UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 26, 2022

Dr. Steven R. Reese, Director
Radiation Center
Oregon State University
100 Radiation Center
Corvallis, OR 97331-5903

SUBJECT: OREGON STATE UNIVERSITY – ISSUANCE OF AMENDMENT NO. 26 TO RENEWED FACILITY OPERATING LICENSE NO. R-106 FOR THE OREGON STATE TRIGA REACTOR (EPID NO. L-2020-NFA-0005)

Dear Dr. Reese:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 26 to Renewed Facility Operating License No. R-106 for the Oregon State University (OSU) TRIGA (Training, Research, Isotopes, General Atomics) Reactor (OSTR). This amendment consists of changes to the Renewed Facility Operating License No. R-106 and Appendix A, Technical Specifications (TSs), in response to the OSU application dated June 17, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession Package No. ML20171A575), as supplemented by letters dated May 21, 2021, and January 19, 2022 (ADAMS Accession No. ML21141A289 and ADAMS Accession Package No. ML22019A297, respectively).

This amendment revises OSU License Condition 2.C.(1) from a temperature limit to a reactivity limit, and revises various OSU TSs to remove the requirements related to the fuel temperature measurement obtained from the licensee's instrumented fuel element (IFE). This amendment also reverses a limitation imposed in License Amendment No. 25 (ADAMS Accession Package No. ML19011A340), that prohibited transient mode operation (i.e., pulse and square-wave) without an IFE. Additionally, this amendment implements numerous grammatical and format changes to improve the clarity and readability of the TSs.

A copy of the NRC staff's safety evaluation is also enclosed. If you have any questions, please contact me at (301) 415-2856, or by email at Michael.Balazik@nrc.gov.

Sincerely,

Signed by Balazik, Michael
on 07/26/22

Michael F. Balazik, Project Manager
Non-Power Production and Utilization Facility
Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-243
License No. R-106

Enclosures:
1. Amendment No. 26 to Renewed
   Facility Operating License No. R-106
2. Safety Evaluation

cc: See next page

cc:

Mayor of the City of Corvallis
Corvallis, OR 97331

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Mr. Daniel Harlan, Chairman
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Test, Research and Training
Reactor Newsletter
Attention: Amber Johnson
Dept of Materials Science and Engineering
University of Maryland
4418 Stadium Drive
College Park, MD 20742-2115

SUBJECT: OREGON STATE UNIVERSITY - ISSUANCE OF AMENDMENT NO. 26 TO RENEWED FACILITY OPERATING LICENSE NO. R-106 FOR THE OREGON STATE TRIGA REACTOR (EPID NO. L-2020-NFA-0005) DATED: JULY 26, 2022

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ADAMS Accession No.: ML22199A309 **NRR-058**

OFFICE	NRR/DANU/UNPL/PM	NRR/DANU/UNPL/PM	OGC
NAME	GWertz	MBalazik	JEzell
DATE	7/18/2022	7/19/2022	7/22/2022
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NAME	NParker	JBorromeo	MBalazik
DATE	7/25/2022	7/26/2022	7/26/2022

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

OREGON STATE UNIVERSITY

DOCKET NO. 50-243

OREGON STATE UNIVERSITY TRIGA REACTOR

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 26
Renewed License No. R-106

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

   A. The application for an amendment to Renewed Facility Operating License No. R-106 filed by Oregon State University (the licensee) on June 17, 2020, as supplemented by letters dated May 21, 2021, and January 19, 2022, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;

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

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) that such activities will be conducted in compliance with the regulations of the Commission set forth in 10 CFR Chapter I;

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

   E. The issuance of this amendment is in accordance with 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," of the Commission's regulations and all applicable requirements have been satisfied; and

   F. Prior notice of this amendment was not required by 10 CFR 2.105, "Notice of proposed action," and publication of a notice for this amendment is not required by 10 CFR 2.106, "Notice of issuance."

2. Accordingly, the license is amended as described in Attachment 1 to this license amendment and by changes to the Technical Specifications as indicated in Attachment 2. Paragraphs 2.C.(1) and 2.C.(2) of Renewed Facility Operating License No. R-106 are hereby amended to read as follows:

   (1) Maximum Power Level

   The licensee is authorized to operate the facility at steady-state power levels not in excess of 1.1 megawatts (thermal), and in the pulse mode, with reactivity insertions not to exceed $2.30.

   (2) Technical Specifications

   The technical specifications contained in Appendix A, as revised through Amendment No. 26, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the technical specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Joshua M. Borromeo

Digitally signed by Joshua M. Borromeo

Joshua M. Borromeo, Chief
Non-Power Production and Utilization Facility
Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Attachments:
1. Changes to Renewed Facility Operating License No. R-106
2. Changes to Appendix A, “Technical Specifications”

Date of Issuance: July 26, 2022

ATTACHMENT 1 TO LICENSE AMENDMENT NO. 26

RENEWED FACILITY OPERATING LICENSE NO. R-106

DOCKET NO. 50-243

Replace the following page of Renewed Facility Operating License No. R-106 with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Renewed Facility Operating License No. R-106

REMOVE	INSERT
3	3

(3) Pursuant to the Act and 10 CFR Part 30 to receive, possess and use in connection with operation of the facility the following:

a. up to a 7-curie sealed polonium-210 beryllium source which may be used for reactor startup;

b. up to a 3-curie sealed americium-241 beryllium neutron source which may be used for reactor startup;

c. such byproduct material as may be produced by the operation of the facility. Byproduct material cannot be separated except for byproduct material produced in experiments.

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Parts 20, 30, 50, 51, 55, 70, and 73; is subject to all applicable provisions of the Act, and to the rules, regulations and orders of the Commission now, or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady-state power levels not in excess of 1.1 megawatts (thermal), and in the pulse mode, with reactivity insertions not to exceed $2.30.

(2) Technical Specifications

The technical specifications contained in Appendix A, as revised through Amendment No. 26, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the technical specifications.

(3) Physical Security Plan

The licensee shall maintain and fully implement all provisions of the NRC-approved physical security plan, including amendments and changes made pursuant to the authority of 10 CFR 50.54(p). The approved security plan consists of documents withheld from public disclosure pursuant to 10 CFR 73.21, entitled “Oregon State University TRIGA Reactor Physical Security Plan,” as revised.

ATTACHMENT 2 TO LICENSE AMENDMENT NO. 26

RENEWED FACILITY OPERATING LICENSE NO. R-106

DOCKET NO. 50-243

Replace the entirety of Appendix A, “Technical Specifications,” with the attached Appendix A, identified by amendment number.

Technical Specifications

REMOVE	INSERT
1 through 49	1 through 47

APPENDIX A

TO

FACILITY LICENSE NO. R-106

TECHNICAL SPECIFICATIONS

AND BASIS

FOR THE

OREGON STATE UNIVERSITY

TRIGA® REACTOR

DOCKET NO. 50-243

Current through Amendment #_____

Date of Issuance:__________

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Table of Contents

Included in this document are the Technical Specifications and the "Bases" for the Technical Specifications. These bases, which provide the technical support for the individual Technical Specifications, are included for informational purposes only. They are not part of the Technical Specifications, and they do not constitute limitations or requirements to which the licensee must adhere.

