March 11, 2016

Mr. Ralph Butler, Executive Director
University of Missouri-Columbia
Research Reactor Center
1513 Research Park Drive
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI—COLUMBIA ISSUANCE OF AMENDMENT NO. 37 TO AMENDED FACILITY LICENSE NO. R-103 TO CHANGE THE TECHNICAL SPECIFICATIONS IN ORDER TO PRODUCE RADIOACTIVE IODINE-131 (TAC NO. MF6514)

Dear Mr. Butler:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 37 to Amended Facility License No. R-103 for the University of Missouri-Columbia Research Reactor. The amendment consists of changes to the technical specifications, in response to your application dated July 20, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos.: ML15203A862; ML15203A867; ML15203A851; and ML15203A855), as supplemented by letters dated December 30, 2015, January 8, 2016, and February 19, 2016 (ADAMS Accession Nos.: ML16004A150, ML16011A388, and ML16055A023, respectively).

The safety evaluation supporting Amendment No. 37 is enclosed. If you have any questions, please contact me at 301-415-0893, or by electronic mail at Geoffrey.Wertz@nrc.gov.

Sincerely,

/RA/

Geoffrey A. Wertz, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186

Enclosures:
1. Amendment No. 37 to
   Amended Facility License No. R-103
2. Safety Evaluation

cc: See next page

Mr. Ralph Butler, Executive Director
University of Missouri-Columbia
Research Reactor Center
1513 Research Park Drive
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DATE	2/4/2016	2/4/2016	2/4/2016	3/10/2016	2/22/2016	3/11/2016

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Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

UNIVERSITY OF MISSOURI-COLUMBIA

DOCKET NO. 50-186

AMENDMENT TO AMENDED FACILITY LICENSE

Amendment No. 37
License No. R-103

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

   A. The application for an amendment to Amended Facility License No. R- 103, filed by the University of Missouri-Columbia (the licensee) on July 20, 2015, as supplemented by letters dated December 30, 2015, January 8, 2016, and February 19, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended, (the Act) and the Commission's rules and regulations set forth as stated in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;.

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission.

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

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

   E. This amendment is issued in accordance with the regulations of the Commission as stated in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," and the licensee has satisfied all applicable requirements.

   F. Prior notice of this amendment was not required by 10 CFR 2.105, "Notice of Proposed Action," and publication of a notice for this amendment is not required by 10 CFR 2.106, "Notice of Issuance."

2. Accordingly, the license is amended by changes to the technical specifications as indicated in the enclosure to this license amendment, and paragraph 3.B of Amended Facility License No. R-103 is hereby amended as follows:

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 37, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Alexander Adams, Jr., Chief
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Amended Facility License
and Appendix A, "Technical Specifications"

Date of Issuance: Date March 11, 2016

ATTACHMENT TO LICENSE AMENDMENT NO. 37

AMENDED FACILITY LICENSE NO. R-103

DOCKET NO. 50-186

Replace the following page of Amended Facility License No. R-103 with the revised page. The revised page is identified by amendment number and contains a vertical line indicating the area of change.

Amended Facility License

Remove	Insert
3	3

Attachment

A. Maximum Power Level

The licensee may operate the reactor at steady state power levels up to a maximum of 10 MWt.

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 37, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

C. Physical Security Plan

The licensee shall maintain and fully implement all provisions of the Commission's approved physical security plan, including amendments and changes made pursuant to the authority of 10 CFR 50.54(p). The approved security plan consists of documents withheld from public disclosure pursuant to 10 CFR 73.21 entitled "Physical Security Plan for University of Missouri Research Reactor Facility" dated June 10, 1983, submitted by letter dated June 10, 1983.

4. This amended license is effective as of date of issuance and shall expire at midnight on October 11, 2006.

FOR THE ATOMIC ENERGY COMMISSION

/RA/

Karl R. Goller
Assistant Director for
Operating Reactors
Directorate of Licensing

Attachment:
Appendix "A" (Change No. 10 to the Technical Specifications)

Date of Issuance: July 9, 1974

ATTACHMENT TO LICENSE AMENDMENT NO. 37

AMENDED FACILITY OPERATING LICENSE NO. R-103

DOCKET NO. 50-186

Replace the following pages of Appendix A, "Technical Specifications," with the revised pages. The revised pages are identified by amendment number and contain vertical lines to indicate the areas of change.

Technical Specifications

Remove	Insert
3.6 page 2 of 5	3.6 page 2 of 5
3.6 page 4 of 5	3.6 page 4 of 5
3.6 page 5 of 5	3.6 page 5 of 5
N/A	3.11 page 1 of 2
N/A	3.11 page 2 of 2
N/A	5.7 page 1 of 2
N/A	5.7 page 2 of 2

Attachment

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 that produce Iodine 131 through 135 and non-fueled experiments that are intended to produce Iodine 131 (See Specifications 3.6.a and 3.6.p).

d. Explosive materials shall not be irradiated or allowed to generate in any experiment in quantities over 25 milligrams.

e. Only movable experiments in the center test hole shall be removed or installed with the reactor operating. All other experiments in the center test hole shall be removed or installed only with the reactor shut down. Secured experiments shall be rigidly held in place during reactor operation.

f. Experiments shall be designed and operated so that identifiable accidents such as loss of reactor coolant flow, loss of experiment cooling, etc., will not result in a release of fission products or radioactive materials from the experiment.

g. Experiments shall be designed such that a failure of an experiment will not lead to a direct failure of other experiments, a failure of reactor fuel elements, or to interference with the action of the reactor control elements or other operating components.

h. Cooling shall be provided to prevent the surface temperature of a submerged irradiated experiment from exceeding the saturation temperature of the cooling medium.

SUBJECT: Experiments (continued)

o. Fueled experiments containing inventories of Iodine 131 through 135 greater than 1.5 Curies or Strontium 90 greater than 5 millicuries shall be in irradiation containers that satisfy the requirements of specification 3.6.i or be vented to the exhaust stack system through HEPA and charcoal filters which are continuously monitored for an increase in radiation levels.

p. Each non-fueled experiment that is intended to produce Iodine 131 shall be limited such that the inventory of Iodine 131 is not greater than 150 Curies.

q. Non-fueled experiments that are intended to produce Iodine 131 shall be processed in hot cells that are vented to the exhaust stack system through charcoal filters which are continuously monitored for an increase in radiation levels.

Bases

a. Specification 3.6.a restricts the generation of hazardous materials to levels that can be handled safely and easily. Analysis of fueled experiments containing a greater inventory of fission products has not been completed, and therefore their use is not permitted.

b. Specification 3.6.b is intended to reduce the likelihood of accidental voiding in the core or water annulus surrounding the center test hole by restricting materials which could generate or accumulate gases or vapors.

c. The limitation on experiment materials imposed by specification 3.6.c assures that the limits of Appendix B of 10 CFR 20 are not exceeded in the event of an experiment failure.

d. Specification 3.6.d is intended to reduce the likelihood of damage to reactor or pool components resulting from detonation of explosive materials.

e. Specification 3.6.e is intended to limit the experiments that can be moved in the center test hole while the reactor is operating, to those that will not introduce reactivity transients more severe than one that can be controlled without initiating safety system action (Ref. Add. 5 to HSR).

SUBJECT: Experiments (continued)

f. Specifications 3.6.f and 3.6.g provide guidance for experiment safety analysis to assure that anticipated transients will not result in radioactivity release and that experiments will not jeopardize the safe operation of the reactor.

g. Specification 3.6.h is intended to reduce the likelihood of reactivity transients due to accidental voiding in the reactor or the failure of an experiment from internal or external heat generation.

h. Specification 3.6.i is intended to reduce the likelihood of damage to the reactor and/or radioactivity releases from experiment failure.

i. Specification 3.6.j provides assurance that no chemical reaction will take place to adversely affect the reactor or its components.

j. Specification 3.6.k provides assurance that the integrity of the beamports will be maintained for all loop-type experiments.

k. Specification 3.6.l assures that corrosive materials which are chemically incompatible with reactor components, highly flammable materials and toxic materials are adequately controlled and that this information is disseminated to all reactor users.

l. The extremely low temperatures of the cryogenic liquids present structural problems which enhance the potential of an experiment failure. Specification 3.6.m provides for the proper review of proposed experiments containing or using cryogenic materials.

m. Specifications 3.6.p and 3.6.q provide assurance that the processing of Iodine 131 can be performed safely and that equipment necessary for accident mitigation has been installed.

UNIVERSITY OF MISSOURI
RESEARCH REACTOR FACILITY

Number 3.11
Page 1 of 2
Date 3/11/2016
Amendment No. 37

SUBJECT: Iodine 131 Processing Hot Cells

Applicability

This specification shall apply to the limiting conditions of operation on the equipment needed to safely process Iodine 131.

Objective

The objective of this specification is to reasonably assure that the health and safety of the staff and public is not endangered as a result of processing Iodine 131.

