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December 16, 2002

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Washington, DC 20555

REFERENCE: Docket 50-186
Missouri University Research Reactor
License R-103

SUBJECT: Technical Specification changes requested pursuant to 10 CFR 50.59(c) and 10 CFR 50.90

Introduction

The Missouri University Research Reactor (MURR) is requesting several changes to the facility Technical Specifications (TSs). Included within these changes are revisions to (1) TS 1.1, definition of "Abnormal Occurrences," (2) the Limiting Conditions for Operation on certain reactor plant systems, and (3) the reporting requirements for unplanned events as stated in TS 6.1.h. The requested changes are consistent with American National Standards Institute/American Nuclear Society (ANSI/ANS) 15.1-1990, *The Development of Technical Specifications for Research Reactors*; the American national standard that establishes the format and content of TSs for research reactors.

The U.S. Nuclear Regulatory Commission (NRC) accepts and endorses the guidance provided by ANSI/ANS 15.1. For areas where ANSI/ANS 15.1 might require modification or clarification in order to provide acceptable TSs, additional guidance is provided by NUREG-1537, Part I, *Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content*. The request is also consistent with the requirements for Limiting Conditions for Operation (LCO) in 10 CFR 50.36(c)(2)(i), which states:

> Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition of operation of a nuclear reactor is not met, the licensee shall

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shut down the reactor or follow any remedial action permitted by the technical specification until the condition can be met.

The following requested changes are necessary to implement the reporting and required action guidance, as stated in ANSI/ANS 15.1, Section 6, for unplanned events. Section 6.6.1 provides guidance for the facility in case of a safety limit violation whereas Section 6.6.2 provides guidance for an Abnormal Occurrence, as defined by TS 1.1. Section 6.7.2 lists the reporting schedule for unplanned events. The proposed revision to TS 1.1 is consistent with the definition of an Abnormal (or reportable) Occurrence stated in Section 6.7.2(1)(c).

Changes

The MURR requests approval to revise the facility TSs as follows:

1. Change the definition of Abnormal Occurrences as stated in TS 1.1 from:

1.1 **Abnormal Occurrences**
An abnormal occurrence is any of the following:

a. Any actual safety system setting less conservative than specified in the Limiting Safety System Setting's section of the Technical Specifications.
b. Operation in violation of a Technical Specification.
c. Safety system component malfunction or other component or system malfunction which could, or threaten to, render the system incapable of performing its intended safety function.
d. Release of fission products from a fuel element.
e. An uncontrolled or unanticipated significant change in reactivity.
f. An observed inadequacy in the implementation of either administrative or procedural controls, such that the inadequacy could have caused the existence or development of an unsafe condition in connection with the operation of the reactor.

To the new requested Abnormal Occurrences definition that is in agreement with the intent of ANSI/ANS 15.1, 6.7.2(1)(c), which states:

1.1 **Abnormal Occurrences**
An abnormal occurrence is any of the following which occurs during reactor operation:

a. Operation with actual safety system settings for required systems less conservative than specified in Section 2.2, Limiting Safety System Settings;

There is no change in the scope or intent of TS 1.1.a; merely a rephrasing of the specification to make the wording in closer agreement with ANSI/ANS 15.1, 6.7.2(1)(c)(i), which states: "Operation with actual safety-system settings for required systems less conservative than the limiting safety-system settings specified in the technical specifications."

b. Operation in violation of Limiting Conditions for Operation established in Section 3.0;

This revision to TS 1.1.b is in agreement with ANSI/ANS 15.1, 6.7.2(1)(c)(ii), which states: "Operation in violation of limiting conditions for operation established in the technical specifications unless prompt remedial action is taken."

c. A reactor safety system component malfunction which renders or could render the reactor safety system incapable of performing its intended safety function unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdowns;

This revision to TS 1.1.c is in agreement with ANSI/ANS 15.1, 6.7.2(1)(c)(iii), which states: "A reactor safety system component malfunction which renders or could render the reactor system incapable of performing its intended safety function unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdowns."

d. An unanticipated or uncontrolled change in reactivity in excess of 0.0025 Δk. Reactor trips resulting from a known cause are excluded;

Current TS 1.1.d is removed. The limitation on operating the reactor with fission products being released from a fuel element is covered by the current and proposed TS 1.1.b and by TS 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} μCi/ml in the primary coolant." The proposed TS 1.1.e also defines abnormal or significant degradation in reactor fuel or cladding as an Abnormal Occurrence.

