



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, ILLINOIS 60532-4352

August 16, 2021

Mr. Cade Register, M.H.P.
Radiation Safety Officer
Curators of the University of Missouri – Columbia
c/o Gary Ward Vice Chancellor of Operations
900 East Stadium Blvd., Suite 180
Columbia, MO 65211

SUBJECT: CURATORS OF THE UNIVERSITY OF MISSOURI – COLUMBIA, REQUEST FOR ADDITIONAL INFORMATION – TECHNICAL REVIEW OF PICKARD HALL DECOMMISSIONING PLAN IN ACCORDANCE WITH TITLE 10 OF THE CODE OF FEDERAL REGULATIONS 30.36(G) UNDER LICENSE NO. 24-00513-32 (MAIL CONTROL NUMBER 596692)

Dear Mr. Register:

This letter is in response to your submittal of a Decommissioning Plan dated November 8, 2019 (ML19312C596) and additional supporting documents dated May 7, 2020 (ML20140A114), November 30, 2020 (ML20344A404) and February 8, 2021 (ML21048A144). The NRC had reviewed the above documents and accepted the Decommissioning Plan for Technical Review as documented in NRC letter dated February 24, 2021 (ML21055A770). To support our Technical Review of the Decommissioning Plan, the NRC performed a site visit on July 13 and 14, 2021 to discuss the contents of the documents.

Upon further review, the NRC has determined that the following additional information is needed to complete our Technical Review of the Decommissioning Plan:

1. In your letter dated February 2, 2021, it is stated, in part, that the assessment results indicated that the nuclides of concern are Ra-226, U-238, Th-232 and progeny. In your latest License Amendment 124, there does not appear to be a reference to U-238, Th-232 or progeny that are authorized for possession incident to decommissioning activities. In addition, Ra-226 is authorized for 100 millicuries total. The NRC is requesting that the licensee estimate the quantity of U-238, Th-232 and progeny and re-evaluate the estimated Ra-226 within Pickard Hall so the license can be updated to reflect the type and quantity of licensed material under the license.
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.

3. Under Title 10 of the Code of Federal Regulations (CFR) 30.36(g)(4)(v), the licensee must provide, in part, a detailed cost estimate for decommissioning. Section 12.1, page 43 of 478 of your letter dated February 8, 2021 states, in part, that the estimated volume of building debris waste is 5,500 cubic yards. However, there is no information to support those volume estimates. Table 16-1 "Decommissioning Cost Estimate" shows that the estimated waste transportation and disposal costs are over 50% of the total cost of the project of just under \$12 million. With the lack of specific information provided, the NRC believes that the 25% contingency may be insufficient. Thus, the NRC is requesting that additional information on the volumetric analysis be provided to justify the estimated 5,500 cubic yards of estimated waste.
4. Under 10 CFR 30.36(g)(4)(v), the licensee must provide, in part, a detailed cost estimate for decommissioning. Section 12.1, page 43 of 478 of your letter dated February 8, 2021 states, in part, soil volumes are expected to be 70 cubic yards from the steam feed tunnel and beneath rooms 12, 17A and 27 and a total volume estimated for the project is 600 cubic yards of soil assuming an average of one-foot of soil is removed across the entire site. However, there is little information to support the 70 cubic yard estimate. In addition, the licensee has not provided information that an average of one-foot of soil removed across the entire site would be adequate to meet NRC's unrestricted release criteria. Thus, the NRC is requesting that additional information on the volumetric analysis be provided to justify the soil volumes as noted above.
5. Under 10 CFR 30.36(g)(4)(iii), the licensee must provide, in part, a description of methods used to ensure protection of the environment against radiation hazards during decommissioning. In Section 3.9.2.2 "Perched Groundwater" in your documented dated February 8, 2021, it states, in part, that isolated areas of "perched" groundwater (i.e., wet soils) were encountered about 7ft below the Pickard Hall basement floor slab and that there are no drinking water wells or any other known uses of water from perched groundwater beneath MU. The NRC is requesting that the licensee demonstrate that residual radioactive material either A) has not reached the perched and, thus, a radiological dose assessment concerning groundwater is not necessary or B) the licensee provide a radiological dose assessment which would meet NRC release criteria for the site. Also, the licensee is requested to provide information that remediation efforts to include, but not limited to, soil removal would not impact the perched groundwater.
6. Under 10 CFR 30.36(g)(4)(i), the licensee must provide, in part, a description of the conditions of the site sufficient to evaluate the acceptability of the decommissioning plan. In Section 4.4 "Contaminated Building Structures and Systems" in your letter dated February 8, 2021, it states, in part, that characterization surveys indicate that residual radioactivity exists within the steam tunnel feeder floor. During NRC's site visit, there was discussion that contamination could have extended beyond the steam tunnel into a connected utility tunnel. In addition, there was no discussion of potential residual radiological contamination in the soil under the steam tunnel nor along piping and cables leading to and from Pickard Hall which could "channel" contamination along the exterior or interior of the piping or cabling. The NRC is requesting that an evaluation of potential contamination within the utility tunnel and potential soil contamination under the steam tunnel be evaluated to show that all reasonable pathways for residual radiological contamination have been identified.

