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December 27, 2000

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attn: Document Control Desk

Dear Sir or Madam:

The University of Missouri ("MU") applies for an amendment to Facility Operating License No. R-103 (Docket No. 50-186) to change the expiration date for its research reactor ("MURR"). The enclosed license amendment application would extend the expiration date for the MURR license from November 21, 2001, to October 11, 2006. Issuance of the requested license amendment would allow MURR to operate for the full forty (40) years as permitted by 10 C.F.R. § 50.51.

The present operating license term for MURR is based on the Nuclear Regulatory Commission ("NRC") policy in effect prior to the 1982 determination by the Commission that the 40-year term of operation may begin upon issuance of the first operating license, rather than upon issuance of the construction permit ("CP"). Thus, the present MURR operating license term commences upon the CP issuance date of November 21, 1961. Accordingly, the MURR operating license currently is scheduled to expire on November 21, 2001 (*i.e.*, forty years after issuance of the CP).

Since 1982, the NRC has accepted and approved requests to amend existing power and non-power reactor operating licenses to change the license expiration date and recapture the time between the effective dates of the CP and the initial operating license. More than 50 such license amendments have been granted by the NRC, including those for research reactors operated by the Massachusetts Institute of Technology Research (R-37/50-20) and Rhode Island (R-95/50-193). Based on the enclosed request, the proposed 40-year license term for MURR would commence on October 11, 1966 (*i.e.*, issue date of the facility operating license) and end on October 11, 2006.

The proposed license amendment is largely administrative in nature, as it does not effect the design, operation, or technical specifications of the facility. Based on a review of the MURR Hazards Summary Report, the University of Missouri concludes that the proposed amendment does not involve significant hazard considerations. Similarly, the University of Missouri also has determined that the environment will not be adversely affected by the proposed change in the

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MURR license term. Therefore, the proposed amendment requires preparation of an environmental assessment and finding of no significant impact. Such action is consistent with the NRC's precedent for similar amendment requests.

Based on our safety and environmental reviews, the University of Missouri requests that the MURR operating license expiration date be changed from November 21, 2001, to October 11, 2006.

Sincerely,

Edward A. Deutsch, Ph.D.
Director

EAD:dcp

Enclosure

cc: Mr. Al Adams, USNRC
Mr. Craig Bassett, USNRC

ENCLOSURE

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket No. 50-186
	)	Facility Operating License
UNIVERSITY OF MISSOURI	)	No. R-103
	)	
UNIVERSITY OF MISSOURI RESEARCH	)	License Amendment Request
REACTOR (MURR)	)	No. 32
	)	

Pursuant to 10 C.F.R. § 50.90, the University of Missouri hereby applies to amend its Research Reactor Operating License No. R-103. The purpose of this license amendment is to change the term of the license to permit 40-years of operation for the facility, calculated from the date of issuance of the operating license.

Information regarding the proposed amendment is provided in Attachments A and B of this enclosure.

The change has been reviewed and is considered not to involve a significant hazard consideration, as defined in 10 C.F.R. § 50.92, and to have no significant environmental impact. Further, there is reasonable assurance that the health and safety of the public will not be adversely affected by the proposed change.

Sincerely,

Edward A. Deutsch, Ph.D.

GIVEN under my hand and notarial seal this day of 27th day of ~~No~~ Dec., 2000.

Michelle M. Blevins
Notary Public

My Commission Expires: 2-10-2003

MICHELLE M. BLEVINS
Notary Public-Notary Seal
STATE OF MISSOURI
CALLAWAY COUNTY
My Commission Expires: Feb. 10, 2003

ATTACHMENT A

UNIVERSITY OF MISSOURI RESEARCH REACTOR (MURR)
40-YEAR OPERATING LICENSE APPLICATION

ATTACHMENT A

UNIVERSITY OF MISSOURI RESEARCH REACTOR (MURR) 40-YEAR OPERATING LICENSE APPLICATION

1.0 DESCRIPTION OF THE AMENDMENT

This License Amendment Request proposes to revise License Paragraph 4, on Page 4 of the license issued on October 11, 1966.

The proposed amendment would change the expiration date for the facility Operating License R-103 from midnight, November 21, 2001, to midnight, October 11, 2006.

A mark-up of the relevant page from the license is included as Attachment B.

2.0 DESCRIPTION AND HISTORY OF THE FACILITY

The University of Missouri Research Reactor ("MURR") is situated on a 7.5-acre lot in the central portion of the University Research Park, an 84-acre tract of land approximately one mile southwest of the University of Missouri at Columbia ("MU") main campus. The campus is situated in the southern portion of Columbia, a city with a population of approximately 69,101 (1990 U.S. Census Bureau). Columbia is the county seat and largest city in Boone County, Missouri.