Current TS 1.1.e is revised and renumbered to be TS 1.1.d. This revision replaces the term "significant" with "in excess of 0.0025 Δk," which is the reactivity limit for an unsecured experiment as specified by TS 3.1.j. The safety significance of a step reactivity insertion of 0.0025 Δk is addressed in Addendum 5 of the MURR Hazards Summary Report, Section 3.2, which concludes with the statement: "Thus, the chosen limit of 0.0025 Δk placed on each unsecured experiment insures that a safety limit will not be violated." This revision is in agreement with ANSI/ANS 15.1, 6.7.2(1)(c)(iv), which states, "An unanticipated or uncontrolled change in reactivity greater than one dollar. A smaller quantity shall be specified for those reactor systems where this is appropriate. Reactor trips resulting from a known cause are

excluded." For MURR, one dollar of reactivity equates to 0.00738 Δk; a value much greater than the requested limit of 0.0025 Δk.

e. Abnormal and significant degradation in reactor fuel or cladding, or both, coolant boundary, or containment boundary (excluding minor leaks), which could result in exceeding prescribed radiation exposure limits of personnel or environment, or both; and

This new proposed TS 1.1.e is directly quoted from ANSI/ANS 15.1, 6.7.2(1)(c)(v).

f. An observed inadequacy in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition involving operation of the reactor.

This revision to TS 1.1.f is only a minor wording change of the current TS 1.1.f and is closer to being a direct quote of ANSI/ANS 15.1, 6.7.2(1)(c)(vi), which states: "An observed inadequacy in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition with regard to reactor operations."

2. Change the LCO for the control blades as stated in TS 3.2.a from:

a. All control blades, including the regulating blade, shall be operable during reactor operation.

To the new requested TS 3.2.a, which states:

a. All control blades, including the regulating blade, shall be operable during reactor operation. Exception: In order to provide time for prompt remedial action, the regulating blade may be inoperable for a period no greater than five minutes.

The regulating blade, which is not a part of the reactor safety system, is designed to provide the following two functions: (1) very fine adjustments in core reactivity in order to maintain the reactor at a desired power level, either manually or by the automatic control system, and (2) two control blade rod run-ins to assure termination of a transient, which is causing a rapid insertion of the regulating blade in automatic operation. This revision requests an exception or "action statement" that allows temporary continued operation of the reactor at a reduced state from that specified in the LCO when the LCO cannot be met (Type I action statement). As stated in ANSI/ANS 15.1, prompt remedial action can be regarded as meeting the constraints of the LCO. The action statement would permit the reactor to be operated with the regulating blade inoperable for a brief period of time – up to five minutes – while actions are being taken to place the reactor in a safe shutdown condition, without the incident being perforce considered an abnormal occurrence. The short time that the regulating blade is inoperable does not represent a safety concern for the reactor or the general public.

3. Change the LCO for the reactor safety system as stated in TS 3.3.a from:

   a. The safety system and the number (N) of associated instrument channels necessary to provide the following scrams shall be operable whenever the reactor is operated. Each of the safety system functions shall have 1/N logic where N is the number of instrument channels required for the corresponding mode of operation.

   To the new requested TS 3.3.a, which states:

   a. The safety system and the number (N) of associated instrument channels necessary to provide the following scrams shall be operable whenever the reactor is operated. Each of the safety system functions shall have 1/N logic where N is the number of instrument channels required for the corresponding mode of operation. Exception: In order to provide time for prompt remedial action, the reactor may operate for a period no greater than five minutes if an instrument channel having N greater than one is reduced by one.

   The objective of TS 3.3.a is to assure the operability of the reactor safety system. The multiple number of channels provides redundancy such that the failure of one instrument channel does affect the operation of the remaining channels or the safety system. This revision requests an exception or "action statement" that allows temporary continued operation of the reactor at a reduced state from that specified in the LCO when the LCO cannot be met (Type I action statement). As stated in ANSI/ANS 15.1, prompt remedial action can be regarded as meeting the constraints of the LCO. The action statement would permit the reactor to be operated with one out of N associated instrument channels inoperable for a brief period of time – up to five minutes – while actions are being taken to place the reactor in a safe shutdown condition, without the incident being perforce considered an abnormal occurrence. The short time that an instrument channel is inoperable does not represent a safety concern for the reactor or the general public.

