October 10, 2008

Mr. Ralph Butler, Director
Research Reactor Center
University of Missouri—Columbia
Research Park
Columbia, MO 65211

SUBJECT: UNIVERSITY OF MISSOURI—COLUMBIA AMENDMENT RE: FUELED EXPERIMENTS (TAC NO. MD5782)

Dear Mr. Butler:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 34 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 of June 8, 2007, as supplemented on January 10, 2008; April 15, 2008; and September 4, 2008.

The amendment revises the requirements for the conduct of fueled experiments.

A copy of the safety evaluation supporting Amendment No. 34 is also enclosed.

Sincerely,

/RA/

Alexander Adams, Jr., Senior Project Manager
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186

Enclosures:
1. Amendment No. 34
2. Safety Evaluation

cc w/ enclosures:
See next page

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OFFICE	PRTA:LA	PRTA:PM	OGC	PRTA:SC
NAME	EBarnhill eeb	AAdams aa	SUttal su	GCasto for DCollins
DATE	10/08/08	10/08/08	10/10/08	10/10/08

Official Record Copy

UNIVERSITY OF MISSOURI—COLUMBIA

DOCKET NO. 50-186

AMENDMENT TO AMENDED FACILITY LICENSE

Amendment No. 34
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 June 8, 2007, as supplemented on January 10, 2008; April 15, 2008; and September 4, 2008, conforms to the standards and requirements of the Atomic Energy Act of 1954, as amended, and the regulations of the Commission as stated in Title 10, Chapter I, "Nuclear Regulatory Commission," of the *Code of Federal Regulations* (10 CFR Chapter I).

   B. The facility will operate in conformity with the application, the provisions of the Atomic Energy Act of 1954, 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 Hearing on Application under Subpart F of 10 CFR Part 52 for a License to Manufacture Nuclear Power Reactors," 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. 34, 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 GCasto for/

Daniel S. Collins, Chief
Research and Test Reactors Branch A
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Enclosures:
1. Amended Facility License No. R-103
2. Changes to Appendix A, "Technical Specifications"

Date of Issuance: October 10, 2008

ENCLOSURE 1 TO LICENSE AMENDMENT NO. 34

AMENDED FACILITY LICENSE NO. R-103

DOCKET NO. 50-186

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

Remove	Insert
3	3

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. 34, 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

ENCLOSURE 2

TO LICENSE AMENDMENT NO. 34

AMENDED FACILITY LICENSE NO. R-103

DOCKET NO. 50-186

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

Remove	Insert
3.6 page 4	3.6 page 4

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.

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 3.5.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).

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 34 TO

AMENDED FACILITY LICENSE NO. R-103

THE UNIVERSITY OF MISSOURI—COLUMBIA

DOCKET NO. 50-186

1.0 INTRODUCTION

By letter dated June 8, 2007, as supplemented on January 10, 2008; April 15, 2008; and September 4, 2008, the University of Missouri—Columbia (UMC or licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) a request for amendment to the technical specifications (TSs) in Appendix A, "Technical Specifications," to Amended Facility License No. R-103 for the UMC Research Reactor (MURR). The proposed amendment would permit the licensee to conduct fueled experiments that contain inventories of iodine-131 (I-131) through I-135 greater than 1.5 curies (Ci) or inventories of strontium-90 (Sr-90) greater than 5 millicuries (mCi) encapsulated in irradiation containers designed to meet the internal pressure design requirements specified in TS 3.6.i. The current TS 3.6.o only permits such fueled experiments that are vented to the exhaust stack system through high-efficiency particulate air (HEPA) and charcoal filters, which are continuously monitored for an increase in radiation levels. The requested amendment would change the limitations on the performance of fueled experiments.