7. 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 5.4 “Radiological Criteria – Demolition” of your letter dated February 8, 2021, it was stated that there were multiple technical documents reviewed relating to Open-Air Demolition to include sites such as the Department of Energy Hanford Site, Connecticut Yankee Nuclear Power Plant, Zion Nuclear Power Station and LaCrosse Boiling Water Reactor decommissioning projects. However, the NRC did not identify specific comparisons between those projects and Pickard Hall decommissioning project. Specifically, the licensee did not address the different nuclides and doses to workers and members of the public nor the close proximity to those populations, especially members of the public as Pickard Hall stands near the middle of campus with adjacent University buildings, businesses and members of the public. Since it is NRC’s understanding that Pickard Hall is planned to be demolished with heavy machinery, a large dust plume can be generated, possibly with residual radioactive material contained within, and the close proximity of members of public make it more likely that members of the public could receive an unnecessary dose as a result. Thus, the NRC is requesting the licensee provide specifics of the monitoring systems, how they will be used and their capabilities considering the environment they are being used into to show that such monitoring can effectively identify residual contamination. The licensee is also requested to provide additional information associated dust suppression effectiveness, again, considering the type of demolition anticipated and the close proximity to members of the public.
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.
9. Under 10 CFR 30.36(g)(4)(i), the licensee must provide a description of the condition of the site sufficient to evaluate the acceptability of the plan. In Section 7.2.4 “Demolition” of your document dated February 8, 2021, it states, in part, “Calculations indicate that timber floor joists are loaded to their maximum safe capacity and it appears that the cast iron columns have been overloaded for many years with respect to recognized codes and practice. While the masonry bearing walls appear to be in relatively good condition, renovations and building construction must be considered when developing the demolition work plan.” It goes on to state “Demolition debris must not be allowed to collect in mass on the upper floors to avoid further overloading and potential floor and/or building collapse.” During the site visit, the licensee verbally provided the NRC information that structural integrity of the building has been addressed and may not be overloaded at this time. The NRC considered the building to be a significant barrier to prevent radioactive material from being released into the environment and potentially unnecessarily exposing members of the public to radiation and radioactive material. The NRC is requesting information associated with the building’s current structural load capabilities to ensure that remediation efforts do not inadvertently cause a floor and/or building collapse.

10. Under 10 CFR 30.36(g)(4)(iii), the licensee must provide a description of methods used to ensure the protection of the environment against radiation hazards during decommissioning. Section 7.2.4 "Demolition" of your document dated February 8, 2021 states, in part, "Any water entering the excavation site will be collected, filtered, and sampled to verify that the water can be discharged to the sanitary sewer system in accordance with 10 CFR Part 20."

Section 11.0 "Environmental Monitoring and Control Program" documents that heavy rains could bring an estimated 10,000 gallons of water per day to the site, water treatment equipment would be sized to ensure 12,000 gallons/day can be treated on site and water awaiting approval for discharge will be stored in 20,000 gallon tanks onsite.

However, there is no data to show how the estimated 10,000 gallons of water per day was arrived at, nor information on how much water could be generated by dust suppression during remediation or demolition or how long such water would need to be retained prior to discharge. In addition, there is no information on the type of filtering system to be used to ensure that discharges of residual contamination are considered water soluble. Thus, the NRC is requesting the licensee provide additional information on: A) a calculated and defensible estimate of the quantity of water to be collected, filtered and sampled; B) an adequate storage system available to ensure that water that is collected, filtered and sampled appropriately prior to discharge; C) the type of filtration system to be used to ensure discharges of residual contamination are considered water soluble.

11. Under 10 CFR 30.36(g)(4)(iii), the licensee must provide a description of methods used to ensure the protection of the environment against radiation hazards during decommissioning. Section 7.2.4 "Demolition" of your document dated February 8, 2021 states, in part, "To limit water infiltration from rain, a tent structure may be installed, if feasible, once demolition has progressed enough to facilitate installation." However, the NRC did not find any information on the conditions under which a tent structure would be installed nor the effectiveness of such a tent structure to limit water intrusion. Thus, the NRC is requesting that the licensee provide conditions under which the tent shall be installed, the potential effectiveness of such a system to limit water intrusion and how such a system would impact the licensee's ability to collect, store, filter and sample water to be discharged.
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.