4. Change the LCO for reactor instrumentation as stated in TS 3.4.c from:

   a. The reactor shall not be operated unless the following rod run-in functions are operable. Each of the rod run-in functions shall have 1/N logic where N is the number of instrument channels required for the corresponding mode of operation.

   To the new requested TS 3.4.c, which states:

   a. The reactor shall not be operated unless the following rod run-in functions are operable. Each of the rod run-in functions shall have 1/N logic where N is the number of instrument channels required for the corresponding mode of operation. Exception: In order to provide time for prompt remedial action, the reactor may

operate for a period no greater than five minutes if N is reduced by one for either the High Power or Period instrument channels.

The High Power and Period rod run-ins listed in TS 3.4.c are provided to introduce shim blade insertion on a reactor transient before the safety system trip is actuated. The multiple number of channels provides redundancy so that the failure of one instrument channel does not affect the operation of the remaining channels or the safety system. This revision requests an exception or "action statement" that allows temporary continued operation of the reactor at a reduced state from that specified in the LCO when the LCO cannot be met (Type I action statement). As stated in ANSI/ANS 15.1, prompt remedial action can be regarded as meeting the constraints of the LCO. The action statement would permit the reactor to be operated with one out of N associated instrument channels inoperable for a brief period of time – up to five minutes – while actions are being taken to place the reactor in a safe shutdown condition, without the incident being perforce considered an abnormal occurrence. The short time that an instrument channel is inoperable does not represent a safety concern for the reactor or the general public.

5. Change the LCO for reactor containment as stated in TS 3.5.a from:

a. Containment integrity shall be maintained at all times except when:
   (1) The reactor is secured, and
   (2) Irradiated fuel with a decay time of less than sixty (60) days is not being handled.

To the new requested TS 3.5.a which states:

a. Containment integrity shall be maintained at all times except when:
   (1) The reactor is secured, and
   (2) Irradiated fuel with a decay time of less than sixty (60) days is not being handled.

   Exception: In order to provide time for prompt remedial action, reactor containment integrity may be inoperable for a period of no greater than 5 minutes when containment integrity is required.

The bases of TS 3.5.a is to assure that the containment building can be isolated at all times except when the plant conditions are such that the probability of release of radioactivity is negligible. This revision requests an exception or "action statement" that allows temporary continued operation of the reactor at a reduced state from that specified in the LCO when the LCO cannot be met (Type I action statement). As stated in ANSI/ANS 15.1, prompt remedial action can be regarded as meeting the constraints of the LCO. The action statement would permit the reactor to be operated without containment integrity for a brief period of time – up to five minutes – while actions are being performed to place the reactor in a safe secured condition, without the incident being perforce considered an abnormal occurrence. This short time

period allows the operator to secure the reactor and make negligible the already low probability of release of radioactivity while operating the reactor.

6. Change the LCO for the auxiliary systems as stated in TSs 3.10.a, 3.10.b, and 3.10.c from:

   a. The reactor shall not be operated unless the emergency electrical generator is operable.
   b. The reactor shall not be operated unless the reactor makeup water system is operable and connected to a source of at least 2,000 gallons of primary grade water.
   c. The reactor shall not be operated unless the emergency pool fill system is operable.

   To the new requested TSs 3.10.a, 3.10.b, and 3.10.c, which state:

   a. The reactor shall not be operated for greater than five minutes with the emergency electrical generator inoperable.
   b. The reactor shall not be operated for greater than five minutes with the reactor makeup water system inoperable or not connected to a source of at least 2,000 gallons of primary grade water.
   c. The reactor shall not be operated for greater than five minutes with the emergency pool fill system inoperable.

   TS 3.10.a provides assurance that the emergency generator would be available to provide electrical power for monitoring the shutdown condition of the reactor. The emergency generator is not required for protection of the fuel element integrity. In addition, the design of the MURR does not require electrical power to safely shut down the reactor or to maintain an acceptable shutdown condition. TS 3.10.b provides for an adequate supply of primary grade water for makeup during all modes of operation. The reactor makeup water system is not a part of the reactor safety system nor is its operability an assumption in any accident analysis. TS 3.10.c requires a supply of water be available that assures the pool water level will remain above the reflector in case a six-inch beamport or a six-inch pool coolant line is sheared. This revision requests an exception or "action statement" that allows temporary continued operation of the reactor at a reduced state from that specified in the LCO when the LCO cannot be met (Type I action statement). As stated in ANSI/ANS 15.1, prompt remedial action can be regarded as meeting the constraints of the LCO. The action statement would permit the reactor to be operated with an auxiliary system inoperable for a brief period of time – up to five minutes – while actions are being performed to place the reactor in a safe shutdown condition, without the incident being perforce considered an abnormal occurrence. The short time that an auxiliary system is inoperable does not represent a safety concern for the reactor or the general public.

