

UNIVERSITY *of* MISSOURI

RESEARCH REACTOR CENTER

February 17, 2012

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Mail Station P1-37
Washington, DC 20555-0001

REFERENCE: Docket 50-186
University of Missouri-Columbia Research Reactor
Amended Facility License No. R-103

SUBJECT: Summary of Anticipated Bases for Exemption from Test-Facility Classification

Dear Sir or Madam:

The University of Missouri-Columbia Research Reactor (MURR) currently operates as a research reactor using highly-enriched uranium (HEU) fuel. Non-power reactor licensees authorized to possess and use HEU fuel are required by 10 CFR § 50.64 to convert to low-enriched uranium (LEU) fuel if federal funding is available unless specifically exempted because of a "unique purpose," as defined in 10 CFR § 50.2. MURR is actively collaborating with the United States Department of Energy (DOE) Reduced Enrichment for Research and Test Reactors (RERTR) Program to find a suitable LEU fuel replacement for its current HEU fuel.

Conversion from HEU to LEU fuel will require MURR to increase its operating power level to approximately 12 MWt. This increase is required to ensure efficient and effective use of the facility by preserving an acceptable level and spectrum of key neutron fluxes to continue to meet the scientific mission of the facility. For this reason, MURR will request an exemption from the definitions of "testing facility," "testing reactor," and "research reactor" (found in 10 CFR §§ 50.2, 100.3, 170.3 and 171.5), to the extent that each refers to a power level limit of 10 MWt.

MURR representatives and NRC Staff met on November 10, 2011, and discussed MURR's plan to request an exemption from the above-noted regulatory definitions. During that meeting, the NRC requested that MURR provide a summary of its anticipated bases for this exemption. In what follows, MURR provides a summary of the bases for such a request. This letter does not constitute MURR's exemption request but is intended to permit the NRC to identify areas of regulatory concern, if any, for MURR to address in its formal request.



ADD
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I. Background

MURR holds Amended Facility License No. R-103, issued on October 11, 1966, and pursuant to 10 CFR Part 50, authorizing the University of Missouri (MU) to operate the facility as a research reactor, initially up to a maximum steady-state power level of 5 MWt. On July 9, 1974, Amendment No. 2 was issued by the NRC authorizing the University to operate the research reactor at steady-state power levels up to 10 MWt.

MURR is a multi-disciplinary research and education facility providing a broad range of analytical, radiographic and irradiation services to the research community and the commercial sector. MURR staff and colleagues perform research for improving medical diagnostic tools and finding ways to battle cancer and other diseases with radioisotopes. MURR is a leader in radiopharmaceutical research, which is used for detecting and treating cancer and other chronic human diseases. Additionally, MURR is currently assisting MU's International Institute for Nano and Molecular Medicine in completing the pre-clinical development of new boron compounds to enhance Boron Neutron Capture Therapy (BNCT) for treating cancer.

MURR's focus on interdisciplinary research and development also contributes to the University's educational mission, providing rich research and training opportunities for an international population of graduate and undergraduate students. MURR-based projects cover such disciplines as anthropology and archaeology, chemistry, engineering (chemical, electrical, mechanical and nuclear), geology, materials science, medical and life sciences (including cancer diagnostics, treatment and prevention), nutrition, physics and veterinary medicine. In addition to MU students, over a five-year period MURR typically accommodates an average of over 300 faculty/research scientists and approximately 150 graduate students from the MU System (*including the Columbia, Rolla, St. Louis and Kansas City campuses*) and over 100 students from other universities who performed research involving the facility.

As an integral component of MU's campus-wide interdisciplinary research and education initiatives, MURR scientists provide lectures and demonstrations for approximately 30 MU classes each year that illustrate scientific and engineering concepts. MURR scientists and engineers conduct facility tours for over 1,000 persons each year from state, national, and international groups, professional and student chapters of organizations (*e.g., the Institute of Nuclear Materials Management*), secondary science and math classes, government and industry. MURR scientists also participate in more extensive laboratory experiences to support classes at MU and other schools for students in Chemistry/Radiochemistry, Physics and Engineering. In a recent five-year period, students conducting thesis research at MURR earned 51 doctoral, 36 master and 3 bachelor degrees.

Since July of 2011, MURR has received \$1.3M in grant funding. This includes new awards as well as cost extensions for existing awards for 13 projects. A total of \$13.5M in proposals has been submitted for the current fiscal year for 31 projects. This includes \$5.4M for proposals at MURR and \$8.1M for proposals directly involving MURR individuals through other departments.

