric Radioactivity Standards for Clearance," May 2013
DOE-STD-1196-2011 "Derived Concentration Technical Standard," US Department of Energy, April 2011
USDA Plant Hardiness Zone Map, https://plants.usda.gov/hardiness.html, USDA
"Radiological and Chemical Properties of Uranium," Oak Ridge Institute for Science and Education
NUREG-1507 Revision 1, "Minimum Detectable Concentrations with Typical Radiation Survey for Instruments for Various Contaminants and Field Conditions," August 2020
NUREG/CR-5512 Volume 1, "Residual Radioactive Contamination from Decommissioning: Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent," August 1999
NUREG/CR-5512, Volume 2, "Residual Radioactivity from Decommissioning: Parameter Analysis," August 1999
NUREG/CR-5512, Volume 4, "Comparison of the Models and Assumptions used in DandD 1.0, RESRAD 5.61, and RESRAD-Build 1.50 Computer Codes with Respect to the Residual Farmer and Industrial Occupant Scenarios Provided in NUREG/CR-5512," August 1999
NUREG/CR-6676, "Probabilistic Dose Analysis Using Parameter Distributions Developed for RESRAD and RESRAD-BUILD Codes," Nuclear Regulatory Commission, July 2000
NUREG/CR-6697, "Development of Probabilistic RESRAD 6.0 and RESRAD-BUILD 3.0 Computer Codes," Nuclear Regulatory Commission, November 2000
NUREG-1549, "Decision Methods for Dose Assessment to Comply with Radiological Criteria for License Termination," July 1998
NUREG-1575, Rev. 1, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), August 2000
NUREG-1720 "Re-evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for NRC's License Termination Rule," June 2002

NUREG-1757, Supplement 1 “Consolidated NMSS Decommissioning Guidance: Updates to Implement the License Termination Rule Analysis,” September 2005
NUREG-1757, Volume 1, Rev. 2 “Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees,” September 2006
NUREG-1757, Volume 2, Rev. 1 “Consolidated NMSS Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria,” September 2006
NUREG-1757, Volume 3, Rev. 1 “Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness,” February 2012

References for 8/16/2021 RAIs:

Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)
NRC Regulatory Guide 8.37 “ALARA Levels for Effluents from Materials Facilities”
NRC Regulatory Guide 4.15 “Quality Assurance for Radiological Monitoring Programs (Inception Through Normal Operations to License Termination) – Effluent Streams and the Environment”
NRC Regulatory Guide 4.14 “Radiological Effluent and Environmental Monitoring at Uranium Mills”
NRC Information Notice 94-07 “Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20”
Pacific Northwest National Laboratory PNNL-15870 “Compendium of Material Composition Data for Radiation Transport Modeling”
Ebadian, M.A.; Boudreaux, J.F.; Dua, S.K.; Williams, P.T.; “Technology Assessment of Dust Suppression Techniques Applied During Structural Demolition” US DOE Office of Fossil Energy, DE-FG21-95EW55094, 1995-1996
Midwest Regional Climate Center https://mrcc.purdue.edu/
R: A Language and Environment for Statistical Computing, R Core Team, R Foundation for Statistical Computing, Vienna, Austria, 2021, https://www.R-project.org
National Council on Radiation Protection Report 123: “Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground” January 22, 1996
US EPA EPA/630/R-97/001 “Guiding Principles for Monte Carlo Analysis” March 1997
US EPA OSWER 9285.6-10 “Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites” December 2002
US FEMA 329 “Debris Estimating Field Guide”
US Nuclear Regulatory Commission NUREG-1475 Revision 1 “Applying Statistics”
US Nuclear Regulatory Commission Regulatory Guide 3.59 “Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations”
US Nuclear Regulatory Commission Regulatory Guide 4.20 “Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees Other Than Power Reactors”
US Nuclear Regulatory Commission NUREG 1640 “Radiological Assessments for Clearance of Materials from Nuclear Facilities”

References Specific to Pickard:

“About the Museum” Museum of Art and Archaeology-University of Missouri. University of Missouri, 2013. Web. Apr. 2014
“Construction History of Pickard Hall: MU in Brick and Mortar,” Construction History of Pickard Hall. N.p., 2003. Web. Apr. 2014