Specification

a. The facility ventilation exhaust system shall be operable when processing Iodine 131 in the Iodine 131 processing hot cells.

b. The facility ventilation exhaust system shall maintain the Iodine 131 processing hot cells at a negative pressure with respect to the surrounding areas when processing Iodine 131.

c. Processing of Iodine 131 shall not be performed in the Iodine 131 processing hot cells unless the following minimum number of radiation monitoring channels are operable.

	Radiation Monitoring Channel	Number
1.	Stack Radiation Monitor	1
2.	Iodine-131 Processing Hot Cells Radiation Monitor	1

Exception: When the required radiation monitoring channel becomes inoperable, then portable instruments may be substituted for the normally installed monitor in specification 3.11.c.2 within one (1) hour of discovery for a period not to exceed one (1) week.

SUBJECT: Iodine 131 Processing Hot Cells (continued)

d. At least three (3) charcoal filter banks each having an efficiency of 99% or greater shall be operable when processing Iodine 131 in the Iodine 131 processing hot cells.

Bases

a. Operation of the facility ventilation exhaust system when processing Iodine 131 in the Iodine 131 processing hot cells ensures proper dilution of effluents to prevent exceeding the limits of 10 CFR 20 Appendix B.

b. Maintaining the Iodine 131 processing hot cells at a negative pressure with respect to the surrounding areas ensures safety for the facility staff.

c. The radiation monitors provide information to operating personnel regarding routine release of radioactivity and any impending or existing danger from radiation. Their operation will provide sufficient time to take the necessary steps to prevent the spread of radioactivity to the surroundings. The Stack Radiation Monitor continuously monitors the air exiting the facility through the exhaust stack for airborne radioactivity. The Iodine-131 Processing Hot Cells Radiation Monitor is a six (6) detector system; two (2) detectors serving each one of the three (3) hot cells. For each hot cell, one (1) detector is located at the processor's work area where the hot cell manipulators are installed and the other is located in the bay above the hot cell next to the exhaust charcoal filters.

d. The potential radiation dose to staff and individuals at the Emergency Planning Zone boundary and beyond have been calculated following an accidental release of Iodine 131 activity. These calculations are based on the facility ventilation exhaust system directing all Iodine 131 processing hot cell effluents through charcoal filtration with an efficiency of 99% or greater prior to being released through the facility exhaust stack.

UNIVERSITY OF MISSOURI
RESEARCH REACTOR FACILITY

Number 5.7

Page 1 of 2

Date 3/11/2016

Amendment No. 37

SUBJECT: Iodine 131 Processing Hot Cells

Applicability

This specification shall apply to the surveillance of the equipment needed to safely process Iodine 131.

Objective

The objective of this specification is to reasonably assure proper operation of the equipment needed to safely process Iodine 131.

Specification

a. An operability test of the facility ventilation exhaust system shall be performed monthly.

b. The operability of the facility ventilation exhaust system to maintain the Iodine 131 processing hot cells at a negative pressure with respect to the surrounding areas shall be verified daily prior to any process (channel check).

c. The radiation monitors as required by specification 3.11.c shall be calibrated on a semi-annual basis.

d. The radiation monitors as required by specification 3.11.c shall be checked for operability with a radiation source at monthly intervals.

e. The efficiency of the Iodine 131 processing hot cells charcoal filter banks shall be verified biennially or following major maintenance. It shall be verified that the charcoal filter banks have a removal efficiency of 99% or greater for iodine.

Bases

a. Experience has shown that monthly tests of the facility ventilation exhaust system are sufficient to assure proper operation.

TECHNICAL SPECIFICATION

SUBJECT: Iodine 131 Processing Hot Cells (continued)

b. Verifying that the Iodine 131 processing hot cells are at negative pressure with respect to the surrounding areas prior to use ensures personnel safety.

c. Semiannual channel calibration of the radiation monitoring instrumentation will assure that long-term drift of the channels will be corrected.

d. Experience has shown that monthly verification of operability of the radiation monitoring instrumentation is adequate assurance of proper operation over a long time period.

e. Biennial verification of filter banks ensures that the filters will perform as analyzed.

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 37 TO

AMENDED FACILITY LICENSE NO. R-103

THE UNIVERSITY OF MISSOURI-COLUMBIA

DOCKET NO. 50-186

1.0 INTRODUCTION

By letter dated July 20, 2015 (Agencywide Document Access and Management System (ADAMS) Accession Nos.: ML15203A862; ML15203A867; ML15203A851; and ML15203A855), as supplemented by letters dated December 30, 2015 (ADAMS Accession No. ML16004A150), January 8, 2016 (ADAMS Accession No. ML16011A388), and February 19, 2016 (ADAMS Accession No. ML16055A023) the University of Missouri-Columbia (the licensee) requested a license amendment to change Appendix A of Amended Facility License No. R-103, "Technical Specifications for University of Missouri Research Reactor Facility." The requested amendment would impose controls necessary to allow irradiation and processing of non-fueled experiments to produce iodine-131 (I-131). Specifically, the proposed amendment would:

1. revise technical specification (TS) 3.6, "Experiments," to establish a specific limit on I-131 inventory for non-fueled experiments intended to produce I-131, and require that non-fueled experiments for I-131 production be processed in hot cells that are vented to the exhaust stack through carbon filters;
2. add TS 3.11, "Iodine 131 Processing Hot Cells," to establish limiting conditions of operation (LCOs) for the ventilation, radiation monitoring, and carbon filtration systems needed to process I-131 in the I-131 processing hot cells; and,
3. add TS 5.7, "Iodine 131 Processing Hot Cells," to establish surveillance requirements for the equipment specified in TS 3.11.

2.0 BACKGROUND

The licensee operates the Missouri University Research Reactor (MURR) at its campus in Columbia, Missouri. The licensee plans to irradiate non-fueled targets (containing no Special Nuclear Material (SNM)) and process these targets in order to produce radiochemical sodium I-131 solution. Existing MURR TS 1, "Definitions," defines an experiment as "any device or material which is exposed to significant radiation from the reactor and is not a normal part of the reactor," or "any operation designed to measure or monitor reactor characteristics or parameters." Since non-fueled targets would be exposed to significant radiation from the reactor, these targets, and consequently the proposed activities involving these targets, would be considered an experiment pursuant to the MURR TSs. The experiment will include:

- irradiation of encapsulated targets, which do not contain SNM, in the graphite reflector region of the MURR;
- removal of targets from the reflector, and transport of the targets to the processing hot cells;

- target de-encapsulation;
- separation of I-131 from the target material;
- formulation of I-131 product solution; and,
- quality control analysis of the final product solution.

There are currently no suppliers of medical I-131 in the United States, and this experiment would allow the licensee to produce this isotope for domestic and international distribution.

The licensee installed the iodine processing equipment in 2014, and had been performing limited acceptance testing, when the U.S. Nuclear Regulatory Commission (NRC) Headquarters inspectors reviewed the licensee's Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59 evaluation and identified the need for additional safety reviews to ensure that any potential routine or accidental release of I-131 was properly evaluated (See NRC Inspection Report No. 50-186/2015-201-201 (ADAMS Accession No. ML15120A338)). As a result of the NRC inspection and subsequent communication, the licensee committed, by electronic mail dated May 28, 2015 (ADAMS Accession No. ML15154B803), to administratively control the quantities of I-131 processed such that the limits of TS 3.7.a, which requires, in part, that I-131 effluent concentrations be maintained below the limits of 10 CFR Part 20, Appendix B, could not be exceeded. The NRC staff documented the licensee's position by letter dated July 21, 2015 (ADAMS Accession No. ML15154B812). In determining compliance with TS 3.7.a, no credit can currently be taken for accident-mitigating safety equipment such as filters, since no TS controls exist for that equipment. In the absence of additional TS controls, the limits in TS 3.7.a do not afford the licensee the ability to produce sufficient quantities of I-131 for subsequent distribution. Therefore, the licensee subsequently determined the need to incorporate additional controls, including requirements on safety equipment which was already installed, into its TSs by proposed changes to TS 3.6 and the proposed addition of TS 3.11 and TS 5.7. The license amendment request provides the basis for the necessary controls and safety equipment described in the proposed TSs, including analyses supporting the licensee's conclusion that production of I-131 for subsequent distribution will not endanger the MURR staff or any member of the public, nor harm the environment.

The current MURR TS 3.6, "Experiments," contains limitations on the conduct of experiments. Current TS 3.6.c requires, in part, that for non-fueled experiments that could fail in a manner that would cause radioactive gasses to be released to the atmosphere, inventories shall be limited to prevent 10 CFR Part 20, Appendix B, airborne radionuclide concentration limits from being exceeded.

During its review, the NRC staff identified areas where clarification and additional information was needed for its review. A request for additional information (RAI) was sent to the licensee by letter dated November 19, 2015 (ADAMS Accession No. ML15307A071). By letter dated December 30, 2015 (ADAMS Accession No. ML16004A150), the licensee provided responses to the NRC RAI letter. Following a telephone conference call with the NRC staff on January 7, 2016, the licensee provided additional clarification to its RAI responses by letter dated January 8, 2016 (ADAMS Accession No. ML16011A388). The licensee also provided a correction to a typographical error in the proposed TS 3.6.c by electronic mail dated January 13, 2016 (ADAMS Accession No. ML16014A086). Additionally, following a telephone conference call with the NRC staff on February 19, 2016, the licensee provided further clarification regarding the proposed TSs 3.6.c, 3.6.p, and 5.7.e by letter dated February 19, 2016 (ADAMS Accession No. ML16055A023).