II. Planned Exemption Request

MURR's conversion from HEU to LEU will use a monolithic fuel design developed by the DOE under the RERTR Program. One of the characteristics of this fuel is very high uranium densities. A study sponsored by the RERTR Program determined that to maintain safety margins during operations, allow sufficient operating cycle lengths for efficient and effective use of the facility, and preserve an acceptable level and spectrum of key neutron fluxes to continue to meet the scientific mission of the facility, use of this LEU fuel system will require increasing the MURR operating power level about 2 MWt to approximately 12 MWt. Current regulations state that a reactor operating above 10 MWt is categorized as a test reactor. As discussed herein, MURR does not believe that the NRC should change the status of its reactor to a test facility based on the increase in reactor power because doing so would constitute an unintended adverse consequence of its satisfaction of RERTR objectives.

Pursuant to 10 CFR §§ 170.3 and 171.5, a research reactor is defined as:

a nuclear reactor licensed by the Commission under the authority of subsection 104c of the [Atomic Energy Act of 1954] and pursuant to the provisions of § 50.21(c) of this chapter for operation at a thermal power level of 10 megawatts or less, and which is not a testing facility

In contrast, a "testing facility" is a nuclear reactor, also licensed under subsection 104c of the Atomic Energy Act (AEA), that is authorized to operate at power levels greater than 10 MWt, or under certain other limited circumstances.¹

After the power uprate required for conversion to LEU fuel, MURR's purpose, use and function would be unchanged. It would remain a reactor used for research. Yet, as a result of the approximately 2 MWt increase in power, MURR would not meet the regulatory definition of a research reactor. Accordingly, in order to comply with 10 CFR § 50.64 and convert to the use of LEU, MURR will request an exemption from the 10 MWt threshold stated in the definitions of "research reactor," "testing facility" and "testing reactor" in 10 CFR §§ 50.2, 100.3, 170.3, and 171.5, to allow operation at approximately 12 MWt using the new LEU fuel design.

III. Basis for Exemption

Because the NRC's definitions of "research" and "testing" facilities are found in Parts 50, 100, 170, and 171, exemption from the relevant sections of each of those parts is needed.² The provisions of 10 CFR § 50.12, however, are the most prescriptive of the exemption provisions. For that reason, the following discussion of how § 50.12 is satisfied substantively addresses the exemption requirements for the other Parts. Section 50.12(a) states that the NRC may grant exemptions which are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and

¹ 10 CFR § 170.3; *see also* 10 CFR §§ 50.2, 140.3, 171.5.

² Parts 50, 170, and 171 have exemption provisions, but Part 100 does not.

security. In addition, the NRC will not consider granting an exemption unless special circumstances are present.

A. *The exemption is authorized by law.*

Issuance of the exemption is authorized by law and would not conflict with any provision of the AEA, the National Environmental Policy Act (NEPA), or any other relevant law.

B. *The exemption does not present an undue risk to the public health and safety.*

Allowing MURR to maintain its “research reactor” status while operating at a power level of approximately 12 MWt with LEU fuel will not present an undue risk to the public health and safety. The basis for this conclusion will be fully set forth in a Preliminary Safety Analysis Report. Although this report is not yet complete, the primary bases for its conclusions and bounding descriptions are as follows:

- MURR’s power uprate will not increase the radiological risk to the public. Argon-41 is the principal source of airborne radioactivity (>99%) released from the facility during normal operations. Argon-41 is produced when naturally occurring Argon-40 in air (~1.0%) is activated by thermal neutrons. The principle Argon-41 production areas within the reactor include the pneumatic tube system, the thermal column and the beamports. The Argon-41 produced in these areas is then subsequently released to the atmosphere through the facility ventilation exhaust stack. The risk from Argon-41 to the public is minimal, with an estimated dose of only 0.5 mrem/year to an individual standing 150 meters from the facility, and 3 mrem/year to the closest resident (760 meters from the facility). The amount of Argon generated or released as a result of the fuel conversion will not significantly change.
- Another method of assessing risk from the estimated doses is to compare them to natural background dose rates. The average whole body dose to an individual in the United States is generally considered to be approximately 360 mrem/year. Since an uprate in power level to approximately 12 MWt is required for a conversion to LEU fuel to achieve about the same thermal flux level in the reactor reflector area, the Argon-41 produced at 12 MWt with LEU fuel is approximately the same as that produced at 10 MWt with HEU fuel. Additionally, with LEU fuel, there will be almost nine times more uranium in the reactor core, which provides a significant increase in the gamma shielding provided by the core from the gamma radiation produced by fission. This results in a lower gamma radiation level outside the core at 12 MWt with LEU than currently occurs at 10 MWt with HEU fuel. Finally, while doses from the Maximum Hypothetical Accident (MHA) at a power level of 12 MWt with LEU fuel are approximately 20 percent higher than those at 10 MWt with HEU fuel, they are still far below the applicable 10 CFR Part 20 regulatory limits, which are generally used by the NRC staff when comparing the results of an accident analysis.