2.0 BACKGROUND

MURR is a 10 megawatt-thermal research reactor located on the licensee's campus in Columbia, Missouri. The licensee plans to perform an experiment in support of a U.S. Department of Energy program to demonstrate the feasibility of producing the fission product molybdenum-99 (Mo-99) using low-enriched uranium (LEU) foil targets. Most of the world's supply of Mo-99 is produced using highly enriched uranium targets. The use of highly enriched uranium targets is seen as a proliferation issue. Mo-99 is a precursor to the metastable isotope, technetium-99 (Tc-99m), which is used for medical diagnostic procedures. The experiment will include target irradiation, disassembly and digestion, Mo-99 separation and purification, and quality control testing of the Mo-99/Tc-99m product. The licensee will perform quality control testing to determine if the finished product meets the U.S. Pharmacopeia—National Formulary sodium pertechnetate Tc-99m injection monograph acceptance criteria for radionuclide identity, radionuclidic purity, radiochemical purity, and chemical purity. The experiment is based on work that Argonne National Laboratory (ANL) has been performing to develop LEU targets and to separate and purify Mo-99 from LEU targets. The separation and purification process is based on the process used at Citichem, a facility formerly located in New York State that produced Mo-99 from 1970 to 1989.

The TSs for the facility contain limitations on the conduct of fueled experiments. Fueled experiments are those where the irradiation target contains special nuclear material, usually

uranium. Fueled experiments usually have specific TSs that control their conduct, in addition to the TS limitations on the conduct of experiments in general. These additional controls on fueled experiments recognize that the irradiation of special nuclear material results in the production of many isotopes in the form of fission products, some of which are gaseous in nature. Fueled experiments also generate their own heat from the fission process. The current TS limitations on the fueled experiment radioactive material inventory date to 1978. TS 3.6.a limits iodine and Sr-90 inventories, and TS 3.6.o contains an additional requirement for the experiment to be vented to the exhaust stack if the fueled experiment radioactive material inventory exceeds a certain limit.

3.0 EVALUATION

The current TS 3.6.a regarding radioisotope inventory limits for conducting fueled experiments at MURR specifies the following:

> Each fueled experiment shall be limited such that the total inventory of iodine isotopes 131 through 135 in the experiment is not greater than 150 Curies and the maximum strontium-90 inventory is no greater than 300 millicuries.

TS 3.6.a places an upper limit on the inventory of iodine and Sr-90 used in fueled experiments.

The current TS 3.6.o includes further requirements for continuous radiation monitoring and filtered ventilation for fueled experiments that contain greater than specified inventories of iodine and Sr-90. The licensee has requested an amendment to TS 3.6.o, which currently specifies the following:

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

TS 3.6.o currently applies limits to experiments previously performed at MURR that used “unclad” fission targets that were continuously monitored for radiation level and vented through the exhaust stack system. To perform experiments in which a fission target is encapsulated in a sealed irradiation container during irradiation, such as the case for the proposed Mo-99 experiment described in the application, the existing TS requires a change. To conduct the proposed experiment, the licensee requests that TS 3.6.o be revised as follows:

> 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.

Although the irradiation of a fueled target to produce Mo-99 is the reason behind the licensee’s amendment request, the changes to TS 3.6.o apply to any fueled experiment that the licensee proposes.

TS 3.6.i, which is referenced in the licensee's proposed TS, specifies the following:

> Irradiation containers to be used in the reactor, in which a static pressure will exist or in which a pressure buildup is predicted, shall be designed and tested for a pressure exceeding the maximum expected pressure by at least a factor of two (2).

The licensee is not requesting any change in TS 3.6.a or TS 3.6.i.

The licensee described the proposed LEU-foil target experiment in the original license amendment request letters dated June 8, 2007, and January 10, 2008, as comprising the following six major steps:

(1) annular target fabrication
(2) target irradiation
(3) target disassembly
(4) dissolution of the LEU foil
(5) separation of Mo-99 from other fission products
(6) Mo-99 purification

From its experimental review process, the licensee determined that the amendment to the TS was necessary to perform irradiation of encapsulated fueled experiments, such as the proposed LEU-foil target experiment, at MURR. The licensee stated that it will develop a detailed experimental plan and analysis to ensure that the proposed experiment does not pose a significant risk to MURR staff and the general public.