1 DEFINITIONS

1.1 Channel: A channel is the combination of sensor, line, amplifier, and output devices that are connected for the purpose of measuring the value of a parameter.

1.2 Channel Calibration: A channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter that the channel measures. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip, and shall be deemed to include a channel test.

1.3 Channel Check: A channel check is a qualitative verification of acceptable performance by observation of channel behavior. This verification, where possible, shall include comparison of the channel with other independent channels or systems measuring the same variable.

1.4 Channel Test: A channel test is the introduction of a signal into the channel for verification that it is operable.

1.5 Confinement: Confinement is an enclosure of the overall facility that is designed to limit the release of effluents between the enclosure and its external environment through controlled or defined pathways.

1.6 Control Rod: A control rod is a device fabricated from neutron absorbing material or fuel or both that is used to establish neutron flux changes and to compensate for routine reactivity changes. A control rod may be coupled to its drive unit, allowing it to perform a safety function when the coupling is disengaged. Types of control rods shall include:

- **a. Regulating Rod:** The regulating rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section. Its position may be varied manually or by the servo-controller.
- **b. Shim/Safety Rod:** A shim/safety rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section.
- **c. Transient Rod:** The transient rod is a control rod with scram capabilities that can be rapidly ejected from the reactor core to produce a pulse. It may have a voided follower.

1.7 Core Lattice Position: The core lattice position is defined by a particular hole in the top grid plate of the core. It is specified by a letter indicating the specific ring in the grid plate and a number indicating a particular position within that ring.

1.8 Excess Reactivity: Excess reactivity is that amount of reactivity that would exist if all control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical ($k_{eff} = 1$) at reference core conditions.

1.9 Experiment: An experiment is any operation, hardware, or target (excluding devices such as detectors or foils) that is designed to investigate non-routine reactor characteristics or that is intended for irradiation within an irradiation facility. Hardware rigidly secured to a core or shield structure so as to be a part of their design to carry out experiments is not normally considered an experiment. Specific experiments shall include:

a. **Secured Experiment:** A secured experiment is any experiment, experimental apparatus, or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining forces shall be substantially greater than those to which the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces that are normal to the operating environment of the experiment, or by forces that can arise as a result of credible malfunctions.

b. **Unsecured Experiment:** An unsecured experiment is any experiment or component of an experiment that does not meet the definition of a secured experiment.

c. **Movable Experiment:** A movable experiment is one where it is intended that all or part of the experiment may be moved in or near the core or into and out of the core while the reactor is operating.

1.10 Fuel Element: A fuel element is a single TRIGA® fuel rod.

1.11 Irradiation Facilities: Irradiation facilities shall mean beam ports, including extension tubes with shields; thermal columns with shields; vertical tubes; rotating specimen rack; pneumatic transfer system; and any other in-tank irradiation facilities.

1.12 Measured Value: The measured value is the value of a parameter as it appears on the output of a channel.

1.13 Operable: Operable means a component or system is capable of performing its intended function.

1.14 Operating: Operating means a component or system is performing its intended function.

1.15 Operational Core: An operational core shall be a fuel element core that operates within the licensed power level and satisfies all the requirements of the Technical Specifications.

1.16 Pulse Mode: Pulse mode shall mean any operation of the reactor with the mode selector switch in a pulse position.

1.17 Radiation Center Complex: The Radiation Center Complex is the physical area defined by the Radiation Center Building and the fence surrounding the north, west, and east sides of the Reactor Building.

1.18 Reactor Operating: The reactor is operating whenever it is not secured or shut down.

1.19 Reactor Safety Systems: Reactor safety systems are those systems, including their associated input channels, that are designed to initiate, automatically or manually, a reactor scram for the primary purpose of protecting the reactor.

1.20 Reactor Secured: The reactor is secured when:

a. Either there is insufficient moderator available in the reactor to attain criticality or there is insufficient fissile material present in the reactor to attain criticality under optimum available conditions of moderation and reflection; or,

b. All of the following exist:

    1. The four (4) neutron absorbing control rods are fully inserted;

    2. The console key switch is in the "off" position and the key is removed from the console;

    3. No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods; and

    4. No experiments or irradiation facilities in the core are being moved or serviced that have, on movement or servicing, a reactivity worth exceeding the maximum value of $0.50.

1.21 Reactor Shut Down: The reactor is shut down if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments and irradiation facilities included.

1.22 Reference Core Condition: The reference core condition is the reactivity condition of the core when it is at ambient temperature (cold) and the reactivity worth of xenon is negligible (less than $0.30).

1.23 Safety Channel: A safety channel is a measuring channel in the reactor safety system.

1.24 Scram Time: Scram time is the elapsed time between reaching a limiting safety system setting and the instant that the slowest scrammable control rod reaches its fully-inserted position.

1.25 Shall, Should, and May: The word "shall" is used to denote a requirement; the word "should" is used to denote a recommendation; and the word "may" is used to denote permission, neither a requirement nor a recommendation.

1.26 Shutdown Margin: Shutdown margin is the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems starting from any permissible operating condition and with the most reactive rod in its most reactive position, and that the reactor will remain subcritical without further operator action.

1.27 Square-Wave Mode (S.-W. Mode): Square-wave mode shall mean any operation of the reactor with the mode selector switch in the square-wave position.

1.28 Steady-State Mode (S.-S. Mode): Steady-state mode shall mean operation of the reactor with the mode selector switch in the steady-state or automatic position.

1.29 Substantive Changes: Substantive changes are changes in the original intent or safety significance of an action or event.

1.30 Surveillance Intervals: Allowable surveillance intervals shall not exceed the following:

a. Biennial – interval not to exceed 30 months

b. Annual – interval not to exceed 15 months

c. Semi-annual – interval not to exceed 7.5 months

d. Quarterly – interval not to exceed 4 months

e. Monthly – interval not to exceed 6 weeks

f. Weekly – interval not to exceed 10 days

2 SAFETY LIMIT AND LIMITING SAFETY SYSTEM SETTING

2.1 Safety Limit - Fuel Element Temperature

Applicability. This specification applies to the temperature of the reactor fuel.

Objective. The objective is to define the maximum fuel element temperature that can be permitted with confidence that no damage to the fuel element cladding shall result.

Specifications. The temperature in a TRIGA® fuel element shall not exceed 1150°C (2100°F) under any mode of operation.

Basis. Fuel element cladding is the barrier that prevents fission products from contaminating the coolant. A loss of the integrity of the fuel element cladding could arise from a build-up of excessive pressure between the fuel-moderator and the cladding if the fuel temperature exceeds the safety limit. The pressure is caused by the presence of air, fission product gases, and hydrogen from the dissociation of the hydrogen and zirconium in the fuel-moderator. The magnitude of this pressure is determined by the fuel-moderator temperature and the ratio of hydrogen to zirconium in the alloy.

The safety limit for the TRIGA® fuel element is based on data that indicate that the stress in the cladding due to the hydrogen pressure from the dissociation of zirconium hydride will remain below the ultimate stress, provided the temperature of the fuel does not exceed 1150°C (2100°F) and the fuel cladding is water cooled.