7. Change the reporting requirements as stated in TSs 6.1.h(1), 6.1.h(2) and 6.1.h(3) from:

(1) The U.S. Nuclear Regulatory Commission shall be informed of any incident or condition relating to the operation of the reactor which prevented or could have prevented the reactor safety system from performing its safety function as described in the Technical Specifications. For each occurrence, the University of Missouri shall notify within 24 hours, by telephone or telegraph, the Director of Regulatory Operations and shall submit within ten (10) days a report in writing to the Directorate of Licensing, with a copy to the Directorate of Regulatory Operations.

(2) The Directorate of Licensing shall be informed in writing within thirty (30) days of its observed occurrence any substantial variance disclosed by operation of the reactor from performance specifications contained in the Hazards Summary Report or the Technical Specifications.

(3) The Directorate of Licensing shall be informed in writing within thirty (30) days of its occurrence any significant changes in transient or accident analysis as described in the Hazards Summary report.

To the new requested reporting requirements that are in agreement with the intent of ANSI/ANS 15.1, Sections 6.6.1, 6.6.2 and 6.7.2, which state:

(1) Safety Limit Violation – In the event of a safety limit violation, the following actions shall be taken:
   (a) The reactor shall be shutdown and reactor operation shall not be resumed until authorized by the U.S. Nuclear Regulatory Commission (NRC);
   (b) The safety limit violation shall be promptly reported to the NRC. Prompt reporting of the violation shall be made by the University of Missouri, by telephone or facsimile, to the NRC Operations Center within 24 hours;
   (c) A detailed follow-up report shall be prepared. The report shall include the following:
      1. Applicable circumstances leading to the violation including, when known, the causes and contributing factors;
      2. Date and approximate time of the occurrence;
      3. Effect of the violation upon reactor and associated systems;
      4. Effect of the violation on the health and safety of the facility staff and general public; and
      5. Corrective actions to prevent recurrence.
   (d) The follow-up report will be submitted within fourteen (14) days to the NRC Document Control Desk, with a copy to the NRC Project Manager.

(2) Release of Radioactivity – Should a release of radioactivity greater than the allowable limits occur from the reactor facility boundary, the following actions shall be taken:

(a) Reactor conditions shall be returned to normal or the reactor shall be shutdown;
(b) The release of radioactivity shall be promptly reported to the NRC. Prompt reporting of the violation shall be made by the University of Missouri, by telephone or facsimile, to the NRC Operations Center within 24 hours;
(c) If it is necessary to shutdown the reactor to correct the occurrence, operations shall not be resumed until authorized by the Reactor Manager; and
(d) A detailed follow-up report shall be prepared. The follow-up report will be submitted within fourteen (14) days to the NRC Document Control Desk, with a copy to the NRC Project Manager.

(3) Other Reportable Occurrences – In the event of an Abnormal Occurrence, as defined by Definition 1.1, the following actions shall be taken:
(Note: Where components or systems are provided in addition to those required by these TSs, the failure of the extra components or systems is not considered reportable provided that the minimum number of components or systems specified or required perform their intended reactor safety function.)
(a) The abnormal occurrence shall be promptly reported to the NRC. Prompt reporting of the occurrence shall be made by the University of Missouri, by telephone or facsimile, to the NRC Operations Center within 24 hours;
(b) A detailed follow-up report shall be prepared. The follow-up report will be submitted within fourteen (14) days to the NRC Document Control Desk, with a copy to the NRC Project Manager; and
(c) A return to normal reactor operation will not be allowed until authorized by the Reactor Manager.

(4) Other Reports – A written report shall be submitted to the NRC Document Control Desk, with a copy to the NRC Project Manager within thirty (30) days of:
(a) Any significant change(s) in the transient or accident analyses as described in the Hazards Summary Report; or
(b) Permanent changes in the facility organization involving the Office of Provost or the Director's Office.

This change conforms to the requirements stated in Section 6.6.1 of ANSI/ANS 15.1, which provides action guidance for the facility in case of a safety limit violation whereas Section 6.6.2 provides action guidance in the event of an Abnormal Occurrence, as defined by TS 1.1. Section 6.7.2 lists the reporting schedule for unplanned events. This change captures all of the present reporting requirements stated in the MURR TSs while also providing additional ones recommended by ANSI/ANS 15.1.