The requirement in TS 3.6.o, which specifies that the experiment must be vented to the exhaust stack, was added to the TS in 1978 because of a specific experiment that involved the irradiation of unclad fuel outside of the reactor pool. The current TS limits result in the following two approaches to controlling the fission product inventories in fueled experiments:

(1) in containers that meet the requirements of TS 3.6.i

(2) not in containers with ventilation to the exhaust stack through radiation-monitored HEPA and charcoal filters

Currently, fueled experiments that contain inventories up to and including 1.5 Ci of I-131 through I-135 or 5 mCi of Sr-90 can be irradiated in containers or vented to the exhaust stack. Fueled experiments that contain inventories greater than 1.5 Ci of I-131 through I-135 or 5 mCi of Sr-90 up to the inventory given in TS 3.6.a of 150 Ci of I-131 through I-135 and 300 mCi of Sr-90 can only be vented to the exhaust stack. The licensee's request would add irradiation in containers as an acceptable method for conducting experiments with iodine and Sr-90 inventories up to the TS 3.6.a limits.

The fabrication of fueled-experiment targets and their sealed irradiation containers and the irradiation of the encapsulated fueled experiments affect the requested TS amendment. The technical evaluation focuses on the conduct of these activities and the radiological consequences of the failure of an encapsulated fueled experiment. The staff is not reviewing the conduct of the experiment to produce the Mo-99. The licensee will review the conduct of the experiment to produce Mo-99 against its procedures and the regulations to determine if any

NRC approval is needed before it performs the experiment. The licensee did provide information on how the irradiation of the proposed fueled targets will be conducted to meet the requirements of other experimental TSs that this license amendment does not impact.

Regulatory Guide 2.2, "Development of Technical Specifications for Experiments in Research Reactors," issued November 1973, 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
(3) the administrative controls employed to evaluate, authorize, and carry out experiments

The documentation submitted by the licensee supporting the TS amendment request and supplemented by the responses to the staff's requests for additional information, were reviewed for conformance with the regulatory guidelines and to verify that no proposed operations will expose reactor operations personnel, experimenters, or the general public to unacceptable radiological consequences.

The physical conditions of the design and conduct of experiments include items such as reactivity effects, thermal-hydraulic effects, and mechanical stress effects. The release of krypton, xenon, and iodine from a 5-gram LEU target is the major source of radiation exposure to an individual and thus forms the basis of the source term for dose calculations. The analysis provided by the licensee showed that the activities of radioiodine and Sr-90 are within the inventory limits specified in TS 3.6.o for a proposed LEU-foil target with a maximum mass of 5 grams, irradiated for a maximum of 150 hours at a maximum thermal neutron flux of $1.5x10^{+13}$ neutrons per square centimeter per second (n/cm^2-sec).

The staff reviewed the licensee's descriptions, analyses, and responses regarding the physical conditions of the design, fabrication, and conduct of encapsulated fueled experiments to verify that experimental review and classification processes, procedures, and quality controls are in place to ensure the adequacy of the safety bases for the TS amendment. For example, MURR reviewed and approved the LEU-foil target assembly and fabrication procedure[1] for the proposed experiment in accordance with its experimental review process. The MURR reactor manager observed a partial target assembly for the first target, including the verification of all materials and weights, process cleanliness, and assembly of the LEU and nickel foils within concentric annular aluminum tubes, performed at ANL. The first target was then shipped to MURR, where it was received and inspected before it underwent final welding and leak testing at MURR in accordance with MURR procedures. Any subsequent targets of the same type needed for the proposed LEU-foil target fueled experiment will be fabricated and assembled entirely at MURR using the ANL procedure.

The experimental plan required by the licensee's experimental review process calls for accurate flux mapping of the selected graphite reflector irradiation position where the irradiation of the encapsulated fission target experiments will be conducted. Procedures are in place to conduct the preexperiment flux mapping to ensure that the thermal neutron flux limits specified for an experiment, which are the basis for the safety analysis, are met. The licensee described the

[1] ANL, which has significant experience in fabricating and assembling annular LEU-foil targets, developed the LEU-foil target assembly and fabrication procedure.

procedures and controls that it used for handling and securing target irradiation containers in the graphite reflector irradiation position.