13. Under 10 CFR 30.36(g)(4)(iii), the licensee must, in part, provide a description of methods used to ensure the protection of the environment against radiation hazards during decommissioning. Section 7.4 "Soils" in your document dated February 8, 2021, states, in part, "Soils will be remediated using appropriately excavation equipment during spot extraction to avoid over excavation and increasing disposal costs; equipment may consist of hand shovel, mini excavator, or large diesel-powered excavator depending on scope and complexity." Although it is not anticipated that hand shoveling would have a significant impact on inadvertent ground disturbance, mini excavators and large diesel-powered excavators could, while in the course of normal movement, cause residual contamination to be pushed deeper into the soil, especially if the soil is saturated with water, thereby moving residual contamination deeper into the ground. The licensee has already stated in Section 3.9.2.2 "Perched Groundwater" that there may be as little as 7 feet of soil between the basement of Pickard Hall which would imply that radioactive material does not need to travel far before reaching a water saturated zone which could transport licensed material beyond the Pickard Hall footprint requiring additional evaluation. Thus, the NRC is requesting the licensee evaluate the impact of soil moving equipment on residual radioactive material transport and keeping it from moving to the perched groundwater.
14. Under 10 CFR 30.36(g)(4)(iii), the licensee must, in part, provide a description of methods used to ensure the protection of the environment against radiation hazards during decommissioning. Section 7.5 "Groundwater and Surface Water" of your letter dated February 8, 2021 states "There are no identified surface waters or groundwater being used or located at or near Pickard Hall. Therefore, decommissioning activities will not impact surface or groundwater." However, Section 3.9.2.2 of this documented titled "Perched Groundwater" seems to contradict the Section 7.5 statement. The NRC requests the licensee clarify Section 7.5 to address perched water.
15. 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 8.1 "Decommissioning Management" contains Figure 8-1: "Pickard Hall Decommissioning Organization" which provides titles and diagram schematic of the Pickard Hall management structure to include an "MU Project Manager." However, a further review of the document does not list what the background or responsibilities of the MU Project Manager are or will be which, presumably, is to help ensure the protection of workers and the environment against the radiation hazards during decommissioning. The NRC requests that the licensee provide education and experience background of the MU Project Manager and include the responsibilities during the decommissioning process.
16. 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 9 "Occupational Health and Safety Program" of your document dated February 8, 2021 states the "Utilities to the building will be verified de-energized before demolition." Failure of the licensee to de-energize all utilities could result in flooding or a fire which could spread radioactive material outside the confines of Pickard Hall and unnecessarily increase radiation hazards to workers, members of the public and environment. The NRC is requesting that the licensee designate an appropriate manager that will verify and certify the de-energization before demolition.

17. 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 10.1 "Air Sampling Program" of your document dated February 8, 2021, it states, in part, "The RSO will apply professional judgement and experience to identify air sampling appropriate for the specific situation." The NRC is requesting the licensee provide more specifics regarding realistic scenarios and plans to deploy the air monitoring systems throughout the decommissioning process. In addition, the NRC is also requesting a process for which unanticipated circumstances where air monitoring would be necessary.
18. 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 10.2 "Respiratory Protection Program" in your document dated February 8, 2021 states "The PHDP respiratory protection program is consolidated into the PHDP RSM." Section 10.3 "Internal/External Exposure Determination and Summation", Section 10.6 "Clearance of Materials" and Section 14.3 "Survey Instrumentation" also refer the user to the PHDP RSM for the details associated with each of these programs above the summaries provided in the sections. The NRC is requesting the licensee submit the PHDP RSM for review.
19. 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 10.5 "Notifications" in your letter dated February 8, 2021 states, in part, The RSO will make notifications to the NRC as required. The NRC is requesting clarification on which notifications the section is referring (such as NRC regulations, policy in the MU radiation protection program, etc...).
20. 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 10.7 "Audits and Inspection" documents that the licensee will provide audits and surveillances to monitor and document compliance at a frequency of periodically. The NRC is requesting the licensee provide further detail on the definition of periodically and base it, in part, on the timeframes anticipated to perform certain critical decommissioning activities.
21. Under 10 CFR 30.36(g)(4)(vi), the licensee shall, for decommissioning plans calling for completion of decommissioning later than 24 months after plan approval, include a justification for the delay. Appendix E "Conceptual Project Schedule" in your document dated February 8, 2021 has estimated dates of start and completion for various portions of the Decommissioning Plan. However, during the site visit, the licensee indicated that there was not consideration for potential delays within the project schedule (e.g.: Weather events such as wind and rain). The NRC is requesting that the licensee provide information addressing any realistic scenario regarding potential delays in each significant area of the decommissioning project.
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 under

10 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.