During a site visit conducted December 7 and 8, 2015, the NRC staff toured the facility in order to fully understand the proposed I-131 process, and also discussed the RAI responses and subsequent TS changes requested by the licensee.

The license amendment request and the licensee responses to the RAIs contain proprietary information, which is withheld from public disclosure in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding." Publicly-available portions (i.e., non-proprietary) of the licensee's application may be accessed in the ADAMS public document collection.

3.0 EVALUATION

3.1 TS Changes Related to LCOs

3.1.1 Proposed TS LCOs

3.1.1.1 Proposed Changes to Current TS LCOs

The current TS 3.6.c and the proposed TS 3.6.c are set forth below to illustrate the change requested by the licensee. The proposed TS 3.6.c would modify the current exception for fueled experiments such that it would only apply to fueled experiments that produce iodine 131 through 135. The proposed TS 3.6.c would add an additional exception for non-fueled experiments that are intended to produce I-131.

The current TS 3.6.c states:

> Where the possibility exists that the failure of an experiment could release radioactive gases or aerosols to the reactor bay or atmosphere, the experiment shall be limited 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).

The proposed TS 3.6.c states:

> Where the possibility exists that the failure of an experiment could release radioactive gases or aerosols to the reactor bay or atmosphere, the experiment shall be limited to the 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 that produce Iodine 131 through 135 and non-fueled experiments that are intended to produce Iodine 131 (See Specifications 3.6.a and 3.6.p).

3.1.1.2 Proposed New TS LCOs

The proposed new TS LCOs requested by the licensee are set forth below.

The proposed TS 3.6.p states:

> Each non-fueled experiment that is intended to produce Iodine 131 shall be limited such that the inventory of Iodine 131 is not greater than 150 Curies.

The proposed TS 3.6.q states:

> Non-fueled experiments that are intended to produce Iodine 131 shall be processed in hot cells that are vented to the exhaust stack system through charcoal filters which are continuously monitored for an increase in radiation levels.

The proposed TS 3.11, "Iodine 131 Processing Hot Cells," states:

Applicability

This specification shall apply to the limiting conditions of operation on the equipment needed to safely process Iodine 131.

Objective

The objective of this specification is to reasonably assure that the health and safety of the staff and public is not endangered as a result of processing Iodine 131.

Specification

a. The facility ventilation exhaust system shall be operable when processing Iodine 131 in the Iodine 131 processing hot cells.

b. The facility ventilation exhaust system shall maintain the Iodine 131 processing hot cells at a negative pressure with respect to the surrounding areas when processing Iodine 131.

c. Processing of Iodine 131 shall not be performed in the Iodine 131 processing hot cells unless the following minimum number of radiation monitoring channels are operable.

	Radiation Monitoring Channel	Number
1.	Stack Radiation Monitor	1
2.	Iodine-131 Processing Hot Cells Radiation Monitor	1

Exception: When the required radiation monitoring channel becomes inoperable, then portable instruments many be substituted for the normally installed monitor in specification 3.11.c.2 within one (1) hour of discovery for a period not to exceed (1) week.

d. At least three (3) charcoal filter banks each having an efficiency of 99% or greater shall be operable when processing Iodine 131 in the Iodine 131 processing hot cells.

3.1.2 Evaluation of Proposed Changes to TS LCOs

The proposed TS LCOs described above would require the licensee to use controls in its conduct of the proposed experiment. The safety evaluation in this section focuses on these controls, and on how these controls limit the radiological consequences of routine conduct of the experiment and the potential consequences of an experiment failure.

The provisions of 10 CFR 50.36, "Technical specifications," require licensees to have TSs. Section 50.36(c)(2) requires, in part, that TSs include LCOs. LCOs are the lowest functional capability or performance levels of equipment required for safe operation of the facility.

Section 50.36(c)(2)(ii)(B) requires that a TS LCO be established for a process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. For the proposed I-131 production experiment at MURR, a limit on iodine inventory is such an operating restriction, and a vented hot cell is such a design feature. The fission product barrier is the I-131 processing system.

Section 50.36(c)(2)(ii)(C) requires that a TS LCO be established for a structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. For the proposed experiment at MURR, the structures, systems, or components are the ventilation systems, radiation monitors, and carbon filters associated with the I-131 processing hot cells.

NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," issued February 1996 (ADAMS Accession Nos.: ML042430055 (Part 1) and ML042430048 (Part 2)) provides guidance for the review of experimental facilities, including the safety analysis of any accidents which could result from the potential failure of experiments.

American Society for Testing and Materials (ASTM) Standard D3803-91 (Reapproved 2014), "Standard Test Method for Nuclear-Grade Activated Carbon," provides guidance for testing carbon used in charcoal filters, and provides guidance on the performance of carbon for radioiodine removal.

NRC Regulatory Guide (RG) 2.2, "Development of Technical Specifications for Experiments in Research Reactors," presents the following three safety-oriented considerations from which TSs for experiments should be developed:

(1) the physical conditions of the design and conduct of experiments;
(2) the materials content of experiments; and,
(3) the administrative controls employed to evaluate, authorize, and carry out experiments.

The documentation submitted by the licensee supporting the TS amendment request, as supplemented by the RAI responses, was reviewed for conformance with the regulatory guidance provided above, and to verify that proposed operations will not expose reactor staff or the general public to unacceptable radiological consequences, as determined by the limits specified in 10 CFR Part 20 "Standards for Protection against Radiation," including 10 CFR 20.1201, "Occupational dose limits for adults," and 10 CFR 20.1301, "Dose limits for individual members of the public;" and 10 CFR Part 20, Appendix B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage."

3.1.2.1 Evaluation of Proposed TS LCOs for Physical Conditions of the Design and Conduct of the I-131 Production Experiment

For the proposed I-131 production experiment, encapsulated targets would be irradiated within the graphite reflector region of MURR, then these targets would be transported to the processing hot cells, where they would be de-encapsulated so that I-131 could be separated

(processed) from the targets. For the irradiation of encapsulated targets, the physical conditions of the design and conduct of experiment include reactivity effects, thermal-hydraulic effects, and mechanical stress effects. The licensee is required to comply with the limits specified in existing TSs 3.1.g through 3.1.k, which will help ensure that any reactivity effects associated with the encapsulated targets will be within ranges that have been determined to pose no safety risk. The licensee is also required to comply with the limits in existing TSs 3.6.h and 3.6.i, which will help ensure that thermal-hydraulic effects and mechanical stress effects, respectively, will not cause the integrity of the experiment irradiation containers to be compromised. Collectively, these existing TSs will help to ensure that the MURR's shutdown margin and other core parameters will be maintained within safe ranges during operation of the proposed experiment. These existing TSs will also help to ensure that any other experiments, in the graphite reflector region or other parts of the reactor, would not be significantly affected by the proposed experiment. The NRC staff therefore concludes that no changes are necessary to existing TSs 3.1.g through 3.1.k and 3.6.h through 3.6.i to help ensure that any reactivity effects, thermal-hydraulic effects, or mechanical stress effects associated with the target irradiation portion of the proposed experiment are within safe levels.

For the I-131 processing portion of the proposed experiment, other conditions of the design and conduct for the processing and handling of I-131 following target irradiation are described in the proposed TS LCOs evaluated below.

3.1.2.1.1 Proposed TS 3.6.q

The licensee proposed to add TS 3.6.q, which would require that non-fueled experiments that are intended to produce I-131 shall be processed in hot cells that are vented to the exhaust stack through charcoal filters which are continuously monitored for an increase in radiation levels. Processing I-131 in hot cells helps to ensure that any I-131 that may be released from the processing is contained, and also helps to ensure that MURR staff are shielded from radiation associated with I-131 processing. Therefore, processing I-131 in hot cells helps to minimize risk to the MURR staff. Venting the hot cells to the exhaust stack system through charcoal filters removes I-131 from the effluent stream, helping to minimize the amount of I-131 released to the environment and lessening any potential radiation exposure to members of the public. Venting also helps ensure that in the event of a release of I-131 from a target being processed, the I-131 will be constrained in a filtered, monitored release path. Continuously monitoring charcoal filters for an increase in radiation levels helps to ensure that the charcoal filter efficiency is properly maintained, which also helps to minimize the amount of I-131 released to the environment and lessen any potential radiation exposure to members of the public.

The NRC staff reviewed the proposed TS 3.6.q and finds that proposed TS 3.6.q would help to ensure that releases of radiation or radioactive I-131 from the processing hot cells to areas occupied by MURR staff, or to the environment, will be minimized, keeping potential doses within 10 CFR Part 20 limits (see Section 3.1.2.2.1 for dose analyses). In addition, the NRC staff reviewed the basis for proposed TS 3.6.q, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information provided above, the NRC staff finds that the proposed TS 3.6.q is acceptable.