The licensee will measure the reactivity worth of an encapsulated fueled experiment using MURR procedures before commencing the 150-hour irradiation run to ensure that it does not exceed the reactivity worth limits for an unsecured experiment as specified in MURR TS 3.1.j or to verify whether the target may be classified as a moveable experiment. In addition, a Monte Carlo N-particle transport code calculation will be performed to estimate the reactivity worth of the target before irradiation.

The experimental plan for fueled experiments will include temperature monitoring of the target irradiation container to ensure compliance with MURR TS 3.6.h and TS 3.6.n. These TSs assure the integrity of the irradiation container by limiting the surface temperature of the experiment to below the saturation temperature of the cooling medium and limiting the maximum temperature of a fueled experiment to a safety factor of 2 below the melting temperature of any material in the fueled experiment. For first-of-a-kind fueled experiments, the experimental plan will incorporate a gradual escalation to full power while the temperature of the encapsulated fueled target is monitored, as required by MURR TS 3.6.n.

A potential exists for the buildup of static pressure within a sealed irradiation container such as the capsule employed in the LEU-foil target fueled experiment. The proposed TS 3.6.o amendment refers to MURR TS 3.6.i, which requires irradiation containers to be designed and tested to withstand a static pressure exceeding the maximum expected pressure by a factor of at least 2 to ensure its integrity. The licensee calculated a worst-case maximum internal pressure expected for an irradiation container of the type used in the LEU-foil target fueled experiment to be 283 pounds per square inch (psi) absolute for the highest temperature predicted for an irradiation run. These types of irradiation containers have been designed and pressure tested to withstand a pressure of at least 2000 psi, which provides the necessary safety factor specified in TS 3.6.i.

Based on its review of the licensee's descriptions, analyses, and responses regarding the physical conditions of the design, fabrication, and conduct of encapsulated fission target experiments, the staff concludes that adequate experimental review and classification processes, procedures, and quality controls are in place to ensure the adequacy of the safety bases for the TS amendment. The staff also confirmed that the existing TS 3.6.i limits for pressure, as specified in the proposed TS 3.6.o amendment, and temperature (TS 3.6.h and TS 3.6.n) provide adequate assurance that the integrity of fueled experiment irradiation containers is not compromised.

Current MURR TSs regarding radioisotope limits for conducting fueled experiments at the MURR specify the following:

- radioisotope limits of no greater than 150 Ci on the total inventory of I-131 through I-135 and no greater than 150 mCi for Sr-90 produced by an experiment (TS 3.6.a)

- fueled experiments containing inventories of I-131 through I-135 greater than 1.5 Ci or Sr-90 greater than 5 mCi shall be vented to the exhaust stack system through HEPA and charcoal filters that are continuously monitored for an increase in radiation levels (TS 3.6.o.)

The proposed amendment to TS 3.6.o enables the licensee to conduct fueled experiments containing inventories of I-131 through I-135 greater than 1.5 Ci or of Sr-90 greater than 5 mCi if they are encapsulated in irradiation containers that satisfy the requirements of TS 3.6.i.

In its letters dated January 10, 2008, and April 15, 2008, the licensee described its detailed analysis, including a justification of assumptions, of the radiological impact to persons in the reactor containment area and to members of the public resulting from the failure of a fueled experiment irradiation container. The release of isotopes of krypton, xenon, and iodine from a 5-gram LEU-foil target is identified as the major source of radiation exposure to an individual and therefore serves as the basis of the source term for the licensee's dose calculations. The dose calculations are based on the iodine, krypton, and xenon activities produced by irradiation of an encapsulated 5-gram LEU-foil target for 150 hours at a thermal neutron flux of $1.5 \times 10^{+13}$ n/cm^2-sec in the graphite reflector region of the reactor. This irradiation produces an iodine inventory of 148.3 Ci and an Sr-90 inventory of 14 mCi. This shows that the iodine inventory is limiting for irradiations of fueled experiments. The dose calculations below are based on a source term of 98.9 percent of the TS limit of 150 Ci of iodine and are therefore representative of the TS limits.