The MURR is a pressurized, reflected, light water moderated and cooled, heterogeneous system designed for operation at a maximum steady state power level of 10 Megawatts thermal ("MWt"). It accommodates an experimental position (flux trap) through the center of the core which is external to the reactor pressure vessel. A flux trap-type reactor is characterized by a thin fuel region adjacent to a moderator which thermalizes the neutrons and causes the thermal flux to peak in a region accessible for experiments. It also provides relatively high beam tube currents resulting from the high power density.

The reactor is located eccentrically within a cylindrically shaped aluminum pool liner approximately 10 feet in diameter and 30 feet deep. The reactor fuel is covered by approximately 23½ feet of shielding water during reactor operation. The pool liner is surrounded by and anchored to a reinforced concrete edifice (biological shield). The biological shield is a massive bulk shield structure varying in thickness from five to 6½ feet, with the smaller dimension at the top.

The reactor pool and control room are enclosed in a multi-story, reinforced concrete containment building with inside dimensions of approximately 67 feet by 62 feet by 64½ feet high. Completely encircling the reactor containment building and extending one story above grade level is a structure containing laboratories and supporting facilities. Surrounding the reactor containment building on three sides below grade level is an excavated area which contains process equipment, demineralizer columns for the primary and pool coolant systems, and radioactive liquid waste retention and disposal facilities.

The MURR is owned by the Curators of the University of Missouri and is operated by a qualified staff that promotes basic and applied research in neutron-related science and engineering. It provides an educational opportunity for students in these fields, as well as radiation and isotope production services for medical research, general research, and public and private consumers. Through its programs in life sciences, healthcare, and radiopharmaceuticals, MURR also is a key component in the MU program to achieve National Cancer Institute designation as a Comprehensive Cancer Center.

The analyses presented in the Hazards Summary Report ("HSR") demonstrate that the MURR can be operated safely, and that it will not constitute an undue hazard or risk to the health and safety of the reactor facility staff and the general public. The Nuclear Regulatory Commission ("NRC") reviewed the HSR as a licensing basis document. With more than 34 years of established operating experience, the MURR has continuously demonstrated safe and reliable facility operation.

The MURR first achieved criticality with a 5.2 kg uranium alloy fuel core on October 13, 1966. Although originally designed for 10 MWt operation, the Atomic Energy Commission ("AEC"), predecessor to the NRC, initially licensed MURR to operate at only 5 MWt, pending sufficient reactor utilization and operating experience justifying full power operation. Prior to operation at 5 MWt, the University of Missouri performed an extensive low power testing and calibration program to verify critical physics and plant parameter compliance with the facility operating license. The reactor operated at 5 MWt for the first time on June 30, 1967. On July 14, 1969, the facility initiated a 5 MWt, 100 hours per week operating schedule. The licensee installed additional cooling equipment and modified the process instrumentation and safety systems to facilitate operation of the reactor at the full design power of 10 MWt. On July 9, 1974 the AEC issued Amendment No. 2 to the facility operating license authorizing the University to operate the MURR at steady state power levels up to a maximum of 10 MWt.

Since achieving initial criticality, the reactor has operated safely for over 200,000 hours. It has done so in support of its primary mission of providing the maximum flux, or current, of neutrons to the maximum number of users without endangering public health and safety. There have been no significant adverse operational occurrences over the course of MURR's operating history.

3.0 SAFETY EVALUATION

The purpose of this safety evaluation is to determine whether the proposed recapture of the 40-year operating license term would adversely affect the health and safety of the public. Most of the information that follows summarizes existing programs and activities that have been previously reviewed, approved, or provided to the NRC.

By way of overview, Section 3.2 outlines administrative programs that assure continued safety through the operating lifetime of the plant. Section 3.3 summarizes the plant material performance and maintenance/testing programs in place which have ensured safe facility operation for over 30 years. The latter section also provides assurances for continued functional capability of safety-related components, systems, and structures through at least 40 years of plant operation, as originally intended.

In summary, the activities and programs described below provide assurance that continued operation for a 40-year term, calculated from the issue date of the facility operating license, are consistent with the protection of public health and safety.

3.1 JUSTIFICATION

MURR has assessed the safety of plant design and facility operation for the proposed 40-year term of operation. Based on this assessment, as provided in Section 3.0 of this attachment, MURR concludes that plant safety will be maintained during the requested 40-year operating term. This conclusion is supported by the following factors: (1) the MURR facility has been analyzed for at least 40 years of operation; (2) the equipment, structures, and materials were purchased or constructed based on operation of at least 40 years; and (3) the original inspection and maintenance program activities imposed by regulation and the facility operating license, including technical specifications, were developed to be applicable for at least 40 years of plant operation -- consistent with industry standards and precedent.