“Experiments on the Extraction and Recovery of Radium from Typical American Carnotite Ores,” The University of Missouri Bulletin, Volume 24, Number 26, September 1923
“MU Swallow Hall Renovation Cost Opinion,” SIRCAL Contracting, March 25, 2014
“Pickard Hall” MU in Brick and Mortar, University of Missouri, 24 Oct. 2006. Web. Apr. 2014
“Subsurface Investigation, Soil Analysis and Foundation Design Recommendations for the University of Missouri Donald J. Reynolds Journalism Institute,” Engineering Surveys and Services, June 25, 2004
Asbestos Overview, Pickard Hall, University of Missouri, April 10, 2014
“Herman Schlundt’s Legacy.” Missourian [Columbia] 16 July 2013.
Hazardous Building Materials Survey, University of Missouri, October 2019
Renovation of the Old Chemistry Building. 15 Feb. 1974. Renovation Proposal by Hoffman/Saur and Associates, Inc.
Nightingale, Dorothy V., Emeritus Professor of Chemistry. A History of the Department of Chemistry University of Missouri-Columbia 1843-1975. 1975. University of Missouri Archives. Columbia, Missouri.
"Pickard Hall Geotechnical and Hydrological Report, Engineering Surveys & Services," March 11, 2020
“2019 Annual Drinking Water Quality Report,” University of Missouri Public Water System
www.como.gov/utilities/stormwater/education/do-you-know-your-watershed
www.census.gov
NowData, https://www.weather.gov/ohx/nowdata, NOAA

NRC RAI Number 8.

Under 10 CFR 30.36(g)(4)(iii), the licensee must provide a description of methods used to ensure protection of workers and the environment against radiation hazards during decommissioning. In Section 7.0 “Planned Decommissioning Activities” of your document dated February 8, 2021, it is stated that, in part, conditions that are outside of the scope of the DP will require work to stop, the condition/issue stabilized and the NRC notified. However, there is no mention of what the licensee will do to continue radiological remediation afterwards. In addition, it is unclear what is to be reported to the NRC. Thus, the NRC is requesting additional information on how the licensee intends to continue with remediation and how and what information is to be provided to the NRC if such a work to stop is initiated.

RESPONSE:

If work is stopped due to a condition outside the scope of DP, the work area will be placed in a safe configuration and MU will promptly notify the NRC. The affected work will not resume until the condition has been corrected and proper controls have been established. Work re-start will be authorized by the Chase RSO with MU RSO and NRC concurrence. Work that is not affected by the stoppage may continue as long as continuance of work will not cause or exacerbate adverse conditions. If work is stopped due to a weather condition such as wind speed or precipitation, work may resume without NRC concurrence when the weather condition no longer exists and it is safe to resume work.

The NRC notification will be by phone and e-mail and will include, at a minimum, the following information:

- Reason(s) for stopping work
- Description of the circumstances leading to the work stoppage
- Actions taken to place the entire site (or affected portion of the site, as applicable) in a safe configuration
- Pertinent radiological data and impact to worker doses, public doses, or releases to the environment
- Proposed corrective actions and timeline

NRC RAI Number 12.

Under 10 CFR 30.36(g)(4)(iii), the licensee must, in part, provide a description of methods used to ensure protection of the environment against radiation hazards during decommissioning. Section 7.2.5 "Backfill and Site Restoration" of your document dated February 8, 2021 states, in part, "Upon completion of the FSS and NRC verification surveys, the excavation will be backfilled with approved, imported backfill materials." However, there is no other information to define the approval process of backfill materials. Specifically, the NRC is concerned that radiologically or other hazardous contaminated material could be placed within the excavated site which could compromise the protection of the environment against radiation hazards. Thus, the NRC is requesting information on the process and analytical procedures to ensure that radioactively contaminated material is not reintroduced into the excavation area. The NRC would also like to state that other regulatory bodies, such as Agencies and Departments within the State of Missouri, may be interested in the non-radiological hazard analysis for materials to be introduced into the excavated area. The NRC would have no objection if the licensee provided those non-radiological hazard analysis in its response.

RESPONSE:

MU and Chase intend to use three protocols to ensure only appropriate imported material is used as backfill.

First, MU will contractually require the supplier to provide backfill material that does not contain debris, solid waste, or free liquids, and Chase will visually observe the material upon arrival onsite to confirm those conditions.