In its radiation dose analysis, the licensee made the following three conservative assumptions regarding fission product releases that resulted in highly conservative or noncredible consequence estimates:

(1) Complete failure of the encapsulated target results in 100 percent of the total activity of the target released into the reactor pool.

(2) All of the noble gases (krypton and xenon) are released into the pool water, where they will immediately evolve directly into and disperse uniformly throughout the air volume of the isolated containment structure.

(3) All of the radioiodine is instantly released and uniformly mixed throughout the 20,000 gallons of bulk pool water.

These assumptions do not account for any physical size or form of the material in the fueled experiment. Noble gases can be trapped in the material matrices, and these assumptions do not provide any credit for trapping. There will be a time delay between the time of capsule failure and fission-product release to the containment building environment considering that the target is under 20 feet of pool water. The assumptions ignore radioactive decay during the finite mixing time.

In analyzing the doses to personnel in the restricted area, the licensee made the following two assumptions:

(1) Reactor pool surface radiation monitors detect activity released by the failed target, thus causing a reactor scram and initiating an automatic containment building isolation and a building evacuation alarm.

(2) Evacuation of the containment building is accomplished within 2 minutes of the initiation of the containment isolation and alarm.

The licensee's emergency plan calls for evacuation of the containment area within 2 minutes of a containment isolation alarm. This 2-minute evacuation time is verified and reinforced through periodic training and emergency evacuation drills for all personnel who are authorized to have unescorted access to the building. This justifies the use of the 2-minute evacuation time as the basis for the stay time in the licensee's dose calculations for personnel who are in the containment area during a worst-case fueled experiment target failure.

The licensee also made the following assumption:

(1) During the 2-minute stay time, 40 gallons of pool water containing the estimated radioiodine concentrations from the failed target capsule will evaporate.

With the reactor at full power and the building ventilation system operating, actual daily pool evaporation is about 80 gallons; therefore, only 0.11 gallons of evaporation would be expected to occur in 2 minutes. The 40-gallon evaporation of pool water within the 2-minute stay time is a conservative assumption.

Based on the above assumptions and on the source term data provided, the licensee's analysis determined the following occupational doses to an individual caused by the release of isotopes of iodine and noble gases for a 2-minute exposure in the containment building following an encapsulated fueled experiment target failure:

- committed dose equivalent (thyroid) 206.92 millirem (mrem)
- committed effective dose equivalent (thyroid) 6.21 mrem
- committed effective dose equivalent (noble gases) 1319.22 mrem
- total effective dose equivalent (TEDE) (whole body) 1325.43 mrem

The licensee further stated in its analysis that Sr-90 will contribute an additional 9.15 mrem to the above TEDE (whole body).

The regulatory occupational dose limits specified in Title 10, Section 20.1201, "Occupational Dose Limits for Adults," of the *Code of Federal Regulations* (10 CFR 20.1201) are 50,000 mrem for an individual organ and 5000 mrem for the whole body. Based on the above conservative assumptions and appropriate methods, the TEDE and target organ (thyroid) occupational doses to an individual staff member for a 2-minute stay time exposure following a worst-case fueled experiment target failure are within the occupational dose limits specified in Subpart C, "Occupational Dose Limits," to 10 CFR Part 20, "Standards for Protection against Radiation."

In determining the dose to the general public, the licensee made the following two conservative assumptions regarding fission product releases for a worst-case fueled experiment encapsulated target failure:

(1) The containment building is isolated following an encapsulated target failure, and no increase in pressure within the building results from the target failure.

(2) Most of the leakage pathways from the containment structure will discharge into the surrounding reactor laboratory building where the leakage will mix with the laboratory building air and then be discharged through the still-operating laboratory building ventilation flow, where it is discharged through the facility exhaust stack at a rate of approximately 30,500 standard cubic feet per minute.