8. Renumber TS 6.1.h (4) to 6.1.h (5).

This change is necessary because of the addition of a new reporting requirement.

Evaluation

The definition of Limiting Conditions for Operation (LCO) is given in 10 CFR 50.36 as the lowest functional capability or performance level of equipment required for safe operation of a nuclear facility. 10 CFR 50.36 further states that when an LCO is not met, the licensee shall shutdown the reactor or follow any remedial action permitted by the TSs until the condition can be met.

Consistent with the NRC's regulatory requirements for an LCO, nuclear power plant TSs have included two types of Action Requirements that are applicable when an LCO is not met. One type (Type I) specifies remedial actions that permit continued operation of the facility without time limits. A second type (Type II) of action requirement specifies a time limit in which an LCO must be met. This time limit is the time allowed to restore inoperable systems or components to operable status or to restore parameters within specified limits. If these actions are not completed within the allowable time limits, a shutdown is required to place the facility in a mode in which the TS no longer applies. The specified time limits of the Action Requirements are applicable from the point in time it is identified that an LCO is not met. Implementation of the Action requirements within the specified time interval constitutes compliance with a TS [reference: TS 3.0.2 and 3.0.3 of Standard TSs on Applicability of Limiting Conditions for Operation and Surveillance Requirements (Generic Letter 87-09)].

The Action statement we request for MURR TSs is similar to that recommended in TS 3.0.3 of Standard TSs which delineates the time limits for placing the reactor in a safe shutdown mode when plant operation cannot be maintained within the limits defined by the LCO.

We are not requesting an Action statement for our LCOs that allow continued operation of the reactor at a reduced state from that specified in an LCO when an LCO cannot be met (Type I action statement). We are requesting only that prompt remedial action be considered as meeting the LCO TSs as recommended in ANSI/ANS 15.1. This means that the reactor could operate out of compliance with existing LCOs for a brief period of time to allow restoration of an inoperable system or component to operable status, to allow restoration of parameters within specified limits, or to place the reactor in a safe shutdown mode, without the incident being considered perforce an abnormal occurrence requiring the generation of a Licensee Event Report (LER). All unscheduled reactor shutdowns or equipment failures associated with the reactor will continue to be documented and are available for review by the NRC.

Attached are the TS pages that will implement the requested changes. These changes do not affect the safety of reactor operation and involve no changes or modifications to the reactor safety system. These changes merely affect the reporting and action requirements for the facility during an unplanned event as well as major facility and administrative changes and conform to the guidance provided by ANSI/ANS 15.1.

If you have any questions regarding these changes, please call me at (573) 882-5264.

Sincerely,

Paul S. Hobbs
Reactor Manager

ENDORSEMENT:
Reviewed and Approved

Ralph Butler
Interim Director

Attachments

xc: Reactor Advisory Committee
Reactor Safety Subcommittee
Dr. Robert D. Hall, Interim Vice Provost for Research
Mr. Craig Basset, U.S. NRC, Region III
Mr. Al Adams, U.S. NRC, Washington, D.C.

TECHNICAL SPECIFICATION

UNIVERSITY OF MISSOURI
RESEARCH REACTOR FACILITY

SUBJECT: Definitions

1.1 Abnormal Occurrences

An abnormal occurrence is any of the following which occurs during reactor operation:

a. Operation with actual safety system settings for required systems less conservative than specified in Section 2.2, Limiting Safety System Settings;
b. Operation in violation of Limiting Conditions for Operation established in Section 3.0;
c. A reactor safety system component malfunction which renders or could render the reactor safety system incapable of performing its intended safety function unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdowns;
d. An unanticipated or uncontrolled change in reactivity in excess of 0.0025 Δk. Reactor trips resulting from a known cause are excluded;
e. Abnormal and significant degradation in reactor fuel or cladding, or both, coolant boundary, or containment boundary (excluding minor leaks), which could result in exceeding prescribed radiation exposure limits of personnel or environment, or both; and
f. An observed inadequacy in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition involving operation of the reactor.

1.2 Calibration or Testing Interval

The period of time between normal checks for accuracy or operability of a system or component. To give some margin

TECHNICAL SPECIFICATION

UNIVERSITY OF MISSOURI
RESEARCH REACTOR FACILITY

SUBJECT: Control Blade Operation

Applicability

This specification applies to the reactor control blade system.