2.2 Limiting Safety System Setting

Applicability. This specification applies to the scram settings that prevent the safety limit from being reached.

Objective. The objective is to prevent the safety limit from being reached.

Specifications The limiting safety system setting (LSSS) shall not exceed 1.1 MW as measured by the safety and percent power level channels.

Basis. During steady state operation, maximum temperatures are predicted to occur in the LEU MOL ICIT core. Chapter 4 shows that, during steady state 1.1 MW operation, maximum temperatures are predicted to occur in the LEU MOL ICIT core, with a maximum hot rod thermal power of 18.52 kW. Analysis shows that the MDNBR in the hot channel (using the Bernath correlation) will reach a value of 2.00 at approximately 19.85 kW hot channel steady state 1.1 MW power. This is 107.2% of the 18.52 kW produced in the hot channel of the LEU MOL ICIT core configuration. The power level channels scram the reactor at 106% of 1 MW power which is far below the power level required to reach a MDNBR of 2.00. The two power level channels provide redundant and independent protection from exceeding the safety limit of 1150°C. Therefore,

measurement of the reactor power by two redundant and independent power level channels will ensure that the safety limit is not reached during steady state operations.

Analysis indicates that at 18.52 kW, the maximum temperature anywhere in the hot channel fuel element will be less than 500°C, which is far below the safety limit of 1150°C.

Additional analysis was performed on the very unlikely accident involving the simultaneous withdrawal of all four control rods, with an initial power of 100 W, a scram setpoint of 1.06 MW, and a 0.5 second delay time to scram the reactor. The analysis showed that the maximum hypothetical reactivity insertion would be $1.13, which is far below the maximum allowable pulse of $2.30. Pulsing thermal hydraulic analysis showed that a pulse of $2.30 would not exceed 830°C, which is below the safety limit and prevents potential damage due to exceeding eutectic limits.

3 LIMITING CONDITIONS FOR OPERATIONS

3.1 Reactor Core Parameters

3.1.1 Steady-State Operation

Applicability. This specification applies to the energy generated in the reactor during steady-state operation.

Objective. The objective is to ensure that the fuel temperature safety limit shall not be exceeded during steady-state operation.

Specifications. The reactor power level shall not exceed 1.1 MW except for pulsing operations.

Basis. Chapter 4 indicates that, in the most conservative core configuration (LEU MOL ICIT core), at 18.52 kW, the maximum temperature anywhere in the hot channel fuel element will be less than 500°C, which is far below the safety limit of 1150°C.

3.1.2 Shutdown Margin

Applicability. These specifications apply to the reactivity condition of the reactor and the reactivity worths of control rods and experiments. They apply for all modes of operation.

Objective. The objective is to ensure that the reactor can be shut down at all times and to ensure that the fuel temperature safety limit shall not be exceeded.

Specifications. The reactor shall not be operated unless the following conditions exist:

The shutdown margin provided by control rods shall be at least $0.55 with:

a. Irradiation facilities and experiments in place and the total worth of all unsecured experiments in their most reactive state;

b. The most reactive control rod fully withdrawn; and

c. The reactor in the reference core condition.

Basis. The value of the shutdown margin ensures that the reactor can be shut down from any operating condition even if the most reactive control rod should remain in the fully withdrawn position.

3.1.3 Core Excess Reactivity

Applicability. This specification applies to the reactivity condition of the reactor and the reactivity worths of control rods and experiments. It applies for all modes of operation.

Objective. The objective is to ensure that the reactor can be shut down at all times and to ensure that the fuel temperature safety limit shall not be exceeded.

Specifications. The maximum available excess reactivity based on the reference core condition shall not exceed $7.55.

Basis. An excess reactivity limit of $7.55 allows flexibility to operate the reactor in various core configurations without the need to add or remove fuel elements when changing between operating modes. Operating with a fuel element in the B1 position is the most reactive core configuration. If operating in this core configuration with the minimum shutdown margin of $0.55 and typical control rod worths of $2.50 (Safety), $2.60 (Shim), $3.70 (Regulating) and $3.00 (Transient), the calculated NRC core excess would be -$0.55+$2.50+$2.60+$3.00 = $7.55. The shutdown margin calculation assumes a) irradiation facilities and experiments in place and the total worth of all unsecured experiments in their most reactive state, b) the most reactive control rod fully withdrawn and c) the reactor in the reference core condition. Activities such as moving away from the reference state or adding negative worth experiments will decrease core excess and increase shutdown margin. The OSTR normally operates with a cadmium-lined irradiation facility (CLICIT) in B1, which is significantly less reactive than the limiting core configuration. The only activity that could result in requiring fuel movement to meet shutdown margin and core excess limits would be the unusual activity of adding an experiment with large positive reactivity worth.

3.1.4 Pulse and Square-Wave Mode Operation

Applicability. This specification applies to the energy generated in the reactor as a result of a pulse or square-wave insertion of reactivity.

Objective. The objective is to ensure that the fuel temperature safety limit shall not be exceeded.

Specifications. The reactivity to be inserted for pulse mode or square-wave mode operation shall be determined and limited by a mechanical block and electrical interlock on the transient rod, such that the maximum reactivity insertion shall not exceed $2.30.

Basis. GA-C26017, Pulsing Temperature Limit for TRIGA® LEU Fuel, recommends that TRIGA® fuel should not exceed 830°C. The fuel temperature rise during a pulse transient has been estimated by RELAP-5-3D using non-adiabatic models. The core at the middle of life was found to have the highest accumulative peaking factor for any core configuration during the fuel lifetime. These models predict pulse characteristics for operation of operational cores and should be accepted with confidence, relying also on information concerning prompt neutron lifetime and prompt temperature coefficient of reactivity. The reactivity value calculated to produce a temperature of 830°C is $2.33. Therefore, limiting reactivity insertions to a maximum of $2.30 will ensure that fuel temperature will not exceed 830°C.

3.1.5 This section intentionally left blank.

3.1.6 Fuel Parameters

Applicability. This specification applies to all fuel elements.

Objective. The objective is to maintain integrity of the fuel element cladding.

Specifications. The reactor shall not operate with damaged fuel elements, except for the purpose of locating damaged fuel elements. A fuel element shall be considered damaged and shall be removed from the core if:

a. The transverse bend exceeds 0.0625 inches over the length of the cladding;

b. Its length exceeds its original length by 0.125 inches;

c. A cladding defect exists as indicated by release of fission products; or

d. Visual inspection identifies bulges, gross pitting, or corrosion.

Basis. Gross failure or obvious visual deterioration of the fuel is sufficient to warrant declaration of the fuel as damaged. The elongation and bend limits are the values found acceptable to the USNRC (NUREG-1537).

3.2 Reactor Control and Safety System

3.2.1 Control Rods

Applicability. This specification applies to the function of the control rods.

Objective. The objective is to determine that the control rods are operable.

Specifications. The reactor shall not be operated unless the control rods are operable. Control rods shall not be considered operable if:

a. Damage is apparent to the rod or rod drive assemblies; or

b. The scram time exceeds 2 seconds.

Basis. This specification ensures that the reactor shall be promptly shut down when a scram signal is initiated. Experience and analysis have indicated that for the range of transients anticipated for a TRIGA® reactor, the specified scram time is adequate to ensure the safety of the reactor.

