OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ADDITIONAL INFORMATION

REGARDING TECHNICAL SPECIFICATION AMENDMENT FOR

THE UNIVERSITY OF MISSOURI-COLUMBIA RESEARCH REACTOR

LICENSE NO. R-103; DOCKET NO. 50-186

By letter dated July 20, 2015, the University of Missouri at Columbia staff requested an amendment to the Technical Specifications (TSs), Appendix A, of Facility Operating License No. R-103, for the University of Missouri at Columbia Research Reactor (MURR) ("the licensee"). The Nuclear Regulatory Commission (NRC) staff has reviewed the information provided and determined that additional information is needed. Provide a response, or justify why no additional information is needed, for the following:

1. The amendment request appears to contain a numbering discrepancy as it contains two Sections numbered 6.0, and Sections 5.1 and 5.2 follow after Section 6.0. Indicate if the second occurrence of Section 6.0 should be numbered Section 7.0, and if Sections 5.1 and 5.2 should be numbered 6.1 and 6.2, or advise if otherwise.

2. NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," Part 1, Section 11.1.1, "Radiation Sources," provides guidance that licensees should provide conservative estimates of external radiation fields in occupied or accessible areas.

    a. For normal operation of the proposed experiment, provide estimates of external doses to personnel that will occur during movement of irradiated targets from the irradiation position to the handling hot cell (HHC).

    b. For normal operation of the proposed experiment, provide estimates of external dose rates in accessible areas near the HHC, the processing hot cell (PHC), and the dispensing hot cell (DHC). Provide estimates of the timeframes over which these dose rates will exist.

    c. Provide estimates of the external dose rates from I-131 processing waste stored in the HHC and PHC.

    d. For normal operation of the proposed experiment, provide estimates of external doses to personnel that will occur during handling of the final product solution following its removal from the DHC.

    e. Discuss the compliance of the values provided for items a. through d., above, with the limits in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20.

Enclosure

3. NUREG-1537, Part 1, Section 11.1.1.1, “Airborne Radiation Sources,” provides guidance that licensees should estimate the release of airborne radionuclides to the environment during normal operation, and should use these releases to determine consequences in the offsite environment. Section 2.0 of the amendment request states that experiments have shown that less than 10 microcuries of Iodine-131 (I-131) could escape from the dry distillation process system “when scaled to a weekly maximum activity process.”

   a. Provide a basis or explanation for the limit of 10 microcuries of I-131.

   b. Provide an estimate of the maximum quantity of I-131 that could be released from the process system to the PHC during normal processing of each irradiated target, and the total quantity of I-131 that could be released to the PHC over a one-year period of normal operation of this experiment.

   c. Provide an estimate of the quantities of I-131 released to the environment from normal processing of irradiated targets, and calculate the maximum predicted concentration of airborne I-131 in unrestricted areas, as well as the timeframes over which this concentration will exist.

   d. Discuss the compliance of the values provided for item c., above, with the limits in 10 CFR Part 20.

4. NUREG-1537, Part 1, Section 13.1.6, “Experiment Malfunction,” provides guidance that licensees analyze the consequences of experiment failures. MURR’s license amendment request, Section 6.0, states that failure of the proposed experiment could result in airborne releases of I-131 to the PHC. Section 5.1 of the amendment request provides estimates of external dose consequences in the restricted area due to I-131 captured on charcoal filters or passing through ventilation systems following a release into the PHC. Section 5.2 of the amendment request provides estimates of dose consequences in the unrestricted area following a release of I-131 into the PHC.

   a. For an experimental failure resulting in a release of 150 curies of airborne I-131 into the PHC, the license amendment request does not appear to consider the external dose consequences in accessible portions of the restricted area near the PHC. Provide calculated dose rates near the PHC for this scenario, and estimate the timeframes over which personnel will be exposed to these dose rates.

   b. Estimates of external dose consequences in the restricted area due to I-131 captured on charcoal filters or passing through ventilation systems following a release of I-131 to the PHC do not appear to include any contribution due to plating of I-131 within the ventilation ductwork. Provide an estimated maximum dose rate in accessible areas from I-131 plated in the hot cell ventilation ductwork, for the allowable combination of online/offline filters that will result in the highest dose rates.

c. Assumptions used for some of the inputs in the dose estimates (using MicroShield, version 8.02) of external dose consequences in the restricted area due to I-131 captured on charcoal filters are not clearly described. Describe how the filter specifications provided in Attachments 7 and 8, are translated to the "Source Dimensions," "Dose Points," and "Shields," inputs used for the dose calculations for the following:

   i. the CAMFIL filters used in Filter Banks Nos. 1, 2, and 3; and
   ii. the Flanders/CSC filters used in Filter Bank No. 4.

d. Dose estimates in the unrestricted area following a release of I-131 into the PHC were provided for the emergency planning zone (EPZ) boundary using the Pasquill-Guifford (P-G) dispersion model methodology. However, dose calculations for the nearest residence were performed using the COMPLY code. It is not clear how the different methodologies used may affect the estimated dose results. Provide information demonstrating that the dose estimates are consistent using either methodology.