3.1.2.1.2 Proposed TS 3.11.a

The licensee proposed to add TS 3.11.a, which would require that the facility ventilation system would be operable whenever I-131 is being processed in the processing hot cells. The

ventilation system draws effluent air from the hot cells to the main facility exhaust stack, helping to ensure dilution of effluents such that I-131 effluent concentrations will be minimized.

The NRC staff reviewed the information above, and finds that proposed TS 3.11.a would help to ensure a reduction in I-131 effluent concentrations, thus minimizing potential doses to the public. In addition, the NRC staff reviewed the basis for proposed TS 3.11.a, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information provided above, the NRC staff finds that proposed TS 3.11.a is acceptable.

3.1.2.1.3 Proposed TS 3.11.b

The licensee proposed to add TS 3.11.b, which would require that the facility ventilation system maintains the processing hot cells at a negative pressure with respect to surrounding areas during I-131 processing. The negative pressure in the hot cells helps to ensure that any air leakage is into the hot cells, and not out of the hot cells and into the surrounding area; this helps to ensure that the MURR staff's exposure to airborne I-131 is minimized.

The NRC staff reviewed the information above, and finds that proposed TS 3.11.b would help to prevent any potential leakage of airborne I-131 to areas surrounding the hot cells, thus minimizing radiation exposure to the MURR staff. In addition, the NRC staff reviewed the basis for proposed TS 3.11.b, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information provided above, the NRC staff finds that proposed TS 3.11.b is acceptable.

3.1.2.1.4 Proposed TS 3.11.c

The licensee proposed to add TS 3.11.c, which would require that the stack radiation monitor and the I-131 Processing Hot Cells Radiation Monitor would remain operable during I-131 processing. These radiation monitors would help to provide information to MURR staff regarding routine releases of radioactivity, as well as any danger from radiation resulting from the release of I-131 to the hot cells following a failure of the proposed experiment. Their operation would help to provide sufficient time for MURR staff to take the necessary steps to prevent the spread of radioactivity, such as terminating I-131 processing or placing parallel charcoal filters in or out of service as needed. The licensee also proposed that TS 3.11.c allow portable instruments to be substituted for the I-131 Processing Hot Cells Radiation Monitor within one (1) hour of discovery that the monitor is inoperable, for a period not to exceed one (1) week.

The licensee's responses to RAIs No. 11.a and 11.b provided clarification on the location and functions of the I-131 Processing Hot Cells Radiation Monitor and stack radiation monitor. The I-131 Processing Hot Cells Radiation Monitor is a six (6)-detector system that includes two (2) Geiger-Mueller detectors for each of the three (3) hot cells. One (1) of these detectors is located next to the hot cell operator's work station to provide real time dose information to operators when they are performing I-131 processing. The other detector is located next to the first charcoal filter external to the hot cell to allow operators to monitor loading of I-131 onto the filter. The stack radiation monitor includes three (3) radiation detectors, one (1) of which is dedicated to monitoring I-131 releases to the environment. The licensee's response to RAI No. 11.a also clarified the location and function of the I-131 Processing Laboratory Duct Monitor. There are no existing TS requirements for that monitor, and no new TS requirement is being proposed for that monitor. The I-131 Processing Laboratory Duct Monitor is located

downstream of all three (3) hot cells and all charcoal filters, and monitors I-131 in an exhaust duct common to all three (3) hot cells before the effluent enters the main MURR exhaust system. The licensee's response to RAI No. 12 clarified that the portable instruments specified in proposed TS 3.11.c would have the same functionality as the inoperable monitors they replaced.

The NRC staff reviewed the information above, and finds that proposed TS 3.11.c would help to provide assurance that the processing operators would be able to monitor radiological dose information, releases of I-131 from the facility stack, and the condition of the carbon filters, to help minimize the release of radioactivity and comply with the limits specified in 10 CFR Part 20; 10 CFR Part 20, Appendix B; and existing TS 3.7.a, which limits maximum stack discharge rates (see Section 3.1.2.2.1 for dose analyses). The staff concludes that the RAI response clarified that the Processing Laboratory Duct Monitor is not credited in the safety analysis and need not be subject to a TS requirement. In addition, the NRC staff reviewed the basis for the proposed TS 3.11.c, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information provided above, the NRC staff finds that the proposed TS 3.11.c is acceptable.

3.1.2.1.5 Proposed TS 3.11.d

The licensee proposed to add TS 3.11.d, which would require that at least three (3) charcoal filter banks, each having an efficiency of 99% or greater, would be operable during I-131 processing. Although only three (3) banks would be required to be operable for each hot cell, each hot cell is served by four (4) banks: three (3) dedicated filter banks, and one (1) additional bank that filters combined air from all three (3) hot cells. For each hot cell, the first bank is internal to the hot cell and consists of parallel filters that are both maintained in continuous service. The second, third, and fourth banks are external to the hot cells. The second bank for each hot cell consists of two (2) parallel sets of filters that are designed such that one (1) set of filters will be operable while the other is offline. The third bank for each hot cell also consists of two (2) parallel sets of filters that are designed such that one (1) set of filters will be operable while the other is offline. The fourth bank, which filters combined air from all three (3) hot cells, consists of two (2) single filters, and is designed such that one (1) single filter will be operable while the other is offline.

In responses to RAIs No. 7.e and 7.f, the licensee stated that it would use charcoal filter banks containing triethylenediamine/potassium iodide (TEDA/KI) impregnated (nuclear-grade) carbon. These charcoal filter banks have a manufacturer-specified mechanical efficiency of 99.9% or greater. The chemical, and overall, absorption efficiencies of nuclear-grade carbon in charcoal filter banks are determined by specific operating conditions. The NRC staff noted that ASTM D3803-91, which the licensee referenced in its responses to RAIs, reports that new, nuclear-grade carbon tested in accordance with the method prescribed in the standard, which uses a methyl iodide (organic iodine) challenge agent, has a penetration of approximately 1% (corresponding to an efficiency of approximately 99%). However:

- In responses to RAIs No. 7.a and 7.c, the licensee stated that the operating conditions for this experiment are significantly more favorable than ASTM test conditions because the iodine released from I-131 processing is estimated to have a methyl iodide component of less than 0.2%, with the balance being molecular iodine which is much more readily absorbed by carbon.

- In responses to RAIs No. 7.a and 7.d, the licensee provided data showing that humidity and temperature conditions will also be more favorable than ASTM test conditions.
- In response to RAI No. 7.g, the licensee provided residence times for filters; the NRC staff noted that MURR's filter residence times are longer (more favorable) than those of ASTM test conditions.

The NRC staff reviewed the information above, and finds the licensee's evaluation of its ability to maintain the overall efficiency of each charcoal filter bank at greater than 99% for removal of I-131 under the operating conditions of the proposed experiment, in accordance with proposed TS 3.11.d, is acceptable. The NRC staff based its review on manufacturer specifications for the charcoal filters, guidance found in ASTM D3803-91, and data provided by the licensee. The NRC staff also finds that the proposed TS 3.11.d would help maintain radiation doses to members of the public below 10 CFR Part 20 limits, based on the radiological analyses that follow (see Section 3.1.2.2.1 for dose analyses). In addition, the NRC staff reviewed the basis for the proposed TS 3.11.d, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information above, the NRC staff finds that proposed TS 3.11.d is acceptable.

3.1.2.2 Evaluation of Proposed TS LCOs for Materials Content of the Proposed I-131 Production Experiment

The hazardous materials content of experiments can include radioactive materials, or other highly-reactive, corrosive, flammable, or toxic materials. For the proposed I-131 production experiment, radioactive materials are the primary concern, as no other materials of concern were identified that will be utilized or generated. Radioactive materials that will be present in the proposed experiment include I-131, as well as other activation products of the targets and of trace elements and impurities, and activation products of irradiation canisters.

3.1.2.2.1 Proposed TS 3.6.p

Proposed TS 3.6.p would limit the I-131 inventory of non-fueled experiments that are intended to produce I-131 to 150 curies. The proposed TS 3.6.p limit would apply to irradiation of non-fueled targets in the reactor as well as I-131 processing in hot cells. In the original amendment request, as supplemented by responses to the RAIs, the licensee provided detailed analyses, including justifications of assumptions, of the radiological impact to persons in the MURR restricted area and members of the public resulting from routine operation of the proposed experiment, as well as from possible failure of the proposed experiment. These analyses estimated doses from I-131 and other activation product radionuclides, as applicable. The results of the radiological analyses follow below.