Second, the Chase Project Manager will evaluate the backfill material's historical and current uses. If the historical review concludes that the material has a potential to have been contaminated with a hazardous material at any time, then Chase will reject the material and it will not be used as backfill.

Third, Chase will scan the material for radioactivity. Certain soils or geologic formations may contain elevated naturally occurring radioactivity. The backfill material will be scanned by a Chase Radiation Control Technician using a 2" x 2" sodium iodide detector, using the scanning techniques approved for the Pickard Hall Decommissioning Plan (PHDP) final status survey. The survey may occur either in-situ at the donor site or upon arrival at the Pickard Hall site prior to placement into the excavation. Any detectable audible increase in the count rate above background count rates will be investigated and the MU RSO will make a decision regarding the suitability of the material for use as clean fill to ensure that residual radioactivity is below the level to obtain an unrestricted release of the site; however, any material with count rates above two times the average count rate for soils in the background reference area will not be used as fill.

NRC RAI Number 22.

Under 10 CFR 30.36(g)(4)(ii), the licensee shall provide a description of planned decommissioning activities. In previous correspondence to the NRC, the licensee had requested the NRC review methods for approval of radioactive waste disposal under10 CFR 20.2002. As a result of that request, the NRC opened a licensing action under Mail Control No. 608968. However, the documentation provided associated with this review did not address such an action. The NRC is requesting that the licensee either retract its 10 CFR 20.2002 request or provide additional information to support the NRC review.

RESPONSE:

On May 30, 2018, MU submitted a request for alternate disposal of licensed radioactive waste. The request was acknowledged by the NRC on August 3, 2018 (mail control number 608968). MU is no longer pursuing alternate disposal of licensed material and hereby retracts that request. Accordingly, please terminate the separate licensing action mentioned in the RAI.

NRC RAI Number 25.

Under 10 CFR 30.36(g)(4)(iii), the licensee must provide a description of methods used to ensure the protection of workers and the environment against radiation hazards during decommissioning. Section 8.2.1 of the PHDP, it is indicated that the RSO will issue radiation work permits (RWPs), but the issuance of RWPs is not listed as a responsibility of the University RSO as detailed in Section 8.3.3, and is listed as a responsibility of the contractor radiation control supervisor (RCS) in Section 8.3.5. It is not clear which activities are the responsibility of the licensee RSO and which activities are the responsibility of the contractor's radiation safety staff. The NRC is requesting delineation of duties and responsibilities for the licensee radiation safety staff and the contractor radiation safety staff. In addition, the organizational chart provided in Section 8.0 identifies a Project Manager from the licensee but the PHDP does not provide any information associated with this individual's duties and responsibilities. The NRC is requesting to include this information when revising Section 8 of the PHDP.

RESPONSE:

Positions and qualifications of the decommissioning organization are described below.

Director of MU Campus Facilities Planning, Design, and Construction

The Director of MU Campus Facilities Planning, Design, and Construction (MU CF-PDC) reports to the MU Vice-Chancellor of Operations. The Director MU CF-PDC maintains fiduciary and contractual responsibilities for the PHDP. Contractually, Chase reports to the Director of MU CF-PDC via the MU Project Manager.

MU Project Manager (MU PM)

The MU PM has no direct radiation protection responsibilities. The MU PM reports to the MU CF-PDC and is responsible for managing contractual aspects of the project; coordinating MU support; administering contracts; and tracking PHDP scope, schedule and budget performance.

MU Environmental Health & Safety Director

The MU EHS Director has overall responsibility for development and implementation of all MU EHS programs including occupational safety, radiation safety, industrial hygiene, biological safety, and environmental management. The EHS Director will ensure all EHS resources are available as needed to oversee project activities to ensure they are completed safely and compliantly.

MU Radiation Safety Officer (RSO)

The MU RSO is responsible for overseeing implementation of the PHDP radiation protection program by Chase and ensuring that PHDP activities do not result in a violation of the MU broad scope license. The MU RSO has the responsibility and authority to stop any plan or activity that has the potential to result in an unacceptable radiological condition.