3.2.2 Reactor Measuring Channels

Applicability. This specification applies to the information that shall be available to the reactor operator during reactor operation.

Objective. The objective is to specify the minimum number of measuring channels that shall be available to the operator to ensure safe operation of the reactor.

Specifications. The reactor shall not be operated in the specified mode unless the minimum number of measuring channels listed in Table 1 are operating.

Table 1 - Minimum Measuring Channels

Measuring Channel	Effective Mode		
	S.-S.	Pulse	S.-W.
Linear Power Level	1	-	1
Log Power Level	1	-	1
Safety Power Level	1	-	1
Percent Power Level	1	-	1
Nvt-Circuit	-	1	-

(1) Any single measuring channel (except the Nvt-Circuit) may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration. Note that the Linear Power Level and Log Power Level are connected to the same detector and both become inoperable when performing a channel check, test, or calibration.

(2) If any required measuring channels becomes inoperable while the reactor is operating for reasons other than that identified in footnote (1), the channel shall be restored to operation within 5 minutes or the reactor shall be immediately shut down.

Basis. The power level monitors ensure that the reactor power level is adequately monitored for both steady-state and square wave modes of operation. The Nvt-Circuit provides indication of peak power and total energy generated during a pulse. The specifications on reactor power level indication are included in this section, since the power level is related to the fuel temperature. For footnote (1), taking these measuring channels off-line for short durations for the purpose of a check, test, or calibration is considered acceptable because in some cases, the reactor needs to be operating in order to perform the check, test, or calibration. Additionally there exist two redundant and independent power level indications operating at any given time while the third single channel is off-line. For footnote (2), events that lead to these circumstances are self-revealing to the operator. Furthermore, recognition of appropriate action on the part of the operator as a result of an instrument failure would make this consistent with TS 6.7.2.

3.2.3 Reactor Safety Systems

Applicability. This specification applies to the reactor safety systems.

Objective. The objective is to specify the minimum number of reactor safety systems that shall be available to the operator to ensure safe operation of the reactor.

Specifications. The reactor shall not be operated in the specified mode unless the minimum number of safety systems described in Table 2 are operable.

Table 2 - Minimum Reactor Safety Systems

Safety System	Function	Effective Mode		
		S.-S.	Pulse	S.-W.
Safety Power Level	SCRAM @ 1.1 MW or less	1	-	1
Percent Power Level	SCRAM @ 1.1 MW or less	1	-	1
Manual Scram	SCRAM (button on console)	1	1	1
Preset Timer	Transient rod SCRAM @ ≤ 15 sec after pulse	-	1	-
High Voltage	SCRAM @ ≥ 25% of nominal operating voltage	1	1	1

(1) The Safety Power channel or the Percent Power channel may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration.
(2) If any required safety channel becomes inoperable while the reactor is operating for reasons other than that identified in footnote (1), the channel shall be restored to operation within 5 minutes or the reactor shall be immediately shut down.

Basis.

Safety and Percent Power Level Scrams: The set point for both the safety and percent power channels are normally set to 106% of 1 MW, which is below the licensed power of 1.1 MW. The 6% difference allows for expected and observed instrument fluctuations at the normal full operating power of 1 MW to occur without scramming the reactor unnecessarily. Conversely, SAR Chapter 13 shows that this set point is more than sufficient to prevent the operator from inadvertently exceeding the licensed power.

Manual Scram: The manual scram shall be functional at all times the reactor is in operation. It has no specified value for a scram set point. It is initiated by the reactor operator manually.

Preset Timer Scram: The preset timer ensures that the reactor power level will reduce to a low level after pulsing and preclude an unintentional restart or ramped increase to some equilibrium power.

High Voltage Scram: The high voltage scram shall be set to initiate a scram before the high voltage for any of the three detectors drops below 25% of the nominal operating voltage. The loss of operating voltage down to this level is an indication of detector failure. Many measuring channels and safety systems are fundamentally based upon accurate response of the detectors.

For footnote (1), taking these safety channels off-line for short durations for the purpose of a check, test, or calibration is considered acceptable because in some cases, the reactor needs to be operating in order to perform the check, test, or calibration. Additionally there exist two redundant and independent power level indications operating at any given time while the third single channel is off-line. For footnote (2), events that lead to these circumstances are self-revealing to the operator. Furthermore, recognition of appropriate action on the part of the operator as a result of an instrument failure would make this consistent with TS 6.7.2.

3.2.4 Reactor Interlocks

Applicability. This specification applies to the reactor safety system interlocks.

Objective. The objective is to specify the minimum number of reactor safety interlocks that shall be available to the operator to ensure safe operation of the reactor.

Specifications. The reactor shall not be operated in the specified mode unless the minimum number of interlocks described in Table 3 are operable.

Table 3 – Minimum Reactor Interlocks

Interlock	Function	Effective Mode		
		S.-S.	Pulse	S.-W.
Wide-Range Log Power Level Channel	Prevents control rod withdrawal @ less than 2 cps	1	-	-
Transient Rod Cylinder	Prevents application of air unless fully inserted	1	-	-
1 kW Pulse Interlock	Prevents pulsing above 1 kW	-	1	-
Shim, Safety, and Regulating Rod Drive Circuit	Prevents simultaneous manual withdrawal of two rods	1	-	1
Shim, Safety, and Regulating Rod Drive Circuit	Prevents movement of any rod except transient rod	-	1	-
Transient Rod Cylinder Position	Prevent pulse insertion of reactivity greater than $2.30	-	1	1

(1) Any single interlock may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration.
(2) If any required interlock becomes inoperable while the reactor is operating for reasons other than that identified in footnote (1) above, the interlock shall be restored to operation within 5 minutes or the reactor shall be immediately shut down.

Basis.

Wide-Range Log Power Level Channel Interlock: The rod withdrawal prohibit interlock prevents the operator from adding reactivity when the count rate on the wide-range log power channel falls below 2 cps. When this happens, the count rate is insufficient to produce meaningful instrumentation response. If the operator were to insert reactivity under this condition, the period could quickly become very short and result in an inadvertent power excursion. A neutron source is added to the core to create sufficient instrument response that the operator can recognize and respond to changing conditions.

Transient Rod Cylinder Interlock: This interlock prevents the application of air to the transient rod unless the cylinder is fully inserted. This will prevent the operator from pulsing the reactor in steady-state mode.

1 kW Pulse Interlock: The 1 kW permissive interlock is designed to prevent pulsing when wide range log power is above 1 kW. Analysis of pulsing at full power shows that if the initial temperature was higher, the resulting peak temperature will be lower. However, there has not been an experiment to look at the relationship between heat generated within the fuel at power (i.e., > 1 kW) and heat generated on the surface of the fuel during a pulse. Therefore, this interlock prevents the reactor from pulsing at power levels that produce measurably significant increases in fuel temperature.

Shim, Safety, and Regulating Rod Drive Circuit: The single rod withdrawal interlock prevents the operator from removing multiple control rods simultaneously such that reactivity insertions from control rod manipulation are done in a controlled manner. The analysis in SAR Chapter 13 shows that the reactivity insertion due to the removal rate of the most reactive rod or all the control rods simultaneously is still well below $2.30 of reactivity.