e. The offsite dose estimates do not indicate whether the calculations assumed an instantaneous release, or a release over some time period. Provide the release type and/or rate of release used in the dose calculations.

f. The COMPLY offsite dose calculations use wind rose data from the Columbia Regional Airport for the period from 1984 to 1992. However, other inputs and assumptions used in the calculations are not provided. For the calculations, provide the following:

   i. the stability class(es) used;
   ii. the release height or effective release height(s) used;
   iii. whether, and how, topography is accounted for;
   iv. whether, and how, building wake effects are accounted for;
   v. the exposure timeframe considered;
   vi. the inhalation rate(s) used;
   vii. the dose conversion factor(s) used; and,
   viii. whether the calculated doses include committed effective dose equivalent (CEDE) from inhalation, submersion, or both.

g. The P-G offsite dose calculations specify that D stability class and a southern wind direction are assumed, but other inputs and assumptions used for the calculations are not provided. For the calculations, provide the following:

   i. the wind speed(s) used;
   ii. the release height or effective release height(s) used;
   iii. whether, and how, topography is accounted for;
   iv. whether, and how, building wake effects are accounted for;
   v. the inhalation rate(s) used; and,
   vi. whether calculated doses include CEDE from inhalation, submersion, or both.

h. The P-G offsite dose calculations specify that the dose conversion factors used are from NRC Regulatory Guide (RG) 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluation Compliance with 10 CFR 50, Appendix I." However, more widely-used and current dose conversion factors are available, such as those provided in Environmental Protection Agency Federal Guidance Report (EPA FGR) No. 11, "Limiting Values of Radionuclide Intake

and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion." The NRC staff noted that, for I-131 inhalation, NRC RG 1.109 lists a whole-body dose conversion factor of 6.92E-10 Sieverts per Becquerel (Sv/Bq); whereas, EPA FGR No. 11 lists a more conservative whole-body dose conversion factor of 8.89E-9 Sv/Bq. Justify the use of the less conservative dose conversion factors listed in RG 1.109.

i. The P-G offsite dose calculations indicate that the D stability class provides the most conservative results. However, the NRC staff notes that depending on the release height or effective release height(s) used for the P-G calculations, the D stability class may not be most conservative for some downwind locations. NRC RG 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," recommends that for atmospheric dispersion calculations for the first eight hours following a release, F stability and a windspeed of 1 meter/sec with uniform direction should be used to provide sufficiently conservative results. Additionally, the NRC staff is interested if the highest calculated doses could occur beyond the EPZ boundary (150 meters from the stack) or the nearest residence (760 meters from the stack), depending on stability class. Provide justification (such as sample calculations performed for varying stability classes for varying locations downwind, including locations between the EPZ boundary and the nearest residence, and beyond the nearest residence) as to why the following parameters were chosen to be most conservative:

    i. D stability class; and,
    ii. EPZ boundary and nearest residence receptor locations (include a map showing the EPZ, nearest residence, and the boundary (beyond the EPZ) under the evacuation control of the licensee, if possible).

5. NUREG-1537, Chapter 14, "Technical Specifications," and American Nuclear Standards Institute/American Nuclear Society (ANSI/ANS)-15.1-2007, "The Development of Technical Specifications for Research Reactors," provides guidance that tests to establish carbon filter efficiency should be performed annually to biennially, and following major maintenance. The licensee's proposed TS 5.7, Specification e, states, in part, that carbon filter efficiency measurements shall be performed biennially.

    a. The proposed TSs do not appear to include a requirement that carbon filter efficiencies be tested following major maintenance. Provide an explanation.

    b. Attachment 8 of the amendment request stated that the lifetime of carbon filters "can be as long as" five years. While new carbon filters are unlikely to exhibit a significant decrease in efficiency for the first two years following installation, a marked decrease in efficiency could occur between years 2 to 4, or years 4 to 6. Provide a justification to support biennial surveillance testing for carbon filters after two years of use.

    c. Section 2.0 of the amendment request states that some I-131 could escape to the PHC during normal I-131 processing. Provide an explanation of how long-term routine releases of I-131 to the carbon filters could reduce the carbon filter efficiency over time.

    d. Describe the process that will be used to perform carbon filter efficiency measurements.

6. The amendment request, Section 2.0, states that the non-fueled irradiation targets for I-131 production will be doubly encapsulated. However, no TS requirements have been proposed to require double encapsulation of non-fueled irradiation targets for this process. Provide an explanation.