Chase Project Manager (Chase PM)

The Chase PM is responsible for task radiological operations from initiation through completion. The Chase PM reports to the MU PM for contractual obligations and to the Chase RSO for regulatory obligations. The Chase PM is responsible for daily implementation of the Radiation Protection Program (RPP). The PM's duties include the following:

- Maintaining working conditions which assure health, safety, and protection for all project personnel, visitors and the environment;
- Maintaining compliance with conditions of operating licenses, permits, rules, regulations and company procedures;
- Ensuring that employees are provided physical examinations as required by company policy, local, state and federal regulations;
- Ensuring that PHDP personnel are instructed regularly, or as required by law, on precautions, procedures and practices to be followed to minimize exposure to radioactive materials and to conduct operations safely;
- Notifying the Chase RSO and the MU RSO promptly, of any operation or condition which appears to present a radiological hazard to PHDP personnel, the public, the environment or exceed limitations set forth in the Radiation Safety Manual (RSM) or applicable procedures and work plans;
- Furnishing proper personnel protective equipment (PPE);
- Ensuring that PHDP personnel are instructed in the proper use of PPE and enforcing rules for the equipment's utilization;
- Ensuring the project has sufficient staffing to conduct daily operations in compliance with regulatory requirements; and
- Maintaining project radiation exposures ALARA.

The PHDP PM will possess at least a B.S. Degree and more than 10 years combined experience in decommissioning, project management, and radiation safety with at least ten (10) of the years specific to radioactive materials decommissioning. The PM will also have familiarity with applicable federal and state regulations, MARSSIM and NRC decommissioning guidance.

Chase Radiation Safety Officer (Chase RSO)

The Chase RSO bears ultimate responsibility to manage and oversee radiological safety under the PHDP. The Chase RSO has the responsibility and authority to stop any plan or activity that has the potential to result in an unacceptable radiological condition. The following duties and responsibilities will be assigned to the Chase RSO, or designee:

- Overseeing the implementation of the PHDP RPP by Chase Radiation Control Supervisors;
- Reviewing and approving radiation safety procedures to ensure compliance with the RSM;

- Ensuring compliance with terms and conditions of the Chase radioactive materials license pertaining to the PHDP;
- Developing, maintaining and implementing procedure, recordkeeping and program audits;
- Overseeing the training and qualification program;
- Ensuring personnel assigned to licensed activities are qualified and competent; and
- Serving as a point of contact with the NRC for events such as the loss, theft or damage of radioactive material.

Chase Radiation Control Supervisor (RCS)

The RCS reports directly to the PM for day-to-day supervision and is approved by the Chase RSO for field implementation of the radiation protection program at the PHDP. If an RCS is not designated for a task, the PM will assume duties of the RCS as approved by the Chase RSO. The responsibilities of the RCS include but are not limited to the follow:

- Monitoring on-site operations to ensure compliance with the RSM;
- Implementing radiological monitoring programs;
- Tracking worker doses;
- Determining appropriate PPE for project personnel;
- Issuing respiratory protection where applicable;
- Ensuring that the Chase RSO and MU RSO are notified of conditions or situations that present a radiological hazard, concern or exceed limitations set forth in the RSM or applicable procedures and work plans;
- Issuing Radiological Work Permits (RWP) to govern work involving radioactive material; and
- Maintaining records related to the RPP in an auditable condition for the duration of the project.

The RCS will possess at least an associate degree in science or engineering and have at least two years of experience in the use or handling of radioactive material or demonstrate equivalency of this requirement to the satisfaction of the Chase RSO.

Chase Radiation Control Technician (RCT)

RCTs report to the RCS and act as the RCS's representatives in specifically implementing the RPP. Responsibilities include but are not limited to the following:

- Performing and documenting radiological surveys;
- Maintaining, inspecting and performing operational checks of field instrumentation;
- Identifying and controlling radiation protection hazards;
- Tracking worker doses;

- Ensuring that the Chase RSO and MU RSO are notified of conditions or situations that present a radiological hazard, concern or exceed limitations set forth in the RSM or applicable procedures and work plans; and
- Performing job coverage duties, (i.e., surveys, contamination control, air sampling, sample analysis, environmental sampling, custody control, etc.)

RCTs will possess at least one year of working experience in radiation protection or demonstrate equivalency to this requirement to the satisfaction of the Chase RSO.