3.1.2.2.1.1 Doses to Staff from Routine Operation of the Proposed Experiment

In response to RAI No. 2.a, the licensee provided estimates of doses to staff resulting from routine transfer of irradiated targets from the reactor pool to hot cell HC-01 (where the targets are transferred to a different transfer cask specifically designed to mate with the I-131 handling hot cell (HHC)), and from HC-01 to the HHC. The licensee assumed that each transfer cask held quantities of I-131, plus activation products and sodium-24 (Na-24), consistent with four (4) targets (irradiated at specified flux for specified time) that had been allowed to decay for 24 hours. The quantity of I-131 that the licensee assumed each of the four (4) targets would contain was less than the 150 curie limit of proposed TS 3.6.p, but was determined based on expected routine operating conditions in which the I-131 in each target is kept below the limit. Based on staff being an average of one (1) meter from each type of cask for 15 minutes, the licensee calculated a total personnel dose of approximately one (1) milli-roentgen equivalent man (mrem). The licensee utilized the MicroShield 8.02 code to calculate dose rates for this calculation. In response to RAI No. 4.c, the licensee provided a detailed description of the methodology and assumptions used for these and other MicroShield 8.02 calculations provided in the original amendment request and the responses to RAIs.

In response to RAI No. 2.b, the licensee provided estimates of dose rates to personnel outside of the processing hot cells during normal operation of the experiment. Based on four (4) targets containing similar radioactivity to those assumed in the response to RAI No. 2.a (above), and assuming that the HHC and processing hot cell (PHC) contain both I-131 and activation products while the dispensing hot cell (DHC) contains only separated I-131, the licensee calculated that the dose rate 0.5 meters from the front face of any of the three (3) hot cells would be 0.09 mrem per hour (mrem/hr). For the PHC, the calculation is conservative, in part, because only one (1) target will be processed in the PHC at a time, so the PHC will only contain the I-131 and activation products associated with one (1) target. The licensee utilized MicroShield 8.02 to perform these calculations. Based on a maximum expected eight (8) hours per week spent by any one (1) individual in front of the processing hot cells during processing, the dose for one (1) individual per week would be 0.72 mrem.

In response to RAI No. 2.c, the licensee provided an estimate of the dose rate from processing waste stored in the HHC. The calculations conservatively assumed that no waste was ever removed from the HHC. The waste dose is dominated by target activation products. Accounting for production of new waste from processing four (4) targets per week as well as radioactive decay of the waste, the licensee calculated that the waste dose rate 0.5 meters from the HHC would reach an equilibrium (maximum) value of 2.7E-6 mrem/hr. The licensee utilized MicroShield 8.02 to perform this calculation.

In response to RAI No. 2.d, the licensee provided an estimate of the dose rate from final product solution following its transfer to the shipping cask that will be used to transport it offsite. The licensee assumed the cask would contain I-131 from processing of four (4) targets and calculated a dose rate of 0.47 mrem/hr at 0.5 meters from the cask surface. The licensee utilized MicroShield 8.02 to perform this calculation.

As proposed TS 3.11.b would require that the I-131 processing hot cells be kept at negative pressure with respect to surrounding areas, doses to staff from airborne radioactivity in the restricted area from routine operation of this experiment are expected to be negligible.

In response to RAI No. 2.e, the licensee used estimates from its responses to RAIs No. 2.a through 2.d to provide a conservative estimate that the maximum whole body dose to any one

(1) member of the MURR staff from routine operation of the proposed experiment would be approximately 50 mrem per year (mrem/yr), which is well below the 5000 mrem/yr whole-body occupational dose limit specified in 10 CFR 20.1201.

The NRC staff reviewed the licensee's methodology for estimating doses to MURR staff from routine operation of the proposed experiment, and found that it was consistent with accepted practices for performing dose calculations. The assumptions used by the licensee to establish the physical conditions for the material transfer and processing in the hot cells were reviewed and found to be conservative (i.e., provide an over-estimate of the radiological doses). Additionally, the NRC staff finds that the expected doses to MURR staff from routine operation of the proposed experiment are well within the limits of 10 CFR 20.1201. The NRC staff therefore finds the expected doses to MURR staff from routine operation of the proposed experiment to be acceptable.

3.1.2.2.1.2 Doses to the Public from Routine Operation of the Proposed Experiment

The licensee provided the results of analyses for the radiological dose to members of the public from the routine operation of the proposed experiment in their responses to RAIs No. 3.a through 3.d and RAI No. 9. The licensee provided experimentally-determined estimates of quantities of I-131 and metastable xenon-131 (Xe-131m, from decay of I-131), respectively, that could be released to the environment, through the facility stack, from routine operation of the proposed experiment. The licensee's estimates indicated that the proposed experiment can be operated such that the limits of existing TS 3.7.a and 10 CFR Part 20, Appendix B, would be satisfied. Additionally, in its response to RAI No. 3.b, the licensee indicated that the maximum number of I-131 targets processed per week would be limited such that the I-131 effluent concentration limit in 10 CFR Part 20, Appendix B, (2E-10 microcuries per milliliter (μCi/ml)), would not be exceeded.

During the licensee's initial process testing, I-131 and Xe-131m were the only radioisotopes identified that could produce a measurable airborne radioactivity release to the environment, for routine operation or any credible accident scenario. In response to RAI No. 9, the licensee provided analyses indicating that airborne iodine-128 (I-128, from activation of trace amounts of the stable iodine-127 (I-127) impurity in the target material) could not be released from the PHC in any significant quantity as a result of routine operation or from any credible accident scenario, since the short half-life of I-128 ensures that effectively all of the I-128 will have decayed by the time the targets are processed in the PHC. The licensee's response to RAI No. 9 also indicated that during process testing experiments, no measurable releases of selenium-75 (from activation of trace amounts of the stable selenium-74 impurity in the target material) from the PHC could be observed. In its letter dated January 8, 2016, the licensee stated that process testing experiments had also shown that no measureable activation products of the target material itself are released to the PHC during target processing, and that no measureable release of target activation products to the environment is anticipated under normal operations or from any credible accident scenario.

The NRC staff reviewed the licensee's analyses and experimental results, and finds that they provide adequate assurance that the proposed experiment can be operated such that the effluent concentration limits of existing TS 3.7.a and 10 CFR Part 20, Appendix B, would be satisfied. The NRC staff also notes that the licensee has stated that it will monitor I-131 releases using equipment required by proposed TS 3.11.c, and will administratively control the amount of I-131 processed per week to ensure compliance with the effluent concentration limits, ensuring that members of the public are protected. Existing TS 6.1 requires administrative

controls that help ensure recordkeeping and reporting of effluents, and would also help ensure the adequacy of procedures for performing the proposed experiment such that effluent limits are met (see Section 3.1.2.3 for discussion of administrative controls). The NRC staff therefore finds the expected doses to members of the public from routine operation of the proposed experiment to be acceptable.

3.1.2.2.1.3 Doses to Staff from Postulated Failures of the Proposed Experiment

In evaluating failures of the proposed experiment, the licensee analyzed postulated experiment failures that could result in doses to MURR staff or to members of the public.

In its response to RAI No. 6, the licensee provided an accident analysis for a complete encapsulation failure of a non-fueled irradiation capsule containing 150 Ci of I-131. The limit of 150 Ci is also the existing TSs 3.6.a limit for fueled experiments; therefore this accident is bounded by current TS 3.6.a. Additionally, in response to RAI No. 8.a, the licensee provided experimental results showing that the assumption that all I-131 is released to the reactor pool following an encapsulation failure, which was used for previous analyses involving fueled experiments, is extremely conservative for the proposed non-fueled experiment. This assumption is conservative because the physical and chemical form of the target, as well as the conditions of the target irradiation, ensure that only a minimal fraction of the I-131 in a non-fueled target is likely to be released from the target in any form following encapsulation failure.

In response to RAI No. 8.b, the licensee provided the results of its evaluation of possible experiment failures involving an I-131 release during the movement of irradiated targets from the irradiation position in the reactor bay to the HHC. The licensee indicated that no credible failure could by identified that could cause a release during this portion of the experiment, since all the movement of the encapsulated target occurs in a specifically-designed sealed transfer cask. However, the licensee also referred to experimental results, discussed in response to RAI No. 8.a, which indicated that if an encapsulated, irradiated target were punctured, the release of I-131 would be very small and significantly less than any quantity that could cause 10 CFR Part 20 limits to be exceeded, since only a small fraction of the total I-131 inventory is in gaseous form and available for release.

In response to RAI No. 8.c, the licensee provided a review of a possible experiment failure involving a spill of I-131 solution outside the hot cells. The licensee stated that this type of failure was not credible because the product solution vials would be transferred directly to transportation containers through the air lock seals beneath the DHC. The only I-131 solution that would be handled outside of hot cells or transportation casks would be a small quantity used for quality assurance analyses, which would be administratively controlled to safe activity levels. Existing TS 6.1 requires administrative controls that would help ensure the adequacy of procedures for performing quality assurance analyses such that quantities of I-131 handled outside the hot cells are kept at safe levels (see Section 3.1.2.3 for discussion of administrative controls).

The licensee provided the results of its review of a postulated experimental failure involving a release of I-131 into the hot cells. The analyses assumed that 150 curies of I-131 was accidentally released into the PHC during target processing (as 150 curies is the limit provided by the proposed TS 3.6.p); however, the assumption that the entire 150 Ci would be released to the PHC is conservative for the following reasons:

- Experiments and calculations have shown that the total I-131 generated in each target is significantly less than 150 curies.
- The processing equipment in the PHC is designed based on a containment approach, such that I-131 is sequestered in discrete traps and filters within the PHC, and releases of volatile I-131 to the air space within the PHC are minimized.