Objective

The objective of this specification is to reasonably assure proper operation of the reactor control system, thus avoiding conditions which could endanger the fuel element cladding or endanger personnel health and safety.

Specification

a. All control blades, including the regulating blade, shall be operable during reactor operation. Exception: In order to provide time for prompt remedial action, the regulating blade may be inoperable for a period no greater than five (5) minutes.

b. Above 100 kilowatts the reactor shall be operated so that the maximum distance between the highest and lowest shim blade shall not exceed one inch.

c. The shim blades shall be capable of insertion to the 20% withdrawn position in less than 0.7 seconds.

Bases

a. Specification 3.2a is included to insure that the normal method of reactivity control is used during reactor operation.

TECHNICAL SPECIFICATION

UNIVERSITY OF MISSOURI RESEARCH REACTOR FACILITY

SUBJECT: Reactor Safety System

Applicability

This specification applies to the reactor safety system instrument channels.

Objective

The objective is to assure the operability of the following safety system channels.

Specification

a. The safety system and the number (N) of associated instrument channels necessary to provide the following scrams shall be operable whenever the reactor is operated. Each of the safety system functions shall have 1/N logic where N is the number of instrument channels required for the corresponding mode of operation. Exception: In order to provide time for prompt remedial action, the reactor may operate for a period no greater than five (5) minutes if an instrument channel having N greater than one is reduced by one.

Safety System of Measuring Channel	Number Required (N) Mode 1	Mode II	Mode III	Trip Set Point
High Power	3(6)	3(6)	3(6)	125% Full Pwr (Max)
Period	2(6)	2(6)	2(6)	8 Seconds (Min)
Primary Coolant Flow	4(6)	2(6)	2(2)(6)	1625(1) gpm (Min)
Primary Coolant Low Pressure	4(6)	4(6)	4(2)(6)	75 psia(3) (Min)
Reactor Inlet Temperature	2(6)	1	1(2)	155°F (Max)
Reactor Outlet Temperature	1	1	1(2)	175°F (Max)

SUBJECT: Reactor Safety System (continued)

Pool Coolant Flow	2[6]	2[6]	0	850[4] gpm (Min) for one 100% capacity heat exchanger
Differential Pressure Across Reflector	1	0	0	2.52 psi (Min) 8.00 psi (Max)
Differential Pressure Across Reflector	0	1	0	0.63 psi (Min) 2.00 psi (Max)
Differential Pressure Across Core	1	0	0	3200[5] gpm (Min)
Differential Pressure Across Core	0	1	1[2]	1600[5] gpm (Min)
Pressurizer High Pressure	1	1	1[2]	95 psia (Max)
Pressurizer Low Level	1	1	1[2]	16 inches below centerline (Min)
Pool Level	0	0	1	23 feet (Min)
Primary Coolant Isolation Valves 507A/B Off Open Position	1	1	1[2]	Either valve Off Open Position
Pool Coolant Isolation Valve 509 Off Open Position	1	1	0	Valve 509 Off Open Position
Power Level Interlock	1	1	1	Scram as a result of incorrect selection of operating mode
Facility Evacuation	1	1	1	Scram as a result of actuating facility evacuation system
Reactor Isolation	1	1	1	Scram as a result of actuating reactor isolation system

SUBJECT: Reactor Safety System (continued)

Manual Scram	1	1	1	Push Button at Control Console

(1) Flow orifice or heat exchanger ΔP (psi) in each operating heat exchanger leg corresponding to the flow valve in the table.

(2) Not required below 50 KW operation if natural convection flange and pressure vessel cover are removed or in operation with the reactor subcritical by a margin of at least 0.015 ΔK.

(3) Trip pressure is that which corresponds to the pressurizer pressure indicated in the table with normal primary coolant flow.

(4) Flow orifice ΔP (psi) corresponding to the flow value in the table.

(5) Core ΔP (psi) corresponding to the core flow value in the table.

(6) Number required (N) may be reduced by one for no greater than 5 minutes.

Bases

a. The specifications on high power, primary coolant flow, primary coolant pressure, and reactor inlet temperature provide for the safety system settings outlined in specifications 2.2.a, 2.2.b, and 2.2.c. In Mode I and II operation the core differential temperature is approximately 17° F

SUBJECT: Reactor Instrumentation (continued)

(1) Required for startup only.

(2) The trip setting may be temporarily set upscale during periods of maintenance and sample handling. During this period the indication will be closely monitored.