The MURR staff has reviewed the HSR and its supplements to ensure that 40-year operation of the unit, commencing with the effective date of the operating license, is consistent with the previously evaluated environmental effects, as addressed in past license amendments. The results indicate that no additional significant environmental impacts beyond those considered under current operations are involved with the proposed 40-year operating term. A summary of the environmental aspects of facility operation is provided in Section 3.4 of this attachment.

Benefits expected from the extended operating period include: (1) continued availability of reliable source for the production of radiopharmeceuticals for cancer (and other illnesses) research and treatment; (2) continued availability of irradiation research activities; (3) continued availability of facilities for the education at both undergraduate and graduate levels of study; and (4) continued benefit to the state and local area economies by attracting industry and research fellows. It is fully expected that these and other benefits (*i.e.*, economic, research, social, and educational in nature) would continue throughout the proposed license term.

3.2 ADMINISTRATIVE ASPECTS OF THE FACILITY

3.2.1 Hazards Summary Report and Licensing Basis Document Updates

The HSR is an overview of the detailed analyses originally submitted to the Commission as part of the facility's licensing basis. The purpose of the HSR is to document the technical bases upon which the facility was originally licensed. The HSR and its supporting analyses are updated through a controlled process and updates are provided to the NRC Staff in a Reactor Operations Annual Report.

3.2.2 Operator Training Program

3.2.2.1 Initial Operator Training

Licensed operator trainees (including reactor operator candidates, senior reactor operator upgrade candidates, and instant senior reactor operator candidates) typically are assigned to an

operating crew for a period of approximately 6 months. During this time, the trainees participate in on-the-job training, self-study, system checkouts, and lectures.

Prior to sitting for the NRC license examination, trainees are required to demonstrate their ability to operate facility systems and equipment in a safe manner by completing a qualification card, passing in-house oral and written examinations, and performing operational activities under the supervision of reactor management and other licensed personnel.

The Reactor Operator Qualification Card contains a listing of activities that must be performed satisfactorily by each trainee. These activities are evaluated and signed-off by licensed personnel and require a demonstration of in-depth knowledge about the following:

- each facility system, its function, and operation;
- the Site Emergency Plan and procedures;
- Reactor Emergency Procedures;
- health physics and radiation protection basics;
- Technical Specifications;
- Standard Operating Procedures; and
- selected Titles of the *Code of Federal Regulations*.

The qualification card also requires the performance of designated tasks related to:

- normal facility operation;
- reactivity changes;
- abnormal events; and
- emergency situations.

3.2.2.2 Operator Requalification Program

The licensed operator requalification program has been reviewed and approved by the NRC Staff in numerous inspections in recent years. The MURR operator requalification program is designed in accordance with the guidance provided in NUREG-1478, "Non-Power Reactor Operator Licensing Examination Standard." The 24-month requalification cycle for each licensed individual consists of the following components:

- Required operation: Licensed personnel perform and document designated operational functions for a minimum of four hours per calendar quarter.

- On-the-job training: This component of the program ensures that operators maintain competence related to major evolutions. These major evolutions include reactor start up, power level changes, and reactor shutdown, as well as instrument checks, and refueling operations.

- Document review (*i.e.*, required reading): This review ensures all licensed individuals are cognizant of design, procedure, and license changes. Part of the

on-the-job training checklist is a mandatory review of all abnormal and emergency procedures.

- Annual operating examination: Observation and evaluation of performance of licensed operators by the Operations Training Coordinator, the Reactor Manager, or the Assistant Reactor Manager. Additionally, the on duty licensed operators participate in the annual emergency drill.

- Biennial written examination: Licensed operators must take a written exam administered by the facility in accordance with the guidance provided in ES-401N of NUREG-1478, "Non-Power Reactor Operator Licensing Examination Standard."

Results from licensed operator requalification examinations administered over the past five years indicate a 100% pass rate. The MURR requalification program is reviewed by the NRC Staff as part of the routine inspection process.

3.2.3 Emergency Planning

In July 1984, the NRC Staff reviewed and approved the Emergency Plan for MURR. The plan has been supplemented and improved upon since then to address MURR drill critique comments and comments from the NRC Staff. It meets the requirements of 10 C.F.R. Part 50, Appendix E, and the guidance provided in Regulatory Guide 2.6 and ANSI/ANS 15.16-1982. The plan is designed to cope with emergencies, which arise as a result of, or in connection with, reactor operations and the conduct of experiments at MURR.

The plan specifies the objectives and implementing procedures to be followed during emergency situations at MURR. Major objectives focus on: timely notification of federal, state, and local authorities; protection of the public; and, protection of facility personnel. The plan establishes guidelines and designates areas of responsibility for the MURR staff and other personnel who would augment the on-shift staff for emergency response. Additionally, the plan describes a line of succession for key members of the emergency organization. Support services that are provided by other organizations include fire fighting assistance, ambulance and medical services, hospital facilities, and security/law enforcement assistance.