Chase Radwaste Manager (RM)

The Radwaste Manager is specifically trained and qualified to package, survey, and ship radioactive materials. The RM reports to the PM and is responsible for implementing the requirements set forth in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material." This person is responsible through direct performance, observation, or receipt of written notification for the following:

- Verifying that the consignee is licensed to receive the shipment of radioactive material and that the material meets the consignee's specific acceptance criteria;
- Preparing and submitting advance notification if required by the receiving facility;
- Obtaining the necessary variances in the event that a shipment does not comply with the consignee's general acceptance criteria;
- Performing various physical tasks necessary to complete the shipment; These tasks include, but are not limited to, the following:
    - Inspecting packages;
    - Marking packages;
    - Labeling packages;
    - Loading and shoring packages;
    - Surveying packages and conveyance;
    - Placarding transport vehicles; and
    - Inspecting transport vehicles.
- Preparing shipping documentation including radiological survey data: the Broker will ensure that the materials are properly classified, described and are otherwise appropriate for shipment in accordance with the requirements of 10 CFR Part 71; and
- Verifying that radiation protection equipment used to perform surveys is calibrated, response checked and functioning properly.

The RM will have a minimum of two years of applicable experience in radioactive material shipping and possess verifiable training in accordance with 49 CFR Part 172, Subpart H "Training" and be approved by the PM.

Radiation Worker (RW)

Radiation Workers are individuals who have received training for unescorted access into Restricted Areas to perform work where they may receive exposure to ionizing radiation. A Radiation Worker’s responsibilities include but are not limited to the following:

- Obeying all posted, verbal, and Radiation Work Permit (RWP) instructions;
- Wearing dosimetry as required;
- Tracking and controlling one’s own radiation exposure;
- Minimizing exposure;
- Not eating, drinking or smoking in areas where dispersible radioactive material may be present; and
- Utilizing contamination control techniques to prevent the spread of radioactivity.

NRC RAI Number 26.

Title 10 CFR Part 20.1402 states in part that, "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year…and the residual radioactivity levels have been reduced to levels that are as low as reasonably achievable (ALARA). Determinations must take into consideration any detriments, such as deaths due to transportation accidents, expected to potentially result from decontamination and waste disposal." Section 6.0 of the PHDP, states that an ALARA analysis is not required due to the licensee's conservative decision to demolish the building and ship the demolition debris and remediated soils offsite for disposal. This statement is Section 6.0 seems to be in conflict with the requirement of 10 CFR 20.1402. The NRC is requesting information associated with an ALARA analysis in accordance with the regulation above.

RESPONSE:

Because the RAI relies on 10 CFR § 20.1402, MU interprets this RAI to focus on whether additional soil will need to be excavated and disposed of offsite beyond what is needed to meet the 25 mrem standard, to meet ALARA principles. As stated in the PHDP, MU plans to remove all demolition debris and contaminated soil and ship off-site for disposal. Also as stated in the PHDP, after removal of the demolition debris and remediation of the soils to meet the 25 mrem standard, remaining soils and any adjoining structures will be surveyed and MU will evaluate whether a quantitative ALARA analysis according to NUREG-1757, Volume 2, Chapter 6 and Appendix N is required.

The decision to remediate will be based on the goal of optimizing the proper balance between costs and benefits below the dose limit of 25 mrem/yr. To achieve a proper balance, each cost and benefit factor will be considered. The decision to remediate will be based, at a minimum, on consideration of the potential dose averted, remediation cost, occupational safety risk, transportation safety risks, and public interest factors.

NRC RAI Number 27.

Under 10 CFR 30.36(g)(4)(iii), the licensee must provide a description of methods used to ensure the protection of workers and the environment against radiation hazards during decommissioning. Section 7.1.1. *Pre-Demolition Source Reduction*, sub-paragraph titled *Concrete Cutting*, states in part that “negative pressure enclosures will follow the minimum air changes per hour requirement described in OSHA's asbestos exposure regulations”. The NRC is requesting justification for using the asbestos air exchange rates. As the NRC understands the situation sampling of the concrete for asbestos was conducted; and the areas where asbestos was determined to be present have been remediated. In addition, the NRC is requesting clarification of the status of asbestos in Pickard Hall and the use of the asbestos air exchange criteria.