Possible sources of dose to MURR staff following a release of I-131 to the PHC were identified as:

- shine from the material in the PHC;
- shine from charcoal filters following buildup of I-131 on the filters;
- shine from I-131-contaminated air passing through ventilation ductwork; and,
- shine from I-131 plated within the ventilation ductwork.

As with routine operation, doses from airborne radioactivity in the processing laboratory are expected to be negligible following a release of I-131 to the PHC. Proposed TS 3.11.b would require that the hot cells be kept at negative pressure with respect to their surroundings, helping to provide adequate assurance that airborne radioactivity would not be released directly from the PHC to the processing laboratory.

In response to RAI No. 4.a, the licensee discussed the dose rate due to shine from the PHC following a release of 150 Ci of I-131 into the PHC. The licensee stated that this dose rate would be very similar to the dose rate during routine operation. This is because the major contributors to dose rates outside the PHC are other target material activation products that emit higher-energy, more penetrating gamma radiation, rather than I-131 which emits less penetrating radiation; these activation products will be present in the PHC in similar quantities under routine or accident conditions.

In response to RAI No. 4.c, the licensee provided analyses of dose rates due to shine from charcoal filters following buildup of I-131 on the filters. These analyses were updated from analyses previously provided in the original amendment request. The analyses credited the lead shielding surrounding each filter, and considered scenarios in which either three (3) or four (4) filters were online and the filters were operating at either 99% or 99.9% removal efficiency. These scenarios are consistent with the requirements of proposed TS 3.11.d. The highest dose rate was determined to be from the last of the four (4) charcoal filters downstream of the PHC, for the case in which the first filter downstream is offline and the filters are operating at 99% efficiency. For this worst-case scenario, the dose rate one (1) foot from the last filter was calculated to be 1.25 mrem/hr. The licensee utilized MicroShield 8.02 to perform these calculations.

In the original amendment request, the licensee provided analyses of dose rates due to shine from I-131-contaminated air passing through ventilation ductwork. These analyses were performed using conservative assumptions, including:

- All 150 Ci of I-131 is instantaneously released into the PHC.
- 50% of the PHC volume was considered as free space; although this is a large underestimation, this results in a conservative determination of airborne activity concentrations.
- No credit was taken for mitigation of I-131 concentrations by filters or by plate-out of I-131.

- No credit was taken for shielding from the ductwork itself.

The licensee calculated that the highest dose rate one (1) foot from ductwork would be 16.33 mrem/hr from the ductwork exiting the PHC. The licensee utilized MicroShield 8.02 to perform these calculations.

In response to RAI No. 4.b, the licensee provided analyses of dose rates due to shine from I-131 plated within ventilation ductwork. The licensee performed these analyses for the unshielded section of exhaust ducting immediately outside the PHC shielding, downstream from the second and third filter banks. The licensee credited two (2) of the first three (3) filter banks, each operating at 99% removal efficiency, consistent with proposed TS 3.11.d. The licensee conservatively assumed that the entire inventory of I-131 that passes through the two (2) filter banks is deposited on the 2.5 meter section of PHC ductwork outside the PHC shielding. For this scenario, the licensee calculated dose rates of 0.5 mrem/hr 2.5 meters from the ductwork (the nearest normally-occupied location), and 6.4 mrem/hr 0.5 meters from the ductwork (an area that is not normally occupied). The licensee utilized MicroShield 8.02 to perform these calculations.

The NRC staff reviewed the licensee's analyses of experiment failures during target irradiation, and found that any such failures would be bounded by previous NRC reviewed and approved analyses, specifically those for failure of fueled experiments performed in accordance with existing TS 3.6.a. The NRC staff also reviewed the licensee's analyses of other experiment failures that could cause I-131 to be released within the restricted area but outside the processing hot cells, and found such failures to be non-credible. Additionally, the NRC staff reviewed the licensee's methodology for estimating doses to MURR staff for failures related to material releases within the processing hot cells, and found that it was consistent with accepted practices for performing dose calculations. The assumptions used by the licensee to establish the physical conditions for the calculations were reviewed and found to be conservative (i.e., provide an over-estimate of the radiological doses). The NRC staff concludes that, for any postulated failure of the proposed experiment, dose rates in any portion of the restricted area will be approximately 16 mrem/hr or less. Additionally, should any failure of the proposed experiment occur, the radiation monitors that would be required by proposed TS 3.11.c would alert the operators of the failure, allowing stay time in affected areas to be minimized. The NRC staff therefore concludes that, for any credible failure of the proposed experiment, doses to MURR staff will remain well below the 5000 mrem regulatory occupational whole-body dose limit specified in 10 CFR 20.1201. The NRC staff therefore finds the expected doses to members of the MURR staff from any postulated failure of the proposed experiment, as operated in accordance with the materials content limit of proposed TS 3.6.p, to be acceptable.

3.1.2.2.1.4 Doses to the Public from Postulated Failures of the Proposed Experiment

For the licensee's analyses of the dose to the public from postulated failures of the proposed experiment, the source of the potential dose was identified as a release of I-131 from the facility stack following a release of 150 Ci of I-131 to the PHC. Although Xe-131m from decay of I-131 was identified as a possible contributor to public doses from routine operation of the proposed experiment, Xe-131m was not considered during the accident analyses because the inventory released would not exceed that released during routine operation.

In response to RAI No. 4.d, the licensee provided analyses of doses to the public due to a release of I-131 from the facility stack following a release of 150 Ci of I-131 to the PHC. The licensee performed these analyses using both the Pasquill-Gifford (P-G) methodology and the

COMPLY code; the licensee provided a detailed description of these methodologies, and assumptions used for the analyses, in responses to RAIs No. 4.d through 4.i. These analyses were updated from analyses previously provided in the original amendment request. For these analyses provided in response to RAI No. 4.d, the licensee used the following conservative assumptions:

- Three (3) charcoal filter banks, each with a 99% removal efficiency, are operable, consistent with the minimum requirements of TS 3.11.d.
- No I-131 plate-out occurs within any ventilation ductwork; all I-131 released to the PHC is released from the stack, except for the I-131 that is absorbed by the TS-required charcoal filters.
- Persons downwind of the stack remain in place during the entire time needed for the plume to pass; no credit for evacuation is taken.

Additionally, for the P-G analyses, the licensee provided results based on the assumption of worst-case stability class and wind direction for each receptor location. For the P-G model, the licensee calculated that the highest public dose (effective dose equivalent (EDE) based on thyroid dose) would be 3.03E-4 mrem, received 400 meters north of the facility stack. For COMPLY, the licensee calculated that the highest public dose (EDE based on thyroid dose) would be 1.05E-4 mrem, received 150 meters north of the facility stack at the Emergency Planning Zone (EPZ) boundary.

The NRC staff reviewed the analyses performed by the licensee, and found the licensee's consideration of doses from I-131 only to be acceptable, because the quantities of other radionuclides released during any credible accident scenario would not exceed those quantities released during routine processing of a single target. Since many targets would be processed per year, and since the experiment would be operated in accordance with existing TS 3.7.a, ensuring that annual public doses from routine operation would be within 10 CFR Part 20 limits, the public dose from routine processing of a single target would be only a small fraction of the regulatory limit.

The NRC staff also performed independent confirmatory calculations of public doses from I-131 that could be released as a result of failure of the proposed experiment. The NRC staff performed these calculations using RASCAL STDose version 4.3.1 and the conservative assumptions listed above. In addition, the doses calculated by the NRC staff are total effective dose equivalents (TEDEs) which include the relatively small contribution from external dose from I-131 as well as the EDE from I-131 inhalation. The highest public dose (TEDE) calculated by the NRC staff was 2.2E-4 mrem for a receptor at the EPZ boundary.

As specified in 10 CFR 20.1301, the TEDE to an individual member of the public from the licensed operation of the facility shall not exceed 100 mrem/yr. Based on the above analyses, the TEDE to any member of the public, including contributions from I-131 and other radionuclides that could potentially be released, would be significantly below this limit for any credible failure of the proposed experiment. The NRC staff therefore finds the expected doses to members of the public from any postulated failure of the proposed experiment, as operated in accordance with the materials content limit of proposed TS 3.6.p and the charcoal filter requirement of proposed TS 3.11.d, to be acceptable.

Based on the information above, the NRC staff finds that the proposed I-131 production experiment, operated in accordance with the materials content limit of proposed TS 3.6.p and in accordance with other proposed and existing TSs, will limit radiological doses to the MURR staff

and to the public to values that are within the regulatory limits specified in 10 CFR Part 20, for both routine operation and postulated accident scenarios. In addition, the NRC staff reviewed the basis for the proposed TS 3.6.p and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information provided above, the NRC staff finds that proposed TS 3.6.p is acceptable.

3.1.2.2.2 Proposed Revision to TS 3.6.c

Current TS 3.6.c requires that, where the possibility exists that the failure of an experiment could release radioactive gases or aerosols to the reactor bay or atmosphere, the experiment shall be limited to that amount of material such that the airborne concentration of radioactivity averaged over a year will not exceed the limits of 10 CFR Part 20, Appendix B. Current TS 3.6.c does not apply to fueled experiments, which are subject to materials limits of existing TS 3.6.a.