(3) The monitor may be placed out of service for up to 2 hours for calibration and maintenance. During this out-of-service time, no experimental or maintenance activities will be conducted which could likely result in the release of unknown quantities of airborne radioactivity.

b. Sufficient instrumentation shall be provided to assure that the following limits are not exceeded during steady state operation.

Parameter	Limit
Primary Coolant pressure	110 psig (Max)
Anti-siphon system pressure	27 psig(1) (Min)
Pool temperature	120°F (Max)

(1) Not required for Mode III operation.

c. The reactor shall not be operated unless the following rod run-in functions are operable. Each of the rod run-in functions shall have 1/N logic where N is the number of instrument channels required for the corresponding mode of operation. Exception: In order to provide time for prompt remedial action, the reactor may operate for a period no greater than five (5) minutes if N is reduced by one for either the High Power or Period instrument channels.

SUBJECT: Reactor Instrumentation (continued)

Rod Run-In Function	Number Required (N) Mode I	Mode II	Mode III	Trip Set Point
High Power	3(3)	3(3)	3(3)	115% Full Pwr (Max)
Period	2(3)	2(3)	2(3)	10 sec (Min)
Pool Level	1	1	0	27 ft (Min)
Vent Tank Low Level	1	1	0	1 ft below CL (Min)
Rod Not in Contact With Magnet	4	4	4	Magnet Disengaged from Any Rod
Anti-Siphon Line High Level	1	1	1(1)	6 inches above valves (Max)
Truck Entry	1	1	1	Loss of Truck Entry Door Seal Pressure
Regulating Blade Position	2	2(2)	2(2)	<10% withdrawn and bottomed
Manual Rod Run-In	1	1	1	Push button at control console

(1) Not required below 50 KW operation if natural convection flanges and pressure vessel cover are removed or in operation with the reactor subcritical by a margin of at least 0.015 ΔK.

(2) Not required during calibration measurements of the regulating blade.

(3) Number required (N) may be reduced by one for no greater than 5 minutes.

d. A minimum of one decade of overlap shall exist between adjacent ranges of nuclear instrument channels.

TECHNICAL SPECIFICATION

UNIVERSITY OF MISSOURI
RESEARCH REACTOR FACILITY

SUBJECT: Reactor Containment

Applicability

This specification shall apply to the reactor containment building.

Objective

The objective of this specification is to reasonably assure that the health and safety of the public is not endangered as a result of reactor operation.

Specification

a. Containment integrity shall be maintained at all times except when:
   (1) The reactor is secured, and
   (2) Irradiated fuel with a decay time of less than sixty (60) days is not being handled.

   Exception: In order to provide time for prompt remedial action, reactor containment integrity may be inoperable for a period of no greater than five (5) minutes when specifications a(1) and a(2) are not met or do not exist.

b. While containment integrity is required, the containment shall be automatically isolated if the activity in the exhaust air plenum or at the reactor bridge indicates an increase of one decade above previously established levels at the same operating condition. Exception: The isolation setting may be temporarily increased to avoid an inadvertent scram and isolation during controlled experimental transfers or minor maintenance in the reactor pool area. The pool area shall be continuously monitored,

TECHNICAL SPECIFICATION

UNIVERSITY OF MISSOURI
RESEARCH REACTOR FACILITY

SUBJECT: Auxiliary Systems

Applicability

This specification shall apply to the limiting conditions on reactor auxiliary systems.

Objective

The objective of this specification is to provide for the operation of certain auxiliary systems and thus further protect the reactor fuel and personnel.

Specification

a. The reactor shall not be operated for greater than five (5) minutes with the emergency electrical generator inoperable.

b. The reactor shall not be operated for greater than five (5) minutes with the reactor makeup water system inoperable or not connected to a source of at least 2,000 gallons of primary grade water.

c. The reactor shall not be operated for greater than five (5) minutes with the emergency pool fill system inoperable.

Bases

a. On loss of normal electrical power the emergency generator will supply power to the containment ventilation isolation doors, personnel entry

SUBJECT: Administration (continued)

g. In addition to those otherwise required under this license and applicable regulations, the following records will be maintained:

(1) Reactor operating records, including power levels and periods of operation at each power level.

(2) Records showing radioactivity released or discharged into the air or water beyond the effective control of the licensee as measured at or prior to the point of such release or discharge.

(3) Records of emergency shutdowns and inadvertent scrams, including reasons for emergency shutdowns.