RESPONSE:

Status of Asbestos in Pickard Hall

Asbestos floor tiles and mastic were removed from the concrete floors in the basement in 2020. Minor amounts of asbestos remain in Pickard Hall that are not impacted by radioactive materials and will be removed prior to building demolition.

Justification for Use of the Asbestos Air Exchange Criteria

The asbestos air exchange criteria was used in modeling the expected dose to workers from dust generated during basement concrete removal activities. As described below, Chase modeled the smallest and largest enclosures using the four air changes per hour from OSHA’s asbestos exposure regulations. This modeling showed that using the OSHA air exchange criteria would, even assuming conservative modeling inputs, results in minimal radiation dose to workers. Therefore, it is appropriate to use the minimum air changes per hour requirement described in OSHA's asbestos exposure regulations.

Prior to cutting the floor slab to access underlying soils, concrete surface radiological contamination will be remediated to the extent practical using shrouded equipment with HEPA-filtered exhausts. Based on previous concrete surfacing operations, it is expected that surface radiological contamination can be effectively removed to limit the potential for spread of radioactivity during concrete cutting. Concrete cutting will use wet methods that have been demonstrated to be effective for controlling dusts.

Chase developed a dose model using RESRAD-BUILD version 3.5 to estimate the doses associated with concrete cutting within the smallest and the largest enclosures listed in Table 7-1 of the Pickard Hall Decommissioning Plan Rev. 1 (PHDP). Surface contamination was assumed to be present at the average levels measured during characterization of the floors in the former radium processing room (16,823 dpm/100 cm^2); this is conservative because lower surface contamination levels are present in other areas where cutting will occur and floor surfaces will be remediated prior to concrete cutting. Activity in soils underneath the slab is not significant relative to the surface contamination on the floors.

Input parameter values were selected to conservatively represent the saw cutting activities. A summary of the parameter values is provided in the table below. Detailed descriptions are provided after the table.

Dose Model Parameter Value Summary

Parameter	Symbol	Value	Comments
Dose/Risk Library	N/A	FGR-11	Consistent with 10 CFR 20
Time Parameters			
Exposure Duration (days)	TTIME	5	5 workdays of cutting
Indoor Fraction	FTIN	0.333	8 hours per workday
Evaluation Times (years)	DOSE_TIME	0.0000, 0.0027, 0.0082, 0.0137	0, 1, 3, and 5 days
Time Integration Max #of Points for Dose/Risk	POINT	17	RESRAD-BUILD Default
Building Parameters			
Number of Rooms	NROOM	1	
Deposition Velocity (m/s)	UD	0.01	RESRAD-BUILD Default
Resuspension Rate (1/s)	DKSUS	5.00E-7	RESRAD-BUILD Default
Building Exchange Rate (1/hr)	LAMBDAT	Small 90 Large 4.5	Smallest and Largest Enclosures from PHDP Table 7-1
Area (m^2)	AREA	Small 9 Large 46	Smallest and Largest Enclosures from PHDP Table 7-1
Height (m)	H	3	10 ft Ceiling Height
Receptor Parameters			
Receptor #	ND	1	
Room #	DLVL	1	
Time Fraction	TWGHT	0.33	8 hr/day

Parameter	Symbol	Value	Comments
Breathing Rate (m^3/d)	BRTRATE	38.4	NUREG-5512 Default for Renovation Scenario
(Indirect) Ingestion Rate (m^2/hr)	INGE2	0	NUREG-5512 Default for Renovation Scenario
Location (x,y,z in meters)	DX	Small 1.5, 1.5, 1 Large 3, 3.25, 1	Center of Enclosure, Midpoint of Receptor
Source Parameters			
Source #	NS	1	
Room	SLVL	1	
Type	STYPE	Area	
Direction	SDIR	Z	
Location (x,y,z in meters)	SX	Small 1.5, 1.5, 0 Large 3, 3.25, 0	Center of Enclosure on Floor
Source Geometry		Rectangular	Rectangular Enclosure
Source Length X (m)	Used to Calculate Source Area (SAREA)	1.6	Square Root of Surface Area to be Cut
Source Length Y (m)		1.6	Square Root of Surface Area to be Cut
Air Fraction	AIRFR	1	All Particles Assumed Respirable
Direct Ingestion (1/hr)	INGE1	0	Engineering Controls, PPE and Hygiene Practices Prevent Ingestion Doses
Removable Fraction	RMVFR	1	Activity is assumed to be 100% Removable
Lifetime (days)	RF0	365	Significantly Longer than Cutting Time to Limit Source Reduction in the Model
Radon Release Fraction	N/A	0.2	RESRAD-BUILD Default Emanation Rate

Dose Conversion Factors (FGR-11)

The dose conversion factors are based on Environmental Protection Agency (EPA) Federal Guidance Reports (FGR) No. 11 and No. 12. These dose factors were selected to ensure consistency with 10 CFR Part 20.