- Operating at a power level of approximately 12 MWt will not decrease MURR's margins of safety. An LEU core operating at 12 MWt will have the same steady-state operational safety margins as does the current HEU core at 10 MWt.

Thus, operating MURR at a power level of approximately 12 MWt in order to continue to conduct research activities will not lead to an increase in hazards to the MURR staff or the public or an undue risk to public health and safety. Accordingly, continuing to categorize MURR as a research reactor, rather than changing its status to a test reactor, would **not** contravene the safety basis inherent in the NRC's distinction between research and testing facilities. Thus, categorizing MURR as a "testing facility" is unnecessary to achieve the underlying purpose of distinguishing between research reactors and testing facilities. In addition, other than the minimal increase in MURR's power level to that assigned to testing facilities, MURR will exhibit no other characteristic of such a facility in design, use or purpose.

C. *The exemption is consistent with the common defense and security.*

The RERTR Program supports the minimization and, to the extent possible, elimination of the use of HEU in civil nuclear applications by working to convert research reactors and radioisotope production processes throughout the world to the use of LEU.³ Such conversions have been, and continue to be a national and international priority for reducing the risk of weapons grade nuclear material proliferation. The increase in power level is driven solely by MURR's conversion from HEU to LEU fuel in order to satisfy the objectives of the RERTR Program. In contrast, increasing MURR's thermal power as required by the conversion while retaining MURR's categorization as a research reactor will not create or exacerbate risk to the common defense or security.

D. *Special circumstances are present.*

10 CFR § 50.12(a)(2) states that special circumstances are present whenever any of six listed circumstances exist. The NRC will not consider granting an exemption unless one of the six special circumstances is present. MURR has evaluated these special circumstances and considers the following three most applicable to the subject request:

1. ***There is present any other material circumstance not considered when the regulation was adopted for which it would be in the public interest to grant an exemption.***

Clearly, in this instance, neither the NRC nor DOE contemplated the material circumstance of inadvertently causing a research reactor, which contributes to the public good, to shoulder the burden of additional requirements applicable to a test reactor when taking steps to satisfy 10 CFR § 50.64, at the time 10 CFR § 50.64 was issued in 1986. Also, launching the RERTR initiative in 1978 is a material circumstance not considered when the testing-facility definition was adopted in 1960. MURR's research has not identified any legislative or regulatory history that addresses the fact that research reactors may have to change license status as a result of their compliance with

³ Argonne National Laboratory, Reduced Enrichment for Research and Test Reactors Mission Statement, available at <http://www.rertr.anl.gov/>.

the RERTR program. Nor did it identify any language that commented on the need for research reactors affected in this manner to shoulder the adverse consequences associated with a change of reactor status.

Given that MURR is the only university research reactor licensed to operate at 10 MWt, it is also the **only** university research reactor in the nation negatively impacted as a result of acting in the national interest and converting to LEU.⁴ Without an exemption, MURR will be forced to comply with regulations applicable to test reactors even though it will continue to engage in the research activities discussed above and not engage in the kinds of activities historically associated with a testing facility. Finally, MURR had no way of anticipating it would need to convert to LEU or the impact of such conversion on its operating characteristics when it was initially licensed and when it subsequently received a power uprate amendment.

2. *Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.*

The distinction between a research reactor and a test reactor is the magnitude of the potential hazards arising from their intended use. In particular, a test reactor would involve more significant potential hazards than a research reactor.⁵ The additional “significant hazards considerations”⁶ have not been specifically stated, but in our view, would reasonably involve matters like potential additional radiological risk to the public, decreased margins of operation, and the need for additional security measures. In this instance, none of these additional considerations exist.

3. *Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.*

Compliance with the additional regulations that apply to testing facilities would result in undue hardship and other costs to MURR that are significantly in excess of those incurred by other similarly-situated facilities and seemingly in conflict with RERTR program objectives. As discussed above, MURR provides several public services, including development of cancer-treatment isotopes and other research and training opportunities. MURR plays a leading role in

⁴ See NUREG-1350 at Appendix E.