7. The proposed MURR TS 3.11, Specification d, requires three charcoal filter banks with an efficiency of at least 99 percent to be operable when I-131 is being processed in the PHC.

   a. It is not clear if the 99 percent requirement pertains to each individual filter bank, or to all operable (three) filter banks collectively. Explain.

   b. It is not clear if the 99 percent requirement pertains to a mechanical efficiency, a chemical adsorption efficiency, or a total (mechanical plus chemical) decontamination efficiency. Explain.

   c. It is not clear what form(s) of I-131 (elemental, organic, or particulate) the 99 percent requirement pertains to, and whether these form(s) are representative of what would be expected for I-131 adsorbed on the carbon filters following a release of I-131 to the PHC. Explain.

   d. It is not clear what temperature and humidity the 99 percent requirement pertains to, and whether this temperature and humidity is representative of what would be expected for I-131-contaminated air passing through the carbon filters following a release of I-131 to the PHC. Explain.

   e. MURR's license amendment request, Attachment 8, specifies that the Flanders/CSC filters used in Filter Bank No. 4 have a mechanical efficiency of at least 99.9 percent. However, the NRC staff is not clear how this value compares to the total (mechanical plus chemical) efficiency of these filters for their use as described in MURR's license amendment request. Explain.

   f. MURR's license amendment request, Attachment 7, provides specifications for the CAMFIL filters used in Filter Bank Nos. 1, 2, and 3. However, the NRC staff is not clear if the vendor provides efficiency ratings (mechanical, chemical, or total) for the CAMFIL filters for their use as described in MURR's license amendment request. Explain.

   g. NRC RG 1.52, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," provides guidance that a 99 percent carbon filter decontamination credit should be taken, provided that carbon filters comply with certain criteria. Clarify if these criteria are being met by providing the following additional information for the carbon filters used in Filter Banks 1 through 4:

      i. total bed depth;
      ii. rated flow rate; and,
      iii. residence time associated with the rated flow rate.

8. The amendment request discusses the possible consequences of an accidental release of I-131 to the PHC. However, I-131 releases outside of the hot cells do not appear to be discussed in the amendment request.

a. Discuss whether any experiment failure could cause an I-131 release during target irradiation.

b. Discuss whether any experiment failure could cause an I-131 release during movement of irradiated targets from the irradiation position to the HHC.

c. The NRC staff noted, in Attachment 25, Section 6.4, of the licensee's letter dated January 28, 2015 (ADAMS ML15034A474), an evaluation for a spill of I-131 solution outside the hot cells. However, this accident does not appear to be discussed in the amendment request. Provide an explanation.

d. Discuss whether any experiment failure, other than those indicated in items a., b., or c., above, or in responses to those items, could cause an I-131 release outside of the hot cells.

9. Accidental airborne releases of any radioactive materials other than I-131 (such as other isotopes of iodine, or activation products of target impurities), or toxic materials, inside or outside the hot cells do not appear to be discussed in the amendment request. Discuss whether other failures exist that could cause these releases to occur at any point during the experiment.

10. The NRC staff noted that the proposed MURR TS 3.6, Specification p, limits the I-131 inventory of a non-fueled experiment to 150 curies. However, the current MURR TS 3.6, Specification c, appears to limit non-fueled experiments to "that amount of material such that the airborne concentration of radioactivity averaged over a year will not exceed the limits of Appendix B, Table I of 10 CFR Part 20. Exception: Fueled experiments (See Specification 3.6.a)." Explain how the limits of TS 3.6, Specification c, and proposed TS 3.6, Specification p, are satisfied for the proposed Iodine production.

11. The proposed TS 3.11, Specification c, lists Radiation Monitoring Channels in a table, with item no. 2 identified as the Iodine-131 Processing Hot Cells Radiation Monitor. The amendment request, Section 5.0, "Radiation Monitoring Equipment," refers to a I-131 Processing Laboratory Exhaust Duct Monitor for each hot cell, and also describes the ALMO-6 Hot Cell Dose Rate Radiation Monitor, which is a six detector system that includes one detector location at the operator's work station of each of the three hot cells, and one detector located in each of the bays above the three hot cells.

    a. Clarify whether the I-131 Processing Laboratory Exhaust Duct Monitors for each of the three hot cells are the same as the three detectors "located in each of the bays above the three hot cells."

    b. Clarify whether the Iodine-131 Processing Hot Cells Radiation Monitor in proposed TS 3.11, Specification c, item no. 2, refers to the detector "located in each of the bays above the three hot cells," for the PHC only, to the detectors "located in each of the bays above the three hot cells," for all three hot cells, or to the entire six-detector ALMO-6 Hot Cell Dose Rate Radiation Monitor system.

    c. Provide a basis for the TS requirement of one, rather than two, operable radiation monitors above each hot cell.

12. The proposed TS 3.11, Specification c, Exception, provides information which allows the use of a portable monitor as a substitute for the monitors listed in the accompanying table. It is not clearly described in the TS or Basis how a portable monitor will be capable of providing all the functions of the permanently installed monitors as described in Section 5.0 of the amendment request, e.g., audible and visual alarms, display and record of output, etc. Explain.

13. The proposed TS 5.7, Specifications c and d, require that the radiation monitors listed in proposed TS 3.11, Specification c, be calibrated semi-annually and tested monthly. Provide a basis for these surveillance requirements.

14. The current revision of the MURR Emergency Plan is Revision 17, dated October 17, 2014. Given the changes to the facility as described in the amendment request, discuss whether any changes are needed to the MURR Emergency Plan.