Exposure Duration (5 days)

The exposure duration was selected based on the number of days of cutting assuming a production rate of 320 linear feet per day. The floor slab is assumed to be cut into 1.5 ft x 1.5 ft squares. The calculations are presented in the table below.

Room	Length (ft)	# of Length Cuts	Width (ft)	# of Width Cuts	Total Length of Cuts (ft)	Days of Cutting (320 ft/day)
12	25	18	25	18	900	2.8
17A/Corridor	34	7	8	24	430	1.3
27	13	10	13	10	260	0.8
				Total	**1,590**	**5.0**

Indoor Fraction (0.333)

The indoor fraction of 0.333 was selected based on 8 hours of continuous cutting per 24-hour workday, which exceeds the amount of time per day that Chase will perform any basement floor slab cutting.

Evaluation Times (0.0000, 0.0027, 0.0082, and 0.0137 years)

Evaluation times were set at various times (0, 1, 3, and 5 days) during the cutting to evaluate trends.

Time Integration (17)

The default number of points used in integrating the dose rate over the exposure duration to achieve convergence criteria is set at the RESRAD-BUILD default of 17.

Number of Rooms (1)

Only one enclosure is modeled at a time. The smallest and largest enclosures were modeled one at a time.

Deposition Velocity (0.01 m/s)

The RESRAD-BUILD default deposition velocity of 0.01 m/s is accepted because values are not published for conditions similar the conditions within the enclosures and this parameter is relatively insensitive in the model.

Chase performed sensitivity analysis on the deposition velocity parameter by running the model with deposition velocities of 0.1 m/s and 2.7E-6 m/s. The value of 0.1 m/s is the maximum value in the User's Manual for RESRAD-BUILD Version 3 Figure J.3 (graph of deposition velocity vs. particle size) and of the value of 2.7E-6 m/s is the minimum value for the default probabilistic distribution. The maximum resulting dose was less than 2% higher than the result using the default parameter value; therefore use of the default value is appropriate.

Resuspension Rate (5E-7/s)

The RESRAD-BUILD default resuspension rate of 5E-7/s is accepted because values are not published for conditions similar the conditions within the enclosures and this parameter is relatively insensitive in the model.

Chase performed sensitivity analysis on the resuspension rate parameter by running the model with resuspension rates of 5E-5/s and 5E-9/s. The maximum resulting dose was less than 2% higher than the result using the default parameter value; therefore use of the default value is appropriate.

Radiological Units (dpm)

Units of disintegrations per minute (dpm) were chosen to be consistent with standard surface contamination units.

Dose (mrem)

Units of mrem were chosen to be consistent with NRC dose-based release criteria.

Building Exchange Rate (90 per hour for smallest enclosure and 4.5 per hour for largest enclosure)

The enclosure air exchange rate is set to 90 for a small enclosure and 4.5 for a large enclosure based on the rates listed in Table 7.1 of the PHDP.

Room Area (9 square meters for smallest enclosure and 46 square meters for largest enclosure)

The Room Area is based on the sizes of the enclosures listed in Table 7.1 of the PHDP.

Room Height (3 meters)

The Room Height is based on a ceiling height of 10 ft, which is representative of the basement ceiling height. Higher ceiling heights do not exist in the basement.

Receptor, Room and Time Fraction (1)

The Receptor, Room, and Time Fraction are all set to one because the model consists of one receptor (worker) in one room (enclosure). The receptor is placed at the center of the source so the model will calculate the maximum dose to any receptor that may be within the enclosure.

Receptor Inhalation Rate (38.4)

The inhalation rate was set to match the breathing rate of the renovation scenario in NUREG/CR-5512.