⁵ See Letter from H. L. Price, Director, Atomic Energy Commission Division of Licensing and Regulation to C. Rogers McCullough, Chairman, Atomic Energy Commission Advisory Committee on Reactor Safeguards (Mar. 5, 1958) (explaining that the definition of “testing facility” was developed to include most reactors that are likely to involve “more significant hazards considerations”), ADAMS Accession No. ML021960128. The letter states that the definition of a testing facility “will include most reactors which are likely to involve the more significant hazards considerations,” but acknowledges the possibility that the definition may cover reactors involving “fairly routine hazards questions.” The bright line testing-facility definition was chosen primarily due to its “easy application in a regulatory context.” As explained above, however, a power uprate to 12 MWt will not increase MURR’s potential hazards so it does not meet the intent behind the testing-facility definition.

⁶ See *id.*

radiopharmaceutical research, which is used for detecting and treating cancer and other chronic human diseases, and is currently assisting the MU's International Institute for Nano and Molecular Medicine in completing the pre-clinical development of new boron compounds to enhance BNCT for treating cancer. Additionally, MURR provides significant research and training opportunities for its graduate and undergraduate students. Classification as a testing facility would greatly burden MURR by increasing security costs and regulatory review fees, requiring additional inspections, and adding infrastructure costs when the reactor has not substantively or materially changed. Draining funds from MURR to attend to administrative and regulatory expenditures unnecessary to protect public health and safety or the common defense and security will unnecessarily and substantially impact MURR's ability to promote its research mission and provide public services. No commensurate public or regulatory benefit will result from forcing MURR to comply with burdens placed on testing facilities.

MURR is and will continue to be comparable to other research reactors, especially other university research reactors that converted to LEU, in essentially all material respects except for its operating power level. On the other hand, MURR has little in common with testing facilities. Operating as a "testing facility" would add increased regulatory burdens—substantive, procedural and financial—on MURR that none of the other university research reactors that have converted to LEU fuel incurred.

For example, if MURR was reclassified as a test facility, its activities would be subject to additional, unwarranted burdens. Its license amendment applications would be considered for review by the Advisory Committee on Reactor Safeguards pursuant to 10 CFR § 50.58(b)(2), which involves unnecessary additional fees without an apparent safety benefit. Similarly, test reactor license amendment applications are subject to adjudicatory hearings, which involve additional expenditures and fees.⁷ MURR believes that its activities already receive an appropriate level of regulatory scrutiny and public transparency. As such, these additional burdens without benefit to MURR or the public appear to be unnecessary. Additionally, pursuant to 10 CFR § 50.71(b), testing facility licensees must submit an annual financial report, including certified financial statements, to the Commission, which is another unnecessary burden without apparent benefit.

Moreover, pursuant to 10 CFR § 50.10(a)(2)(x), research reactors are excepted from a construction permit requirement for "the erection of buildings which will be used for purposes other than operation of a facility and which may also be used to house a facility (e.g., the construction of a college laboratory building with space for installation of a training reactor)," while testing facilities are not. Consequently, if MURR sought possible future improvements entailing construction, it would be saddled with a permit requirement that is unnecessary since its power uprate will not materially change the research character of the reactor. Construction permits can cost from tens to hundreds of thousands of dollars, which would create a financial drain on MURR funds that could be better spent furthering its research and development

⁷ 10 CFR § 50.58.

activities. Furthermore, adequate safeguards are already in place to ensure that new university construction is safe and not adverse to the public interest.

IV. Conclusion

In order to comply with 10 CFR § 50.64 while continuing to meet its scientific mission, MURR plans to request an uprate of its authorized power level to approximately 12 MWt, placing it within the definition of a "testing facility" or "testing reactor." Thus, MURR plans to seek to retain its "research reactor" status through issuance of an exemption from the 10 MWt threshold in the definitions of "research reactor," "testing facility" and "test reactor" to permit power levels to approximately 12 MWt, based on the information summarized above. Please provide us with feedback regarding any areas of significant regulatory concern upon review of this letter.

Respectfully submitted,



Ralph A. Butler, P.E.
Director

xc: Reactor Advisory Committee
Reactor Safety Subcommittee
Dr. Robert Duncan, Vice Chancellor of Research
Mr. Alexander Adams, U.S. NRC
Mr. John Adams, U.S. NRC
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