Shim, Safety, and Regulating Rod Drive Circuit: In pulse mode, it is necessary to limit the reactivity insertion to $2.30. This interlock ensures that all pulse reactivity is due to only the transient rod while in pulse mode. Otherwise, any control rod removal in pulse mode would add to the inserted reactivity of the transient rod and create an opportunity for exceeding the reactivity insertion limit.

Transient Rod Cylinder Position Interlock: The transient rod cylinder interlock shall limit reactivity insertions below $2.30. Furthermore, this interlock is designed such that if the electrical (i.e., limit switch) portion fails, a mechanical (i.e., metal bracket) portion will still keep the reactivity insertion below the criterion.

For footnote (1), taking these interlocks off-line for short durations for the purpose of a check, test, or calibration is considered acceptable because in some cases, the reactor needs to be operating in order to perform the check, test, or calibration. For footnote (2), events that lead to these circumstances are self-revealing to the operator. Furthermore, recognition of appropriate action on the part of the operator as a result of an interlock failure would make this consistent with TS 6.7.2.

3.3 Reactor Primary Tank Water

Applicability. This specification applies to the primary water of the reactor tank.

Objective. The objective is to ensure that there is an adequate amount of water in the reactor tank for fuel cooling and shielding purposes, and that the temperature of the reactor tank water remains sufficiently low to guarantee reactor tank integrity.

Specifications. The reactor primary water shall exhibit the following parameters:

a. The tank water level shall be at least 14 feet above the top of the core;

b. The tank water temperature shall not exceed 49°C (120°F); and

c. The conductivity of the tank water shall not exceed 5 μmhos/cm.

Basis. The minimum height of 14 feet of water above the top of the core guarantees that there is sufficient water for effective cooling of the fuel and that the radiation levels at the top of the reactor are within acceptable levels. The water temperature limit is necessary, according to the reactor manufacturer, to ensure that the aluminum reactor tank maintains its integrity and is not degraded. Experience at many research reactor facilities has shown that maintaining the conductivity within the specified limit provides acceptable control of corrosion (NUREG-1537).

3.4 This section intentionally left blank.

3.5 Ventilation System

Applicability. This specification applies to the operation of the facility ventilation system.

Objective. The objective is to ensure that the ventilation system shall be in operation to mitigate the consequences of possible releases of radioactive materials resulting from reactor operation.

Specifications.

a. The reactor shall not be operated unless the facility ventilation system is operating and the reactor bay pressure is maintained negative with respect to surrounding areas, except for periods of time not to exceed two (2) hours to permit repair, maintenance, or testing of the ventilation system.

b. The ventilation system shall be shut down upon a high activity alarm from the Exhaust Particulate Radiation Monitor.

c. Experiments with significant potential for airborne radioactivity release shall not be transferred from an irradiation facility unless the facility ventilation system is operating and the reactor bay pressure is maintained negative with respect to surrounding areas.

Basis. During normal operation of the ventilation system, the annual average ground concentration of ^{41}Ar in unrestricted areas is well below the applicable effluent concentration limit in 10 CFR 20. In addition, the worst-case maximum total effective dose equivalent is well below the applicable annual limit for individual members of the public. This has been shown to be true for scenarios where the ventilation system continues to operate during the maximum hypothetical accident (MHA), where the ventilation system is secured during the MHA, and where the ventilation system and the confinement building are not present during the MHA (SAR Chapter 13). Therefore, operation of the reactor for short periods while the ventilation system is shut down for repair or testing does not compromise the control over the release of radioactive material to the unrestricted area, nor should it cause occupational doses that exceed those limits given in 10 CFR 20 (SAR Chapter 11). The two hour exception to permit repair, maintenance, or testing should not diminish the effectiveness of the reactor top area radiation monitor or the continuous air particulate radiation monitor. The sampling locations for both of these monitors are located directly above the core. Any fission product release should be detected in the same manner regardless of the status of the ventilation system because of the close proximity of the sampling point to the source term. Moreover, radiation monitors in the building, independent of the ventilation system, will give

warning of high levels of radiation that might occur during operation of the reactor while the ventilation system is secured (SAR Chapter 11). The exhaust gas and particulate radiation monitors will be affected by the status of the ventilation system as they are designed to monitor the ventilation exhaust directly and are not in close proximity to the source term (i.e., reactor core). However, control of the release into the unrestricted area will be minimally compromised because the ventilation will be by definition off and the leak rate is negligible compared to the ventilation rate.

Furthermore, this situation is bounded by the MHA scenario A (i.e., without the reactor building) and C (i.e., ventilation off) in the SAR (SAR Chapter 13). Significant potential for airborne radioactivity is the radioactivity that when released into the reactor bay results in the calculated occupational or general public dose equivalent or committed dose equivalent greater than half that of the corresponding calculated value for the maximum hypothetical accident as described in the Safety Analysis Report (as amended).

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3.7 Radiation Monitoring Systems and Effluents

3.7.1 Radiation Monitoring Systems

Applicability. This specification applies to the radiation monitoring information that shall be available to the reactor operator during reactor operation.

Objective. The objective is to specify the minimum radiation monitoring channels that shall be available to the operator to ensure safe operation of the reactor.

Specifications. The reactor shall not be operated nor shall experiments with significant potential for airborne radioactivity be transferred from an irradiation facility unless the minimum number of radiation monitoring channels listed in Table 4 are operating.

Table 4 - Minimum Radiation Monitoring Channels

Radiation Monitoring Channels	Number
Reactor Top Area Radiation Monitor	1
Continuous Air Particulate Radiation Monitor	1
Exhaust Gas Radiation Monitor	1
Exhaust Particulate Radiation Monitor	1

Exception: When a single required radiation monitoring channel becomes inoperable, operations may continue only if portable instruments, surveys, or analyses may be substituted for the normally installed monitor within one (1) hour of discovery for periods not to exceed one (1) month.

Basis. The radiation monitors provide information to operating personnel regarding routine releases of radioactivity and any impending or existing danger from radiation. Their operation will provide sufficient time to evacuate the facility or take the necessary steps to prevent the spread of radioactivity to the surroundings. Furthermore, calculations show that for both routine operations

and under the three accident scenarios identified in SAR Chapter 13, predicted occupational and general public doses are below the applicable annual limits specified in 10 CFR 20 (SAR Chapters 11 and 13). That being the case, we have reasonable assurance that the applicable regulatory limits are being satisfied for the one hour period. Significant potential for airborne radioactivity is the radioactivity that when released into the reactor bay results in the calculated occupational or general public dose equivalent or committed dose equivalent greater than half that of the corresponding calculated value for the maximum hypothetical accident as described in the Safety Analysis Report (as amended).

3.7.2 Effluents

Applicability. This specification applies to the release rate of ^{41}Ar.

Objective. The objective is to ensure that the concentration of the ^{41}Ar in the unrestricted areas shall be below the applicable effluent concentration value in 10 CFR 20.

Specifications. The annual average concentration of ^{41}Ar discharged into the unrestricted area shall not exceed 4×10^{-6} μCi/ml at the point of discharge.