Receptor Indirect Ingestion Rate (0 m^2/hr)

The indirect ingestion rate is set to 0 because engineering controls, PPE and standard hygiene practices will be used. For the NUREG/CR-5512 renovation scenario it is assumed that ingestion is only from the direct contact with the source.

Receptor Location (1.5 meters, 1.5 meters, 1 meter for smallest enclosure, and 3 meters, 3.25 meters, 1 meter for largest enclosure)

The receptor was placed to calculate the dose in the center of the modeled enclosure at a height midpoint on the receptor. For example, the model input was 1.5 meters from the edges of the smallest enclosure and 1 meter in height.

Shielding Thickness (0)

The shielding thickness was set to zero because it is assumed that no shielding exists between the occupant and the surface contaminated layer.

Source Number and Room Number (1)

The Source Number and Room Number were set to one because only one source in one room is modeled.

Source Type (Area)

The Source Type was set to "Area" because the source consists of surficial contamination on building structural surfaces.

Source Direction (Z)

The source direction was set to "Z" because the source is modeled as surficial contamination on the floor.

Source Location (1.5 meters, 1.5 meters, 0 meter for smallest enclosure and 3 meters, 3.25 meters, 0 meter for largest enclosure)

The source location was set to the floor in the center of the room.

Geometry (Rectangle)

The source is modeled as a square; this conservatively concentrates the source activity within the enclosure. The actual source geometry of long, thin saw cuts is not compatible with the enclosure geometry in the model.

Length Along X and Y (1.6 m)

The source is modeled as a square that covers the floor. The length along the axes is the square root of the source area. The source area is calculated by multiplying the saw kerf (0.005 m) and the linear feet of saw cuts (1,590 ft or 482 m) which will occur over five days. Because residual radioactivity will be encapsulated, the only loose material will be material that is in the cut line.

Air Release Fraction (1)

For conservatisms, all of the source is assumed to be released into the air in the respirable particulate range.

Direct Ingestion Rate (0 per hour)

Because engineering controls, PPE, and hygiene practices will be used, direct ingestion rate is set to 0.

Removable Fraction (1)

All of the source term activity is assumed to be removable during saw cutting.

Time for Source Removal or Source Lifetime (365 days)

The source lifetime is conservatively set to 365 days.

Radon Release Fraction (0.2)

The RESRAD-BUILD default radon emanation rate of 0.2 is used.

Radionuclide Concentration (1 dpm/100 cm^2 with 88.8% Ra-226, 8.6% Th-nat, 2.6% U-nat)

An activity concentration of 1 dpm/100 cm^2 (100 dpm/m^2) is input to develop a scaling factor to relate surface activity concentrations to an annual TEDE. Nuclides with very short half-lives relative to the parent are implicit in the parent activity in RESRAD-BUILD. The initial inputs are presented in the table below.

Nuclide	dpm/m^2
Ra-226	88.8
Pb-210	88.8
Po-210	88.8
Th-232	8.6
Ra-228	8.6
Th-228	8.6
U-238	2.6
U-234	2.6

Th-230	2.6
U-235	0.125
Pa-231	0.125
Ac-227	0.125

RESRAD-BUILD Results

The results from RESRAD-BUILD dose modeling are presented in the table below.

Output Report	Enclosure Size	RESRAD-BUILD Result (mrem/yr per dpm/100 cm^2)	Average Total Surface Activity (dpm/100 cm^2)	TEDE (mrem)
Pickard1	Small	8.10E-05	16,823	1.4
Pickard2	Large	3.03E-04	16,823	5.1

These results are conservative because conservative parameter values were selected and the enclosures will be designed to direct air flow away from the workers breathing zone.

Chase additionally modeled the smallest and largest enclosures with an air exchange rate of 4/hr. It should be noted that an air exchange rate of 4/hr for the small enclosure cannot be achieved due to the high flow rate of a negative air machine relative to the volume of the enclosure. The results are presented in the table below.

Output Report	Enclosure Size	RESRAD-BUILD Result (mrem/yr per dpm/100 cm^2)	Average Total Surface Activity (dpm/100 cm^2)	TEDE (mrem)
Pickard3	Small	1.72E-03	16,823	28.9
Pickard4	Large	3.40E-04	16,823	5.7