The emergency plan describes three standardized classes of emergency situations grouping the accidents according to the severity of off-site radiological consequences. Emergency response measures for each emergency class include: activating the emergency response organization; assessing actions; corrective actions; and protective measures.

Maintaining emergency preparedness at MURR is accomplished by means of training, drills and exercises, plan review and update, and periodic equipment inventory and maintenance. Drills and exercises are critiqued to enhance the program, the procedures, and personnel performance.

3.2.4 Radiological Protection Program

The MURR Radiation Protection Program protects the health and safety of the MURR staff, research associates, students, and the general public. This program supports the R-103 facility license as well as the other NRC and state-issued materials licenses and registrations. The elements of the program are designed to ensure compliance with the requirements of 10 C.F.R. Parts 19 and 20, and its companion regulations. Additionally, the program's radiation safety goals and ALARA concepts are more restrictive than regulatory requirements. The MURR Directors' Office ensures that adequate resources, both personnel and equipment, are available for effective program implementation.

The MURR Health Physics Manager is the site's radiation safety officer. Annual audits are conducted of the radiation protection program and the ALARA program. An Isotope Use Subcommittee ("IUS") serves as an advisory group to the Reactor Advisory Committee regarding radiological matters involving the R-103 license.

MURR incorporated three classification levels of radiation safety training into the overall MURR personnel training scheme, based on competency and skill: 1) Class III, which is required for all workers needing unescorted access to the facility and provides basic health physics principles; 2) Class II, which provides a more advanced form of radiological control training that ensures workers are aware of proper practices while performing tasks within the facility; and 3) Class I, which is needed to direct or supervise radiologically-related work. Records of formal training conducted at MURR are maintained by the health physics organization.

Effluent and environmental monitoring information can be found in Section 3.4 of this attachment.

3.2.5 Security Program

The Security Plan at MURR has been approved by the NRC Staff and is periodically monitored by the Staff during routine inspections. The purpose of the MURR security program is to protect against the theft of special nuclear material ("SNM"), in accordance with the requirements set forth in 10 C.F.R. Part 73. The NRC Staff will be kept apprised of any proposed changes to the plan, pursuant to the requirements of 10 C.F.R. § 50.54(p).

3.2.6 Quality Assurance Practices

Quality assurance-type requirements are contained in Section 6.1, "Administrative Controls," of the MURR Technical Specifications ("TS").[1] Specifically, Section 6.1 contains requirements with respect to procedure review and approval, facility change process, management and committee oversight and responsibilities, record retention, and special and periodic reports to be

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[1] Appendix B to 10 C.F.R. Part 50 is not applicable to non-power reactors, pursuant to Appendix A of NUREG-1537,"Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors."

made to the NRC Staff. Additionally, Section 6.1.e specifies the following requirement associated with facility repairs or replacements:

> Any additions, modifications or maintenance to the systems described in these specifications shall be made and tested in accordance with specifications to which the system was originally designed and fabricated or to specifications approved by the U.S. Nuclear Regulatory Commission.

For additions or modifications to systems described in TS, compliance with this requirement is demonstrated through the use of the Modification Record system, which is described in Section 3.2.7. How a proposed addition or modification meets or exceeds the original specifications, and how it will be tested in accordance with original specifications, are described in the Modification Record and demonstrate the compliance with TS 6.1.e. The spare parts used for maintenance of the systems described in TS are ordered to be equivalent or better than original parts.

3.2.7 Facility Change Process

Modifications to reactor systems are performed, when necessary, to ensure continuity of operation of the reactor, maintain compliance with applicable regulations, and/or further enhance the capabilities of the experimental facilities. The Modification Record system, as outlined in the "Reactor Operation 10 MW Standard Operating Procedures" (Section I.4.7), is used to document changes to reactor license-related systems as described in the HSR and its addenda. These records include a description of the proposed change and a Safety Evaluation, which provides the bases for the determination as to whether the modification involves an unreviewed safety question as defined in 10 C.F.R. § 50.59. A Modification Record is prepared by a licensed reactor operator or senior reactor operator, reviewed and evaluated by crew members, and subsequently reviewed by the Reactor Manager. If the Reactor Manager determines the change to be an improvement, then he or she will approve the Modification Record. The change is then made to the facility. The Reactor Safety Subcommittee ("RSSC") and/or the Reactor Advisory Committee ("RAC") will review the Modification Record.

To ensure that operation of the reactor facility does not jeopardize the health and safety of the general public, a committee has been chartered to provide objective and independent reviews, evaluations, and recommendations on matters affecting reactor safety. The RAC is a committee of the University of Missouri, appointed by the Office of the Provost, University of Missouri-Columbia, to satisfy the Technical Specification requirements. The University and the NRC expect the RAC to review and make recommendations concerning experimental and operational activities at the facility.