Basis. If ^{41}Ar is continuously discharged at 2.5×10^{-6} μCi/ml (i.e., the concentration produced when the nitrogen purge of the rotating rack is off, all valves on the argon manifold are open, and all beam port valves are open), measurements and calculations show that ^{41}Ar released to the unrestricted areas under the worst-case weather conditions would result in an annual TEDE of 5 mrem (SAR Chapter 11). This is only 50% of the applicable limit of 10 mrem (Regulatory Guide 4.20). Therefore, an emission of 4×10^{-6} μCi/ml would correspond to an annual TEDE of 8 mrem, which is still 20% below the applicable limit.

3.8 Experiments

3.8.1 Reactivity Limits

Applicability. This specification applies to experiments installed in the reactor and its irradiation facilities.

Objective. The objective is to prevent damage to the reactor due to excessive reactivity insertion in the event of an experiment failure.

Specifications. The reactor shall not be operated unless the following conditions governing experiments exist:

a. The absolute value of the reactivity worth of any single unsecured experiment shall not exceed $0.50; and

b. The sum of the absolute values of the reactivity worths of all experiments shall not exceed $2.30.

Basis. The reactivity limit of $0.50 for unsecured experiments is designed to prevent an inadvertent pulse from occurring and maintain a value below the shutdown margin. Unsecured experiments

are located in such a way that it is possible for them to be removed from or inserted into an irradiation facility, either accidentally or deliberately, while the reactor is critical. That being said, the value is clearly less than the limit on pulsing.

The reactivity worth limit for all experiments is designed to prevent an inadvertent pulse from exceeding the recommended limit on pulsing. This limit applies to movable, unsecured, and secured experiments. A maximum reactivity insertion of $2.30 will ensure that fuel temperature will not exceed 830°C.

3.8.2 Materials

Applicability. This specification applies to experiments installed in the reactor and its irradiation facilities.

Objective. The objective is to prevent damage to the reactor or excessive release of radioactive materials in the event of an experiment failure.

Specifications. The reactor shall not be operated unless the following conditions governing experiments exist:

a. Explosive materials, such as gunpowder, TNT, nitroglycerin, or PETN, in quantities greater than 25 milligrams shall not be irradiated in the reactor or irradiation facilities. Explosive materials in quantities up to 25 milligrams may be irradiated provided the pressure produced upon detonation of the explosive has been calculated and/or experimentally demonstrated to be less than half the design pressure of the container; and

b. Experiments containing corrosive materials shall be doubly encapsulated. The failure of an encapsulation of material that could damage the reactor shall result in removal of the sample and physical inspection of potentially damaged components.

Basis. This specification is intended to prevent damage to reactor components resulting from failure of an experiment involving explosive or corrosive materials. Operation of the reactor with the reactor fuel or structure potentially damaged is prohibited to avoid potential release of fission products.

3.8.3 Failures and Malfunctions

Applicability. This specification applies to experiments installed in the reactor and its irradiation facilities.

Objective. The objective is to prevent excessive release of radioactive materials in the event of an experiment failure.

Specifications. Where the possibility exists that the failure of an experiment under normal operating conditions of the experiment or reactor, credible accident conditions in the reactor, or possible accident conditions in the experiment could release radioactive gases or aerosols to the

reactor bay or the unrestricted area, the quantity and type of material in the experiment shall be limited such that the airborne radioactivity in the reactor bay or the unrestricted area will not result in exceeding the applicable dose limits in 10 CFR 20, assuming that:

a. 100% of the gases or aerosols escape from the experiment;

b. Each experiment containing fissile material shall be controlled such that the total inventory of ^{131}I escaping from the experiment shall not exceed 0.0141 curies;

c. If the effluent from an irradiation facility exhausts through a holdup tank that closes automatically on high radiation level, at least 10% of the gaseous activity or aerosols produced will escape;

d. If the effluent from an irradiation facility exhausts through a filter installation designed for greater than 99% efficiency for 0.3 micron particles, at least 10% of these aerosols can escape; and

e. For materials whose boiling point is above 130°F and where vapors formed by boiling this material can escape only through an undisturbed column of water above the core, 10% of these vapors can escape.

Basis. This specification is intended to meet the purpose of 10 CFR 20 by reducing the likelihood that released airborne radioactivity to the reactor bay or unrestricted area surrounding the OSTR will result in exceeding the total dose limits to an individual as specified in 10 CFR 20. The limit on fissile material is based on the amount of ^{131}I estimated to be made available to the reactor bay air during the Maximum Hypothetical Accident found in the Safety Analysis Report.

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3.10 Targets

3.10.1 Permissible In-Core Target Lattice Positions

Applicability. This specification applies to the core at any time when targets are located in any core lattice position.

Objective. The objective is to ensure assumptions made for the neutronic and thermal hydraulic analyses are not compromised.

Specifications. Permissible target locations are core positions G32, G33, and G34. Targets shall not be placed in any other core lattice positions.

Basis. Analyzed target locations were G32, G33, and G34. Location G34 was found to produce the highest integrated power in a target. Thermal hydraulic analysis was based on power distribution in this hot target.

3.10.2 Pulse or Square Wave Mode Operation with Targets Located in Any Core Lattice Position

Applicability. This specification applies to the reactor at any time when targets are located in any core lattice position.

Objective. The objective is to prevent all pulse and square wave activity while targets are present in any core lattice position.

Specifications. The reactor shall not be operated in pulse mode or square wave mode while targets are present in any core lattice position.

Basis. Target performance has not been analyzed under rapid transient pulse conditions; therefore, pulsing shall not be allowed when targets are present in the core. Pulse mode operation is prohibited. Square wave mode operation is also prohibited because it is possible to add more than $1.00 of reactivity in square wave mode. A rod withdrawal accident will not introduce sufficient reactivity to pulse the reactor.

3.10.3 Allowed Target Storage Locations

Applicability. This specification applies to targets at any time targets are located in the reactor tank and not in transit or in an in-core lattice position.

Objective. The objective is to maintain k-effective of stored targets less than 0.9 under all conditions of moderation.

Specifications. The targets shall be stored in the standard in-tank TRIGA® storage racks. No other items shall be present in any storage rack containing targets.

Basis. Storage racks are sufficiently far from the core such that the presence of targets in the core will not affect the criticality condition of targets in the storage racks. Criticality analysis assumes no other objects are present in the vicinity of the stored targets. The criticality analysis for the storage of the fuel assumed no other objects (i.e., fuel elements) were stored with the targets. The k-effective was calculated to be less than 0.9 when stored in the storage racks.

3.10.4 Target Fabrication Requirements

Applicability. This specification applies to any target that will be placed in the reactor tank.

Objective. The objective is to ensure that targets placed in the core may be used with a high degree of reliability with respect to their physical and nuclear properties.

Specifications.

a. The maximum enrichment of uranium in each target shall not exceed 19.75%.

b. The maximum mass of uranium in a target shall not result in a dose to a member of the general public in excess of 100 mrem from an accident involving a single target.

c. Cladding: aluminum, nominal thickness 0.32 cm.