These assumptions are reasonable considering the small volume of the target capsule and the physical arrangement of the MURR facility.

The following three assumptions are conservative in estimating a worst-case fueled experiment encapsulated target failure:

(1) A worst-case barometric change of 0.7 inches of mercury occurs in conjunction with the target failure resulting in a 0.33-psi-gauge differential pressure between the interior of the isolated containment building and the interior of the reactor laboratory building.

(2) The isolated containment building will leak at the maximum TS-allowed leakage rate limit, which will result in leakage from containment for 16.5 hours until the pressure is equalized.

(3) Seventy-five percent of the radioiodine activity is deposited in the containment building, and the remaining 25 percent is distributed in the air volume of the containment structure.

Based on the above assumptions and source term data provided, the licensee's analysis determined the following radiation doses to individuals at the point of maximum concentration in the unrestricted area for the 16.5-hour containment building leakage after target failure:

- committed effective dose equivalent (thyroid) 7.21 mrem
- committed effective dose equivalent (noble gases) 1.32 mrem
- TEDE (whole body) 8.53 mrem

As specified in 10 CFR 20.1301, "Dose Limits for Individual Members of the Public," the TEDE to an individual member of the public from the licensed operation of the facility shall not exceed 100 mrem per year. Based on the above conservative assumptions and appropriate methods, the maximum dose calculated for an individual member of the public who was exposed at the point of maximum concentration for the full 16.5 hours that the containment building was leaking during a worst-case fueled experiment target failure is within the radiation dose limits stated in Subpart D, "Radiation Dose Limits for Individual Members of the Public," to 10 CFR Part 20.

Aside from the radioactive materials in the analysis described above, there were no other materials of concern identified that may be used in experiments associated with the amendment to TS 3.6.o.

The staff evaluated the licensee's assumptions and dose calculation methods and found them to be consistent with guidance contained in regulatory guides, NUREG-series documents, and previous NRC licensing actions. The staff reviewed the licensee's assumptions and dose calculation methods and concludes that the licensee is capable of calculating conservative doses for the limiting radiological hazard associated with the TS amendment (i.e., the release of radioisotopes from a failed fueled experiment target irradiation capsule). The licensee has shown that the resulting doses from the analysis of this event are below applicable regulatory limits.

The MURR organization includes a reactor safety subcommittee to review reactor utilization requests for experiments to be conducted at MURR. These organization and administrative controls will 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 procedures for conducting experiments at MURR.

The staff has reviewed the licensee's proposed changes to TS 3.6.o concerning fueled experiments. The licensee has shown that it can plan and carry out fueled experiments in accordance with the proposed changes to TS 3.6.o and with the existing experimental TSs. The staff concludes that the failure of an encapsulated fueled experiment conducted in accordance with the proposed changes to TS 3.6.o and with the existing experimental TSs will result in doses to MURR staff and to the public that are within the limits of the regulations. The staff has also determined that the proposed changes to the TSs are in accordance with the regulations in 10 CFR 50.36, "Technical Specifications." Therefore, the staff accepts the licensee's proposed changes to TS 3.6.o.

3.0 ENVIRONMENTAL CONSIDERATION

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, or changes in inspection and surveillance requirements. The staff has determined that this amendment involves no significant hazards consideration, no significant increase in the amounts or change in the types of any effluents that may be released off site, and 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.

4.0 CONCLUSIONS

The staff has concluded, on the basis of the considerations discussed above, that (1) the amendment does not involve a significant hazards consideration because the amendment does not involve a significant increase in the probability or consequences of accidents previously evaluated, create the possibility of a new kind of accident or a different kind of accident from any accident previously evaluated, or involve a significant reduction in a margin of safety; (2) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities; and (3) such activities will be conducted in compliance with the Commission's regulations, and the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

Principal Contributors: A. Adams, Jr., NRC
M. Villaran, Brookhaven National Laboratory

Date: October 10, 2008