23. Under 10 CFR 30.36(g)(4)(i), the licensee shall, in part, provide a description of the condition of the separate building sufficiently to evaluate the acceptability of the plan. In your document dated February 8, 2021, there are radionuclides of concern identified – Natural Uranium, Natural Thorium, Separated Radium -226, Separated Radium-228, U-238 and daughters, U-238 and daughters (excluding Ra-226 and daughters), Uranium Tailings, Thorium tailings, Th-232 and daughters., Ra-226 (with and without daughters), etc. The NRC has noted that the radionuclides of concern and the ratios of nuclides are inconsistent throughout this document and others submitted for NRC review. The NRC is requesting the licensee provide a consistent list of the radionuclides of concern and ratios of those nuclides across the documents.
24. 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. NUREG 1757 Volume 1, *Consolidated Decommissioning Guidance*, Table B.2, *Screening Values (pCi/gm) of Common Radionuclides for Soil Surface Contamination* provides values for the identified nuclides of concern that equate to the 25 mrem/year limit and allows the use of the sum of the fractions to determine the appropriate value for a mixture of radionuclides. Rather than use these values, perform the calculation, and establish a value for the site, the contractor chose to provide a calculated value based on extrapolation of Pu-239 data. Also, in discussions with the licensee and contractor during the on-site visit, the NRC was told this was done to “correct for the relative radiological risk.” The NRC is requesting the licensee provide justification of the use of the calculated value based on Pu-239 beyond what was provided in Section 5.0 *Demolition Removeable Activity Limit* of the PHDP; quantify the bounds of the environmental conditions, factors that support the correction for relative risk and the bounds of the reduction in radiological risk as part of the justification to use the extrapolated Pu-239 values; and include information that demonstrates the value used will not exceed the 25 mrem/year limit.
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.

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 in 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.
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.

The NRC understands that due to certain inaccessibility of areas either under the building or within the building structure, the licensee may not be able to provide all the specific information requested. If that is the case, the NRC is requesting that the licensee provide methods, policies, and/or procedures that would address any reasonable unknowns to protect the workers, members of the public and the environment.

Concerning Appendix E "Conceptual Project Schedule," within ID 22 is the licensee indicating that the NRC review and approval of the FSS report is scheduled for 120 days. Although the NRC plans to review and approve the licensee FSS plan as quickly as possible, the NRC shall not agree to a 120-day review and approval timeframe.

The NRC reserves the right to request additional information in future correspondence based upon further review of the Decommissioning Plan or the responses provided by the licensee requested in this letter.

To ensure timely review of your Decommissioning Plan, please review the appropriate NRC guidance associated with the above Request for Additional Information and provide as complete information as possible.

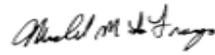
NRC is requesting that the information above be provided within 60 days of the date of this letter. If a response is not received within that time or the response is inadequate, the NRC shall consider whether additional actions are necessary.

If you have any questions concerning the decommissioning process or the requirements for the decommissioning of your facility, you may contact Michael LaFranzo of the Materials Control, ISFSI, and Decommissioning Branch at 1-630-829-9865.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter will be available electronically for public inspection in the NRC's Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC's website at <http://www.nrc.gov/reading-rm/adams.html>.

Any correspondence regarding the decommissioning of your facility should reference the control number specified below, and your license number.

Sincerely,



Signed by LaFranzo, Michael
on 08/16/21

Michael M. LaFranzo, Senior Health Physicist
Materials Control, ISFSI and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket No. 030-02278
License No. 24-00513-32
Mail Control No. 586692

Letter to Cade Register from Michael LaFranzo dated August 16, 2021.

SUBJECT: CURATORS OF THE UNIVERSITY OF MISSOURI – COLUMBIA, REQUEST FOR ADDITIONA INFORMATION – TECHNICAL REVIEW OF PICKARD HALL DECOMMISSIONING PLAN IN ACCORDANCE WITH TITLE 10 OF THE CODE OF FEDERAL REGULATIONS 30.36(G) UNDER LICENSE NO. 24-00513-32 (MAIL CONTROL NUMBER 596692)

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