Basis.

a. Targets shall be fabricated with LEU (i.e., less than or equal to 19.75% enriched in ^{235}U). An enrichment of 20% was assumed for the neutronic and the thermal hydraulic analysis for the purpose of bounding the calculations.

b. The dose to the general public from the target cladding failure accident is a function of many variables. Provided all other variables remain constant, the predicted dose should be directly proportional to the mass of uranium in the target. Analysis has shown that the maximum dose to a member of the general public will not exceed 100 mrem given the assumptions made in the calculation of the target cladding failure accident. Therefore, the mass of uranium in each target is limited by the parameters of the analysis and the dose performance criteria.

c. Cladding of this type provides adequate structural integrity while minimizing parasitic neutron absorption.

3.10.5 ^{99}Mo Target Irradiation

Applicability. This specification applies to the irradiation of ^{99}Mo demonstration targets.

Objective. The objective is to ensure that the time that the ^{99}Mo demonstration targets are irradiated is limited by reactor power history.

Specifications. The ^{99}Mo demonstration targets shall be irradiated in a core lattice position for no more than 7.15-MW days (MWD).

Basis. The predicted radionuclide inventory was based upon a 6.5-day irradiation while the reactor is at full power (i.e., 1.1 MW). The multiple of these two numbers represents the effective full power days for the core while the targets are in the core lattice positions analyzed. This power history creates the source term inventory that was predicted for the accident analysis that could potentially be released from the uranium bearing material within the targets. Limiting the irradiation time to 7.15 MWD will ensure that the potential accident consequences are less than the dose limit for individual members of the general public identified in 10 CFR 20.1301.

4 SURVEILLANCE REQUIREMENTS

4.0 General

Applicability. This specification applies to all surveillance requirements for required reactor systems.

Objective. The objective is to ensure that all required reactor systems are operable when the reactor is operating.

Specifications.

a. Surveillance requirements may be deferred during reactor shutdown (except Technical Specifications 4.3.a and 4.3.e); however, they shall be completed prior to reactor startup unless reactor operation is required for performance of the surveillance. Such surveillance shall be performed as soon as practicable after reactor startup. Scheduled surveillance that cannot be performed with the reactor operating may be deferred until a planned reactor shutdown.

b. Any additions, modifications, or maintenance to the ventilation system, the core and its associated support structure, the pool or its penetrations, the pool coolant system, the rod drive mechanism, or the reactor safety systems shall be made and tested in accordance with the specifications to which the systems were originally designed and fabricated or to specifications reviewed by the Reactor Operations Committee. A system shall not be considered operable until after it is successfully tested.

Basis. This specification relates to changes in reactor systems that are required by these Technical Specifications. As long as changes or replacements to these systems continue to meet the original design specifications, then it can be assumed that they meet the presently accepted operating criteria.

4.1 Reactor Core Parameters

Applicability. This specification applies to the surveillance requirements for reactor core parameters.

Objective. The objective is to verify that the reactor does not exceed the authorized limits for power, shutdown margin, and core excess reactivity; to verify that the specifications for fuel element condition are met; and to verify the total reactivity worth of each control rod.

Specifications.

a. A channel calibration shall be made of the power level monitoring channels by the calorimetric method annually.

b. The total reactivity worth of each control rod shall be measured annually or following any significant change (>$0.25) from a reference core.

c. The shutdown margin shall be determined prior to each day's operation, prior to each operation extending more than one day, or following any significant change (>$0.25) from a reference core.

d. The core excess reactivity shall be determined annually or following any significant change (>$0.25) from a reference core.

e. Twenty percent of the fuel elements comprising the core shall be inspected visually for damage or deterioration and measured for concentric or other swelling annually such that the entire core is inspected over a five year period. Annual inspections shall be of non-repeating representative samples of fuel elements from each ring.

Basis. Experience has shown that the identified frequencies will ensure performance and operability for each of these systems or components. The value of a significant change in reactivity (>$0.25) is measurable and will ensure adequate coverage of the shutdown margin after taking into account the accumulation of poisons. For inspection, looking at fuel elements from each ring annually will identify any developing fuel integrity issues throughout the core. Furthermore, the observed mechanism for non-conforming fuel at the OSTR has been exclusively concentric swell. Looking for swell will both provide early indication of fuel nonconformance and significantly reduce the amount of fuel movements needed.

4.2 Reactor Control and Safety Systems

Applicability. This specification applies to the surveillance requirements of reactor control and safety systems.

Objective. The objective is to verify performance and operability of those systems and components that are directly related to reactor safety.

Specifications.

a. The control rods and drives shall be visually inspected for damage or deterioration biennially.

b. The scram time shall be measured annually.

c. The transient rod drive cylinder and associated air supply system shall be inspected, cleaned, and lubricated as necessary, semi-annually.

d. A channel check of each of the reactor safety system channels for the intended mode of operation shall be performed prior to each day's operation or prior to each operation extending more than one day.

e. A channel test of each item in Table 2 in section 3.2.3 and Table 3 in section 3.2.4 shall be performed semi-annually.

Basis. Experience has shown that the identified frequencies will ensure performance and operability for each of these systems or components.

4.3 Reactor Primary Tank Water

Applicability. This specification applies to the surveillance requirements for the reactor tank water.

Objective. The objective is to ensure that the reactor tank water level and reactor tank water temperature monitoring systems are operating, to verify appropriate alarm settings, and to verify that the reactor tank water conductivity is within the limit.

Specifications.

a. A channel check of the reactor tank water level monitor shall be performed monthly.

b. A channel check of the reactor tank water temperature system, including a verification of the alarm set point, shall be performed prior to each day's operation or prior to each operation extending more than one day.

c. An operability check of the reactor tank temperature alarm shall be performed monthly.

d. A channel calibration of the reactor tank water temperature system shall be performed annually.

e. The reactor tank water conductivity shall be measured monthly.

Basis. Experience has shown that the frequencies of checks on systems that monitor reactor primary water level, temperature, and conductivity adequately keep the tank water at the proper level and temperature and maintain water quality at such a level to minimize corrosion and maintain safety.

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4.5 Ventilation System

Applicability. This specification applies to the reactor bay confinement ventilation system.

Objective. The objective is to ensure the proper operation of the ventilation system in controlling releases of radioactive material to the unrestricted area.

Specifications.

a. A channel check of the reactor bay confinement ventilation system's ability to maintain a negative pressure in the reactor bay with respect to surrounding areas shall be performed prior to each day's operation or prior to each operation extending more than one day.

b. A channel test of the reactor bay confinement ventilation system's ability to be secured shall be performed annually.

Basis. Experience has demonstrated that tests of the ventilation system on the prescribed daily and annual basis are sufficient to ensure proper operation of the system and its control over releases of radioactive material.

4.6 This section intentionally left blank.

4.7 Radiation Monitoring System

Applicability. This specification applies to the surveillance requirements for the area radiation monitoring equipment and the air monitoring systems.

Objective. The objective is to ensure that the radiation monitoring equipment is operating properly and to verify the appropriate alarm settings.

Specifications.

a. A channel check of the radiation monitoring systems in section 3.7.1 shall be performed prior to each day's operation or prior to each operation extending more than one day.

b. A channel test of the continuous air particulate, exhaust gas, and exhaust particulate radiation monitors shall be performed monthly.

c. A channel calibration of the radiation monitoring systems in section 3.7.1 shall be performed annually.