The licensee proposed to revise current TS 3.6.c to add an additional exception to the TS such that it would no longer apply for non-fueled experiments that are intended to produce I-131. The licensee also requested to change the current TS 3.6.c exception for fueled experiments such that it would be specific to fueled experiments that produce iodine 131 through 135.

The NRC staff reviewed the proposed TS 3.6.c and concludes that the exception for non-fueled experiments that are intended to produce I-131 is acceptable because proposed TS 3.6.p. would establish a more specific materials limit for those non-fueled experiments. The NRC staff also concludes that the proposed (revised) TS 3.6.c exception for fueled experiments is acceptable, because the fueled experiments that are covered by the proposed exception would be subject to the limits in existing TS 3.6.a. In addition, the NRC staff reviewed the basis for the proposed TS 3.6.c, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore the NRC staff finds that proposed TS 3.6.c. is acceptable.

3.1.2.3 Administrative Controls for the Proposed I-131 Production Experiment

Existing TS 6.1 requires administrative controls that are applicable to activities at MURR, including experiments. Specifically, existing TS 6.1.b requires, in part, that written procedures shall be in effect for normal operations, emergencies, and radiological control. As required by existing TS 6.1.c, the MURR organization includes a Reactor Advisory Committee, which shall review any changes to procedures that have safety significance, change the intent of the procedure, or involve an unreviewed safety question pursuant to 10 CFR 50.59. The MURR Reactor Advisory Committee includes a reactor safety subcommittee with administrative requirements to review reactor utilization requests for experiments to be conducted at MURR. The organization and administrative controls of existing TSs 6.1.b and 6.1.c help ensure the conduct of the required reviews and authorizations for experiments; the performance of quality assurance for the design, fabrication, and testing of experiments and their associated components and tools; and the identification, development, and implementation of the written procedures for conducting experiments at MURR. Existing TS 6.1.g requires, in part, that the licensee maintain records of all radionuclide releases from the facility to the environment, including any releases that would result from conduct of the proposed experiment, and existing TS 6.1.h requires, in part, that the licensee make annual reports to the NRC of radionuclide releases. The NRC staff therefore concludes that no changes are necessary to existing TS 6.1 to help ensure adequate administrative controls for activities related to the proposed I-131 production experiment.

3.1.3 Conclusion

The NRC staff reviewed the licensee's proposed changes to TS 3.6 and addition of TS 3.11 concerning the proposed experiment to produce I-131. The NRC staff also reviewed the information and analyses provided by the licensee in the amendment request, as supplemented, in support of the proposed TSs. The NRC staff performed confirmatory calculations to verify offsite dose calculations provided by the licensee for a failure of the proposed I-131 experiment, and determined that the licensee's calculations were performed using acceptable calculational methods with acceptable results. On the basis of its review, the NRC staff concludes that the licensee has shown that it can plan I-131 production experiments that would be conducted in accordance with the proposed TSs 3.6.c, 3.6.p, 3.6.q, 3.11, and with existing TSs. The NRC staff also concludes that the licensee has shown that either the routine operation, or any potential failure, of I-131 production experiments conducted in accordance with the proposed TSs 3.6.c, 3.6.p, 3.6.q, 3.11 and existing TSs would result in doses to MURR staff and to the public that are within the limits of 10 CFR Part 20. The NRC staff has also determined that, since the proposed changes and additions include TS LCOs for design features and operating restrictions as required by section 50.36(c)(2)(ii)(B), and TS LCOs for structures, systems, and components as required by section 50.36(c)(2)(ii)(C), the proposed changes and additions to the TSs are in accordance with 10 CFR 50.36. Therefore the NRC staff concludes that the licensee's proposed changes to TS 3.6 and addition of TS 3.11 are acceptable.

3.2 TS Changes Related to Surveillance Requirements

3.2.1 Proposed (New) TSs

The licensee requests to add new TS 5.7, which provides surveillance requirements for the equipment that would be required by LCO TS 3.11. The proposed (new) TS surveillance requirements requested by the licensee are set forth below.

The proposed TS 5.7, "Iodine 131 Processing Hot Cells," states:

Applicability

This specification shall apply to the surveillance of the equipment needed to safely process Iodine 131.

Objective

The objective of this specification is to reasonably assure proper operation of the equipment needed to safely process Iodine 131.

Specification

a. An operability test of the facility ventilation exhaust system shall be performed monthly.

b. The operability of the facility ventilation exhaust system to maintain the Iodine 131 processing hot cells at a negative pressure with respect to the surrounding areas shall be verified daily prior to any process (channel check).

c. The radiation monitors as required by specification 3.11.c shall be calibrated on a semi-annual basis.

d. The radiation monitors as required by specification 3.11.c shall be checked for operability with a radiation source at monthly intervals.

e. The efficiency of the Iodine 131 processing hot cells charcoal filter banks shall be verified biennially or following major maintenance. It shall be verified that the charcoal filter banks have a removal efficiency of 99% or greater for iodine.

3.2.2 Evaluation of Proposed Changes to TSs for Surveillance Requirements

The proposed TSs described above would require surveillance of equipment that would be used by the licensee in its conduct of the proposed experiment. The safety evaluation in this section focuses on these surveillance requirements, and how they would help to ensure that minimum performance levels of equipment are maintained. The documentation submitted by the licensee supporting the TS amendment request, as supplemented by the RAI responses, was reviewed for conformance with the regulatory guidance listed below.

The provisions of 10 CFR 50.36, "Technical specifications," require licensees to have TSs. Section 50.36(c)(3), "Surveillance requirements," requires that TSs include requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operations will be met. In the case of the proposed experiment at MURR, these systems and components are the ventilation systems, radiation monitors, and carbon filters associated with the I-131 processing hot cells.

American Nuclear Standards Institute/American Nuclear Society (ANSI/ANS)-15.1-2007, "The Development of Technical Specifications for Research Reactors," provides guidance for identifying and establishing the content of TSs for research reactors. (ANSI/ANS)-15.1-2007, Section 4, provides guidance for TSs related to surveillance requirements.

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," and NRC RG 1.140, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," provide guidance for the design, inspection, and testing of charcoal filters used for absorption of radioiodine.

3.2.2.1 Proposed TS 5.7.a

The licensee proposed to add TS 5.7.a, which would require that an operability test of the existing facility exhaust system be performed monthly. The licensee's basis for the proposed TS is that its experience has shown that monthly tests of the existing facility ventilation system are sufficient to ensure proper operation.

The NRC staff reviewed the information above, and noted that while NUREG-1537 and ANSI/ANS-15.1-2007 do not provide recommended surveillance intervals specific to research reactor exhaust systems, they do recommend quarterly operability checks for emergency exhaust systems. Furthermore, ANSI/ANS-15.1-2007 provides guidance that "in general, […] depending on the facility and system, operability checks shall be established from monthly to quarterly." Therefore, based on the guidance provided in NUREG-1537 and ANSI/ANS-15. 1-2007, and on the licensee's history of adequate surveillance with the existing ventilation

system, the NRC staff finds that the proposed monthly surveillance interval specified in proposed TS 5.7.a is adequate to help ensure that the exhaust system that would be required by proposed TS 3.11.a is maintained in an operable condition. In addition, the NRC staff reviewed the basis for the proposed TS 5.7.a, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information provided above, the NRC staff concludes that the proposed TS 5.7.a is acceptable.

3.2.2.2 Proposed TS 5.7.b

The licensee proposed to add TS 5.7.b, which would require that, prior to processing of I-131, daily channel checks would be performed to verify the operability of the facility exhaust system to maintain the I-131 processing hot cells at a negative pressure with respect to surrounding areas. This verification would help to ensure that the facility exhaust system can prevent any leakage of airborne I-131 into areas surrounding the processing hot cells, minimizing doses to MURR staff.

The NRC staff reviewed the information above, and concludes that, by requiring that channel checks be performed prior to I-131 processing, proposed TS 5.7.b would help to provide assurance that the processing cells are at a negative relative pressure during I-131 processing as would be required by proposed TS 3.11.b. In addition, the NRC staff reviewed the basis for the proposed TS 5.7.b, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore, based on the information above, the NRC staff finds that proposed TS 5.7.b is acceptable.

3.2.2.3 Proposed TSs 5.7.c and 5.7.d

The licensee proposed to add TS 5.7.c, which would require that the stack radiation monitor and Iodine-131 Processing Hot Cells Radiation Monitor, which are required by TS 3.11.c, be calibrated semi-annually. The licensee also requested to add proposed TS 5.7.d, which would require that these radiation monitors be tested monthly with a radiation source. In response to RAI No. 13, the licensee stated that the stack radiation monitor required by TS 3.11.c is identical to the stack radiation monitor currently required by existing TS 3.4.a. Existing TSs 5.4.a and 5.4.b require semi-annual calibration and monthly testing, respectively, for the stack radiation monitor required by existing TS 3.4.a. Therefore, for the stack radiation monitor, the licensee concluded that proposed TSs 5.7.c and 5.7.d are consistent with existing TSs 5.4.a and 5.4.b, which have previously been approved by NRC to demonstrate proper performance of the existing radiation monitor.