Responsibilities of the RAC include, but are not limited to, the following:

- Review and make recommendations concerning proposed changes to reactor equipment or procedures when such changes are safety significant, involve an amendment to the operating license including a change in the Technical Specifications, or create an unreviewed safety question as defined by 10 C.F.R. § 50.59.

- Review and make recommendations concerning proposed tests or experiments significantly different from any previously reviewed or which involve an unreviewed safety question as defined by 10 C.F.R. § 50.59.

- Review circumstances surrounding abnormal occurrences and violations of the Technical Specifications, as well as remedial measures to prevent recurrence.

The RSSC and IUS act on behalf of the RAC in performing reviews of the three bulleted items above. Upon completion of the review, the RSSC makes recommendations concerning the proposed change, experiment, or remedial measure and reports its recommendation to the Chairman of the RAC and to the Reactor Manager. If the review results in a negative recommendation, then the RSSC shall recommend alternatives for the experiment and report this conclusion to the Chairman of the RAC and the Reactor Manager. In the latter instance, the Reactor Manager apprises the Chairman of the RSSC of the course of action selected, or the Reactor Manager submits a new proposal for review.

Recent events at MURR have led to a heightened awareness of the importance of Section 50.59 reviews. MURR is preparing to implement the newly amended Section 50.59, which becomes effective on March 13, 2001.

3.3 MATERIAL ASPECTS OF THE FACILITY

3.3.1 Safety Systems

The MURR Reactor Safety System is that combination of sensing devices, circuits, signal conditioning equipment, electronic equipment, and electro-mechanical devices that serves to effect a reactor scram (Reactor Scram System), initiate a containment building isolation, or activate the primary coolant anti-siphon system. The anti-siphon and containment isolation systems are Engineered Safety Features ("ESFs"). ESFs are active or passive features designed to mitigate the consequences of accidents and to keep radiological exposures to the public, the facility staff, and the environment within acceptable limits. The concept for ESFs evolved from the defense-in-depth philosophy of multiple layers of design features to prevent or mitigate the release of radioactive materials to the environment during accident conditions. The need for ESFs is determined in the HSR. The HSR and its underlying analyses consider accidents that could occur, even though prudent and conservative design of the reactor facility has made the incidence of an accident very unlikely.

The Reactor Scram System is designed to prevent operation of the reactor under conditions in which fuel damage may occur. This is accomplished through promptly placing the reactor in a subcritical, safe shutdown condition by a reactor scram, which initiates the instantaneous drop of the control blades by interrupting power to their electromagnets should a monitored parameter exceed a predetermined value. Inputs, which govern Reactor Scram System output, are supplied from the neutron flux monitors, process transducers, and safety interlocks. A reactor scram also may be initiated manually by the reactor operator. The Reactor Scram System consists of two Non-Coincidence Logic Units ("NCLUs") and two Trip Actuator Amplifiers ("TAAs") located in the control room instrument panel. The NCLUs receive input signals from the neutron

monitoring and process instruments and provide outputs to control the TAAs. The TAAs are arranged in parallel, each controlling current to two control blade electromagnets. Should an input signal to either logic unit be interrupted, the TAAs will actuate and interrupt current to the electromagnets, allowing the control blades to drop.

The Containment Isolation System is designed to completely isolate the reactor containment building, thereby preventing or mitigating an uncontrolled release of radioactive materials to the environment during an accident. Isolation of the reactor containment building can be automatically initiated by radiation detectors located at the reactor pool upper bridge and in the containment building exhaust plenum. Isolation can be manually actuated by switches in the reactor control room or the facility lobby.

The Anti-Siphon System functions as a backup system to the various safety instrumentation and equipment (*e.g.*, pressure sensors, pump and valve interlocks) which ensure that the reactor core does not become uncovered during a Loss of Coolant Accident ("LOCA"). The system is designed to admit a fixed volume of air to the high point of the reactor outlet piping, or invert loop, instantaneously establishing the pressure in this area at equal to or greater than atmosphere. This prevents a siphon action from being created due to a rupture of the primary coolant piping. The anti-siphon system is automatically actuated upon detection of primary coolant system low pressure. System pressure is monitored by two electronic pressure transmitters (PT 944A and PT 944B) located on the 12-inch primary coolant outlet piping between the reactor pressure vessel and primary coolant isolation valve 507A.

Although not part of the Reactor Safety System, the Rod Run-In System is designed to initiate the automatic insertion of the control blades at a controlled rate should a monitored parameter exceed a predetermined value. The Rod Run-In System does provide a protective function by introducing shim blade insertion to terminate a transient prior to actuating a reactor safety system set point trip. A rod run-in signal also may be initiated manually by depressing a push button on the reactor control console.

3.3.2 Surveillance Testing

The following are the surveillance specification requirements stated in the MURR Technical Specifications that prescribe the frequency and scope of surveillance that is performed in order to demonstrate the performance of the above-mentioned safety systems.