(4) Records of maintenance operations involving substitution or replacement of reactor equipment or components.

(5) Records of experiments installed including description, reactivity worths, locations, exposure time, total irradiation and any unusual events involved in their performance and in their handling.

(6) Records of tests and measurements performed pursuant to these specifications.

h. The following reports shall be made in addition to those otherwise required under applicable regulations:

(1) Safety Limit Violation – In the event of a safety limit violation, the following actions shall be taken:

(a) The reactor shall be shutdown and reactor operation shall not be resumed until authorized by the U.S. Nuclear Regulatory Commission (NRC);

SUBJECT: Administration (continued)

(b) The safety limit violation shall be promptly reported to the NRC. Prompt reporting of the violation shall be made by the University of Missouri, by telephone or facsimile, to the NRC Operations Center within 24 hours;

(c) A detailed follow-up report shall be prepared. The report shall include the following:

1. Applicable circumstances leading to the violation including, when known, the causes and contributing factors;
2. Date and approximate time of the occurrence;
3. Effect of the violation upon reactor and associated systems;
4. Effect of the violation on the health and safety of the facility staff and general public; and
5. Corrective actions to prevent recurrence.

(d) The follow-up report will be submitted within fourteen (14) days to the NRC Document Control Desk, with a copy to the NRC Project Manager.

(2) Release of Radioactivity – Should a release of radioactivity greater than the allowable limits occur from the reactor facility boundary, the following actions shall be taken:

(a) Reactor conditions shall be returned to normal or the reactor shall be shutdown;

(b) The release of radioactivity shall be promptly reported to the NRC. Prompt reporting of the violation shall be made by the University of Missouri, by telephone or facsimile, to the NRC Operations Center within 24 hours;

SUBJECT: Administration (continued)

(c) If it is necessary to shutdown the reactor to correct the occurrence, operations shall not be resumed until authorized by the Reactor Manager; and

(d) A detailed follow-up report shall be prepared. The follow-up report will be submitted within fourteen (14) days to the NRC Document Control Desk, with a copy to the NRC Project Manager.

(3) Other Reportable Occurrences - In the event of an Abnormal Occurrence, as defined by Definition 1.1, the following actions shall be taken:

(Note: Where components or systems are provided in addition to those required by these TSs, the failure of the extra components or systems is not considered reportable provided that the minimum number of components or systems specified or required perform their intended reactor safety function.)

(a) The abnormal occurrence shall be promptly reported to the NRC. Prompt reporting of the occurrence shall be made by the University of Missouri, by telephone or facsimile, to the NRC Operations Center within 24 hours;

(b) A detailed follow-up report shall be prepared. The follow-up report will be submitted within fourteen (14) days to the NRC Document Control Desk, with a copy to the NRC Project Manager; and

(c) A return to normal reactor operation will not be allowed until authorized by the Reactor Manager.

SUBJECT: Administration (continued)

(4) Other Reports - A written report shall be submitted to the NRC Document Control Desk, with a copy to the NRC Project Manager, within thirty (30) days of:

(a) Any significant change(s) in the transient or accident analyses as described in the Hazards Summary Report; or

(b) Permanent changes in the facility organization involving the Office of the Provost or the Director's Office.

(5) An annual report on reactor operation due 60 days following each calendar year to include:

(a) A brief narrative summary of (1) operating experience (including operations designed to measure reactor characteristics), (2) changes in facility design, performance characteristics and operating procedures related to reactor safety occurring during the reporting period, and (3) results of surveillance tests and inspections;

(b) A tabulation showing the energy generated by the reactor (in megawatt-days);

(c) The number of emergency shutdowns and inadvertent scrams, including the reasons therefore and corrective action, if any, taken;

(d) Discussion of the major maintenance operations performed during the period, including the effects, if any, on the safe operation of the reactor;

(e) A summary of each change to the facility or procedures, tests, and experiments carried out under the conditions of 10 CFR 50.59;

SUBJECT: Administration (continued)

(f) A summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee as measured at or prior to the point of such release or discharge;

(g) A description of any environmental surveys performed outside the facility; and

(h) A summary of radiation exposures received by facility personnel and visitors, including the dates and time of significant exposure, and a brief summary of the results of radiation and contamination surveys performed within the facility.

i. There will be two facility staff personnel at the facility during reactor operation. One of these persons must be a licensed reactor operator or senior reactor operator and the second person must be knowledgeable of the facility.