Also in response to RAI No. 13, the licensee indicated that the manual for the Iodine-131 Processing Hot Cells Radiation Monitor stated that the instrument did not require any particular maintenance, and that the vendor for the instrument confirmed that the instrument does not require periodic calibration. However, the guidance in NUREG-1537 and ANSI/ANS-15.1-2007 recommends that radiation monitoring systems be calibrated annually to biennially, and operability checks of radiation monitoring systems should be verified monthly using a radiation source. Therefore, for the Iodine-131 Processing Hot Cells Radiation Monitor, the licensee concluded that proposed TSs 5.7.c and 5.7.d provide surveillance intervals that are conservative relative to guidance provided by the instrument manufacturer and by NUREG-1537 and ANSI/ANS-15.1-2007.

The NRC staff reviewed the information provided by the licensee, and finds that the surveillance intervals specified in proposed TSs 5.7.c and 5.7.d are consistent with the guidance in

NUREG-1537 and ANSI/ANS-15.1-2007, and conservative relative to manufacturer recommendations. Therefore, based on the information provided above, the NRC staff concludes that the surveillance that would be required by proposed TSs 5.7.c and 5.7.d would help to ensure that the radiation monitors that would be required by proposed TS 3.11.c would remain operable. In addition, the NRC staff reviewed the bases for the proposed TSs 5.7.c and 5.7.d, and finds that they summarize the rationale for the proposed TSs provided in the amendment request, as supplemented. Therefore, based on the information above, the NRC staff finds that proposed TSs 5.7.c and 5.7.d are acceptable.

3.2.2.4 Proposed TS 5.7.e

The licensee proposed to add TS 5.7.e, which would require that the efficiency of the hot cell charcoal filters be verified biennially or following major maintenance. NUREG-1537 and ANSI/ANS-15.1-2007 recommend that efficiency measurements for filters be performed annually to biennially, or following major maintenance. In response to RAI No. 5.d, the licensee stated that guidance provided in NRC RG 1.52 and ASTM D3803-91 would be used to determine carbon filter efficiency measurements. ASTM D3803-91 provides a stringent test method for establishing the capability of carbon to remove iodine from air streams. In responses to RAIs No. 7.a and 7.d, the licensee provided data showing that humidity and temperature conditions for the proposed experiment will be more favorable than ASTM test conditions. In responses to RAIs No. 5.b and 7.a, the licensee provided analyses showing that the long-term iodine loading (which is predominantly stable I-127 from the I-127 impurity in the target material) of the filters will be very low compared to much higher loading levels at which charcoal filters have been shown to maintain their effectiveness. Also in response to RAI No. 7.a, the licensee stated that air contaminants such as gases, organic vapors, and steam that can degrade carbon filter efficiency, will not be present in significant concentrations in the air passing through the hot cell filters.

In its letter dated February 19, 2016, the licensee provided clarification as to the types of activities that would be considered major maintenance, for the purposes of compliance with proposed TS 5.7.e. The licensee stated that activities that would warrant efficiency testing would include certain maintenance activities, as well as other abnormal events, that could have the potential to reduce the effectiveness of the filters. The licensee also stated that it would follow guidance provided in NRC RGs 1.52 and 1.140 in determining whether particular activities or events would warrant filter testing.

Examples of activities or events that would require testing would include, but not necessarily be limited to, weld repairs near filters; painting, fire, or chemical releases in any ventilation zone communicating with the filters; or, the detection of, or evidence of, penetration or intrusion of water or other material into the filters that could have an adverse effect on the functional capability of the filters.

The NRC staff reviewed the information provided by the licensee, and finds that the proposed TS 5.7.e would require carbon filter surveillance at intervals that are consistent with the guidance of NUREG-1537, ANSI/ANS-15.1-2007, and RGs 1.52 and 1.140. The NRC staff also finds that the filters will be used in conditions that are favorable for maintaining iodine removal efficiency over time. Existing TS 6.1 requires administrative controls that would help ensure the adequacy of procedures for performing filter surveillance (see Section 3.1.2.3 for discussion of administrative controls). Therefore, based on the information provided above, the NRC staff concludes that the surveillance requirement of proposed TS 5.7.e is conservative and is appropriate to help ensure that the charcoal filters that would be required by proposed TS

3.11.d would remain operable. In addition, the NRC staff reviewed the basis for the proposed TS 5.7.e, and finds that it summarizes the rationale for the proposed TS provided in the amendment request, as supplemented. Therefore the NRC staff find that proposed TS 5.7.e is acceptable.

3.2.3 Conclusion

The NRC staff reviewed the licensee's proposed addition of TS 5.7 concerning surveillance requirements for equipment required for the experiment to produce I-131. The NRC staff has also reviewed the information provided by the licensee in the amendment request, as supplemented, in support of the proposed TSs. On the basis of its review, the NRC staff concludes that the licensee has shown that the frequency and scope of surveillance, as described in proposed TS 5.7, for equipment required by proposed TS 3.11, are adequate to demonstrate that minimum performance levels of the equipment are maintained. The NRC staff has also determined that, since the proposed changes and additions include surveillance TSs for requirements relating to testing and calibration as required by section 50.36(c)(3), the proposed additions to the TSs are in accordance with the regulations in 10 CFR 50.36. Therefore the NRC staff accepts the licensee's proposed addition of TS 5.7.

4.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.22(a), licensing actions may be eligible for a categorical exclusion if the action does not individually or cumulatively have a significant effect on the human environment. This amendment involves changes in the installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20 (e.g., the operational boundary), and changes in surveillance requirements. This amendment request meets the requirements for the categorical exclusion of 10 CFR 51.22(c)(9) provided it meets each of the criteria below:

(i) The amendment or exemption involves no significant hazards consideration; [10 CFR 51.22(c)(9)(i)]

Under 10 CFR 50.92(c), the NRC may make a final determination that a license amendment involves no significant hazards consideration if operation of the facility, in accordance with the amendment, would not:

(1) involve a significant increase in the probability or consequences of an accident previously evaluated; or [10 CFR 50.92(c)(1)]

As discussed in Section 3.1.2.1 of the evaluation, existing TSs will ensure that any reactivity effects, thermal-hydraulic effects, or mechanical stress effects associated with the irradiation portion of the proposed experiment are within levels that have been determined to pose no safety risk. The processing portion of the proposed experiment will occur in hot cells that are separate from the areas where other experiments or MURR operations activities associated with other previously evaluated accidents occur. Since there will be no interactions between the proposed experiment, and other experiments or other MURR operations activities, that could significantly affect the probability or consequences of failures of other experiments or any other accidents involving the MURR, the NRC staff finds that this amendment does not significantly increase the probability or consequences of an accident previously evaluated.

(2) create the possibility of a new or different kind of accident from any accident previously evaluated; or [10 CFR 50.92(c)(2)]

The only potential accidents associated with the amendment would be failures of the proposed I-131 experiment described in the amendment request. Experiment failures, including experiment failures that could result in a release of I-131 from the MURR to the environment, is a kind of accident that has been previously evaluated. Therefore, the NRC staff finds that this amendment does not create the possibility of a new of different kind of accident from any accident previously evaluated.

(3) involve a significant reduction in a margin of safety [10 CFR 50.92(c)(3)]

The NRC staff finds that existing TSs will ensure that the proposed experiment, which includes irradiation of targets in the graphite reflector region of MURR, would not significantly affect MURR's shutdown margin or other core parameters, as discussed in Section 3.1.2.1 of the evaluation. Therefore, the NRC staff finds that this amendment does not involve a significant reduction in a margin of safety.

Based on the above, the NRC staff concludes that this amendment involves no significant hazards consideration.

(ii) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite; and [10 CFR 51.22(c)(9)(ii)]

The types and amounts of radionuclides generated by irradiation of the targets and released during target processing will not significantly change from the types and amounts of fission products generated by operation of the reactor and by operation of other experiments. Air exiting the processing hot cells is directed through charcoal filters to remove I-131, and any public doses resulting from the routine operation or failure of the processing equipment will be below 10 CFR Part 20 limits. Also, because the processing hot cells are vented to the facility exhaust stack through the facility ventilation system, there is no change in potential release paths from the facility. For these reasons, there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite as a result of this amendment.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure. [10 CFR 51.22(c)(9)(iii)]

The proposed experiment would result in routine, and possible accident, occupational doses that are significantly below 10 CFR Part 20 limits. The accident doses for the proposed experiment are also below those for a previously-evaluated hypothetical failure of a fueled experiment. Additionally, existing TS 6.1 requires administrative controls that would help ensure the adequacy of radiation protection procedures for the proposed experiment, helping to limit individual or cumulative occupational radiation exposure. Therefore, the NRC staff finds that there is no significant increase in individual or cumulative occupational radiation exposure.

Accordingly, this amendment meets the eligibility criteria for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSIONS

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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Date: March 11, 2016