Technical Specification 5.1

- The containment building leak rate shall be verified annually, plus or minus four months.
- The containment isolation system including each of its radiation monitors shall be tested for operability at monthly intervals.

Technical Specification 5.2

- The primary coolant siphon break valves and isolation valves shall be tested for operability at monthly intervals except during extended shutdown periods when the valves shall be tested prior to reactor operation.

Technical Specification 5.3

- The drop time of each of the four reactor shim blades shall be measured at quarterly intervals.

Technical Specification 5.4

- All instruments, as required by these specifications, shall be calibrated on semi-annual intervals.
- Radiation monitoring instrumentation as required by these specifications shall be checked for operability with a radiation source at monthly intervals.
- All nuclear instrumentation channels shall be channel tested before each reactor startup. This test shall not be required prior to a restart within 2 hours following a normal shutdown or an unplanned scram where the cause of the scram is readily determined not to involve an unsafe condition or a failure of one or more nuclear instrumentation channels.

The MURR Compliance Procedure System provides the written guidance and scheduling for these specifications. The following is a list of the Compliance Procedures, and their frequencies, that are performed to ensure that the aforementioned Technical Specifications are met.

Compliance Procedure	Frequency
Reactor Scram System:	
CP-1 Manual Scram	Semi-annual
CP-2 Pressurizer Level and Pressure Control	Semi-annual
CP-3 LC-966, Below Refuel Level Scram	Semi-annual
CP-4A Primary Flow Transmitter 912A Calibration and Scram	Semi-annual
CP-4B Primary Flow Transmitter 912E Calibration and Scram	Semi-annual
CP-5 PT-917	Semi-annual
CP-6 Building Evacuation/Isolation Scram, Building Hi Activity Scram	Semi-annual
CP-7A Pool Flow Orifice 921 (Green Leg)	Semi-annual
CP-7B Pool Flow Orifice 921 (Yellow Leg); V509 OFF OPEN	Semi-annual
CP-8A Primary RTD's 901A and B	Semi-annual
CP-8B Primary RTD's 980A and B	Semi-annual
CP-9 Nuclear Instrumentation Scram and Rod Run-In	Semi-annual
CP-10 Rod Drop Times	Monthly (each rod)
CP-22 Pressure Switches PS944 A/B and PT943	Semi-annual
CP-23 DPS 928A, DPS 928B, and DPS 929	Semi-annual
CP-27 Power Level Interlock Scram	Semi-annual
Containment Isolation System:	
CP-20 Back-Up Doors	Quarterly
CP-21 16" Ventilation Valves	Quarterly
CP-26 Containment Building Leak Test	Annual
CP-28 Calibration for: Area Radiation Monitors	Semi-annual
CP-30 Area Radiation Monitors	Monthly

Anti-Siphon System:

CP-11	Anti-Siphon High Level RRI & Low Pressure Alarm	Semi-annual
CP-22	Pressure Switches PS944 A/B and PT943	Semi-annual
CP-24	Anti-Siphon System Valves 543A/B	Monthly

Additional Compliance Procedures

CP-8C	Pool RTD's 901C and D	Semi-annual
CP-12	LC 910, Low Pool Level Rod Run-In	Semi-annual
CP-13	Vent Tank Controllers 925A/B	Semi-annual
CP-14	Regulating Rod 10% and Rod Bottomed, and Not-In-Contact RRI	Semi-annual
CP-15	Truck Entry Door Rod Run-In	Semi-annual

In addition to these procedures, a manual actuation of the Containment Isolation System is performed prior to a normal reactor startup.

3.3.3 Material Condition

Overall, the material condition of the reactor facility has remained in such a state that unexpected shutdowns have been minimized and operability of systems important to safety has been maximized. These systems, which are important to safety, include the Reactor Scram System, the Anti-Siphon System, and the Containment Isolation System, as previously mentioned.

Operating experience with the reactor safety system since 1966 has demonstrated that the system is safe and practical, and of proven design. Extremes of power supply voltage and ambient operating temperature have been experienced with no significant effect on the reactor safety system. Periodic updating of the reactor safety system has been performed to take advantage of technological improvements and state-of-the-art developments, while retaining the desirable design characteristics of the previous system. This has increased reliability and enhanced system performance.

Specifics regarding periodic surveillance testing of key features are as follows:

Core Component Inspections:
Technical Specification 5.2.c requires that "[a] primary coolant sample shall be taken during each week of reactor operation and a radio-chemical analysis for Iodine-131 shall be performed on this sample." The weekly radiochemical analysis provides assurance that a fuel element leak will be detected so that corrective action can be taken to prevent the release of fission product isotopes. This specification establishes the frequency of verification of compliance with specification 3.9.c, which states, "The reactor shall not be operated when radiochemical analysis shows that the concentration of the radioisotope I-131 exceeds 5 x 10^{-3} .Ci/ml in the primary coolant." To date, no primary coolant radiochemical analysis has indicated an I-131 concentration greater than this limit.

Technical Specification 5.5 requires that [o]ne out of every eight (8) fuel elements that have reached their end-of-life will be inspected for anomalies." To date, no fuel element

inspection has revealed any significant deviations from the fuel element's original design and fabrication.

Containment Building Testing

Technical Specification 5.1.a requires that "[t]he containment building leak rate shall be verified annually, plus or minus four months. No special maintenance shall be performed just prior to the test." To date, the annual containment building leakage rate test has never exceeded the design limits outlined in specification 4.2.c, which states, "[t]he containment building leakage rate shall not exceed 16.3 ft^3/min (STP) with an overpressure of one pound per square inch gauge or 10% of contained volume over a 24-hour period from an initial overpressure of two pounds per square inch gauge. The test shall be performed by the makeup flow, pressure decay, or reference volume techniques."

Other Performance Testing and Calibrations Related to Monitoring Fission Product Barrier Performance

Other surveillances to verify fission product barrier integrity are:

- A Fuel Element Failure Monitoring System continuously monitors the primary coolant system for fission product activity buildup that may indicate a fuel element failure. Should Fuel Element Failure Monitoring System become inoperable, the primary coolant system will be sampled once every four hours for evidence of fuel element failure.

- An Off-Gas Monitoring System (Stack Monitor) continuously monitors the air exiting the facility through the ventilation system exhaust stack for airborne radioactivity. This instrument has a radiation detection channel that specifically measures the radioactive iodine in the exhaust air.

- Radiation monitors located at the reactor pool surface and containment building ventilation exhaust plenum continuously monitor radiation levels at these locations to verify the integrity of the fuel elements and primary coolant system so that corrective action can be taken to prevent the spread of radioactivity to the surrounding areas.

- A Secondary Coolant Monitoring System continuously monitors the secondary coolant system for the presence of radioactive isotopes which could indicate a leak from the primary or pool coolant systems through their respective heat exchangers.

The material condition of the facility is monitored frequently by the tests summarized above, and results from those tests do not indicate any decline in performance of the facility, nor do they anticipate any decline in facility performance throughout the proposed operating license term of the full 40 years.

3.4 ENVIRONMENTAL CONSIDERATIONS

3.4.1 Environmental and Radioactive Effluent Monitoring Program

Environmental and radioactive effluent monitoring at the MURR site is accomplished by monitoring the gaseous and liquid release points using continuous monitors and grab samples, as well as periodic monitoring of select locations surrounding the MURR facility. The "offsite" environmental monitoring includes taking grab soil, vegetation, or water samples at select locations and the periodic reading of dosimeters posted in the area. Specifics regarding solid, liquid, and gaseous radioactive releases and monitoring are given in the subsequent sections.

3.4.1.1 Radioactive Liquid Effluents

The single radioactive liquid effluent release point for the MURR site is the sanitary sewer effluent line. 10 C.F.R. § 20.2003 requirements limit radioactive liquid releases. All pool, primary system and sample liquid effluents are directed to the facility drain system, which directs all liquid waste to the MURR Liquid Waste Retention and Disposal System. The system acts as a holding point for decay of the radionuclides in the liquid. The liquid is then sampled by the Health Physics Group prior to release. The liquid effluent information from MURR is documented in the Reactor Operations Annual Report.

3.4.1.2 Radioactive Gaseous Effluents

Radioactive gaseous releases associated with operation of the MURR facility are directed to the main stack. This main stack is the only radioactive gaseous release point for the facility and typically is sampled by a continuous monitor, which is located downstream of all inputs to the stack.

The primary isotope released through the stack is Ar-41, which is a result of operation of the reactor. Other incidental releases occur due to the operation of the research reactor and are the result of research and development activities within the laboratory building. All releases have been within TS limits, and isotopes other than Ar-41 have generally been less than 1% of the TS annual limit. The gaseous effluent information from MURR is documented in the Reactor Operations Annual Report.

3.4.1.3 Environmental Sampling

Liquid environmental samples are collected twice each year at three select locations. The liquid samples are analyzed for alpha, beta, and gamma activities, as well as a separate tritium activity value. Additional, environmental samples are taken twice annually of soil and vegetation in eight locations near the MURR facility. There have been no abnormal readings associated with the soil and vegetation samples. The results of these environmental monitoring readings at the eight locations are provided to the NRC Staff in the Reactor Operations Annual Report.

3.4.1.4 Solid Radioactive Waste Disposal

Solid releases from the facility include radioactively contaminated items that cannot be decontaminated or radioactively activated items resulting from reactor operation or other laboratory activities associated with the MURR facility. Those items that can be decontaminated are cleaned and surveyed for free release to the environment. Items that cannot be free released are categorized by isotopic concentrations for shipment to a low-level waste handling facility.

Solid low-level waste ("LLW") is typically compressed and stored in drums. The drums are then shipped to a low-level waste vendor. MURR uses a compactor to reduce the volume of solid low-level waste. The exhaust from the compactor is directly connected to the MURR ventilation system, which provides filtering and continuous monitoring. The solid radioactive waste information from MURR is documented in the Reactor Operations Annual Report.

Regarding high-level waste, MURR transfers approximately 24 fuel elements annually to the U.S. Department of Energy.

3.4.1.5 Off-Site Dose Monitoring

The MURR Staff has posted thermoluminescent dosimeters ("TLDs") in locations external to the MURR facility for the purpose of assessing dose levels surrounding the site. Each of the TLDs is processed to determine the dose once each quarter. The only elevated TLD readings observed are routine elevated quarterly readings in proximity to the loading area, where radioactive materials shipments are conducted. Results of the quarterly TLD readings are provided to the NRC Staff in the Reactor Operations Annual Report.

3.4.1.6 Summary

The environmental and radioactive effluent monitoring program, and the results of the solid LLW disposal program, do not show adverse trends nor does it indicate a significant hazard to the public or environment associated with a 40-year operating license term for the MURR facility.

3.4.2 Non-Radiological Effluents

Any non-radioactive hazardous waste possessed by MURR is transferred for processing to the University of Missouri Environmental Health and Safety group.

3.4.3 Protection of Historic Properties

The University of Missouri staff has performed an assessment of the potential impact on historic properties in accordance with Section 106 of the Historical Preservation Act of 1966, as amended, and in accordance with the provisions of 36 C.F.R. Part 800, Protection of Historic and Cultural Properties. No significant impact on historic properties was identified that could be associated with the proposed license term change.

3.5 FINANCIAL ASPECTS OF THE FACILITY

3.5.1 Indemnity

The Curators of the University of Missouri maintain insurance through American Nuclear Insurers of West Hartford, Connecticut. The policy number is 2000261 and any questions regarding the specifics on indemnity may be directed to the University of Missouri Director of Risk and Insurance Management at (573) 882-3735. The requested extension of the operating license term will have no adverse effects on the insurability of the facility.

3.5.2 Decommissioning Funds

As required by 10 C.F.R. § 50.75(e), cost estimates for decommissioning MURR have been prepared and submitted to the NRC Staff. The curators of MURR have submitted statements of intent regarding reasonable assurances that funds will be available to decommission MURR, when necessary. The facility is part of a state-funded educational institution. The cost estimates were developed using NUREG/CR-1756, "Technology, Safety, and Costs of Decommissioning Reference Nuclear Research and Test Reactors."

The cost estimates will be adjusted periodically, pursuant to 10 C.F.R. § 50.75(d). Decommissioning cost estimates are retained with the decommissioning records required by 10 C.F.R. § 50.75(g). The requested extension of the operating license term will have no adverse effects on the assurances regarding decommissioning funding.

4.0 NO SIGNIFICANT HAZARDS EVALUATION

Section 50.92 requires the NRC to arrive at a conclusion regarding a significant hazard consideration determination. The factors traditionally applied to previous non-power license amendments, to make this determination, are that operation of the facility in accordance with the proposed amendment would not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or

(3) Involve a significant reduction in a margin of safety.

MURR believes that the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated because the requested recapture of operating license time does not involve any physical change to the facility or to its operating procedures. The original analyses for the facility were based on a 40 year operating life, and this amendment allows the facility to operate in accordance with that assumption. The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated because the 40 year operating period was assumed in the design

and construction of the facility. Additionally, the extension of the operating license period to conform with the law and regulations does not introduce any physical or administrative mechanism to create the possibility of a previously unconsidered accident.

Finally, MURR believes that the proposed license amendment does not involve a significant reduction in a margin of safety because any degradation of safety-related equipment within the period has already been accounted for in the original facility analyses. To ensure that these assumptions are correct, existing programs, routine maintenance, periodic surveillance testing, and adherence to TS requirements will assure that an adequate margin of safety is maintained.

Prior recapture amendments have been granted to both power reactors and non-power reactors with no real challenges to significant hazard consideration determinations. The extension of the licensing term to the originally planned 40 years will not be inimical to national security or the common defense. The granting of this amendment request will fulfill the intent of 10 C.F.R. § 50.51.

specifications contained in the Hazards Summary Report or the Technical Specifications.

(3) The licensee shall report to the Director, DRL, in writing within thirty (30) days of its occurrence any significant changes in transient or accident analysis as described in the Hazards Summary Report.

4. This license shall expire at midnight, ~~November 21, 2001.~~ OCTOBER 11, 2006.

FOR THE ATOMIC ENERGY COMMISSION

Peter A. Morris

Director
Division of Reactor Licensing

Attachment:
Appendix A

Date of Issuance: October 11, 1966