Basis. Experience has shown that an annual calibration is adequate to correct for any variation in the system due to a change of operating characteristics over a long time span. A daily channel check and monthly channel test are adequate to ensure that the radiation monitoring equipment is operating correctly.

4.8 Experimental Limits

Applicability. This specification applies to the surveillance requirements for experiments installed in the reactor and its irradiation facilities.

Objective. The objective is to prevent the performance of experiments that may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.

Specifications.

a. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before reactor operation with said experiment.

b. An experiment shall not be installed in the reactor or its irradiation facilities unless a safety analysis has been performed and reviewed for compliance with Section 3.8 by the Reactor Operations Committee in full accord with Section 6.2.3, and the procedures that are established for this purpose.

Basis. Experience has shown that experiments that are reviewed by the staff of the OSTR and the Reactor Operations Committee can be conducted without endangering the safety of the reactor or exceeding the limits in the Technical Specifications.

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5 DESIGN FEATURES

5.1 Site and Facility Description

Applicability. This specification applies to the Oregon State TRIGA® Reactor site location and specific facility design features.

Objective. The objective is to specify the location of specific facility design features.

Specifications.

a. The restricted area is that area inside the fence surrounding the reactor building and the reactor building itself. The unrestricted area is that area outside the fence surrounding the reactor building.

b. The reactor building houses the TRIGA® reactor and is abutted to the Oregon State University Radiation Center Building.

c. The reactor bay shall be equipped with ventilation systems designed to exhaust air or other gases from the reactor building and release them from a stack at a minimum of 65 feet from ground level.

d. Emergency shutdown controls for the ventilation systems shall be located in the reactor control room.

Basis. The Radiation Center, reactor building, and site description are strictly defined. The facility is designed such that the ventilation system will normally maintain a negative pressure in the Reactor Building with respect to the outside atmosphere so that there will be no uncontrolled leakage to the unrestricted environment. Controls for startup and normal operation of the ventilation system are located in the reactor control room. Proper handling of airborne radioactive materials (in emergency situations) can be conducted from the reactor control room with a minimum of exposure to operating personnel.

5.2 Reactor Coolant System

Applicability. This specification applies to the tank containing the reactor and to the cooling of the core by the tank water.

Objective. The objective is to ensure that coolant water shall be available to provide adequate cooling of the reactor core and adequate radiation shielding.

Specifications.

a. The reactor core shall be cooled by natural convective water flow.

b. The tank water inlet and outlet pipes to the heat exchanger and to the demineralizer shall be equipped with siphon breaks not less than 14 feet above the top of the core.

c. A tank water level alarm shall be provided to indicate loss of coolant if the tank level drops more than 6 inches below normal level.

d. A tank water temperature alarm shall be provided to indicate high tank water temperature if the temperature exceeds 49°C (120°F).

Basis.

a. This specification is based on thermal and hydraulic calculations that show that the TRIGA® core can operate in a safe manner at power levels up to 1.9 MW with natural convection flow of the coolant water.

b. In the event of accidental siphoning of tank water through inlet and outlet pipes of the heat exchanger or demineralizer system, the tank water level will drop to a level no less than 14 feet from the top of the core.

c. Loss-of-coolant alarm caused by a water level drop of no more than 6 inches provides a timely warning so that corrective action can be initiated. This alarm is located in the control room.

d. The water temperature alarm provides warning so that corrective action can be initiated in a timely manner to protect the quality of the reactor tank. The alarm is located in the control room.

5.3 Reactor Core and Fuel

5.3.1 Reactor Core

Applicability. This specification applies to the configuration of fuel and in-core experiments.

Objective. The objective is to ensure that provisions are made to restrict the arrangement of fuel elements and experiments so as to provide assurance that excessive power densities shall not be produced.

Specifications.

a. The core assembly shall consist of TRIGA® fuel elements.

b. The fuel shall be arranged in a close-packed configuration except for single element positions occupied by in-core experiments, irradiation facilities, graphite reflector elements, aluminum dummies, control rods, and startup sources.

c. The reactor shall not be operated at power levels exceeding 1 kW with a core lattice position water filled, except for positions on the periphery of the core assembly.

d. The reflector, excluding experiments and irradiation facilities, shall be water or a combination of graphite and water.

Basis.

a. Only TRIGA® fuel is anticipated to ever be used.

b. In-core water-filled experiment positions have been demonstrated to be safe in the Gulf Mark III reactor. The largest values of flux peaking will be experienced in hydrogenous in-core irradiation positions. Various non-hydrogenous experiments positioned in element positions have been demonstrated to be safe in TRIGA® fuel element cores up to 2 MW operation.

c. For cases where one in-core position is water filled, except in the core periphery, the maximum reactor power level is reduced to 1 kW to ensure safe peak power generation levels in adjacent element positions.

d. The core will be assembled in the reactor grid plate, which is located in a tank of light water. Water in combination with graphite reflectors can be used for neutron economy and the enhancement of irradiation facility radiation requirements.

5.3.2 Control Rods

Applicability. This specification applies to the control rods used in the reactor core.

Objective. The objective is to ensure that the control rods are of such a design as to permit their use with a high degree of reliability with respect to their physical and nuclear characteristics.

Specifications.

a. The shim, safety, and regulating control rods shall have scram capability and contain borated graphite, B_4C powder, or boron, with its compounds in solid form as a poison, in aluminum or stainless steel cladding. These rods may incorporate fueled followers that have the same characteristics as the fuel region in which they are used.

b. The transient control rod shall have scram capability and contain borated graphite or boron, with its compounds in a solid form as a poison in an aluminum or stainless steel cladding. The transient rod shall have an adjustable upper limit to allow a variation of reactivity insertions. This rod may incorporate an aluminum or air follower.

Basis. The poison requirements for the control rods are satisfied by using neutron absorbing borated graphite, B_4C powder, or boron. These materials shall be contained in a suitable clad material such as aluminum or stainless steel to ensure mechanical stability during movement and to isolate the poison from the tank water environment. Control rods that are fuel-followed provide additional reactivity to the core and increase the worth of the control rod. The use of fueled-followers in the fueled region has the additional advantage of reducing flux peaking in the water-filled regions vacated by the withdrawal of the control rods. Scram capabilities are provided for rapid insertion of the control rods, which is the primary safety feature of the reactor. The transient control rod is designed for rapid withdrawal from the reactor core, which results in a reactor pulse.

The nuclear behavior of the air or aluminum follower, which may be incorporated into the transient rod, is similar to a void. A voided follower may be required in certain core loadings to reduce flux peaking values.

5.3.3 Reactor Fuel

Applicability. This specification applies to the fuel elements used in the reactor core.

Objective. The objective is to ensure that the fuel elements are of such a design and fabricated in such a manner as to permit their use with a high degree of reliability with respect to their physical and nuclear characteristics.

Specifications. TRIGA® Fuel Elements

The individual unirradiated fuel elements shall have the following characteristics:

a. Uranium content: nominal 30 wt% enriched to less than 20% in ^{235}U;

b. Hydrogen-to-zirconium atom ratio (in the ZrH_x): between 1.5 and 1.65;

c. Natural erbium content (homogeneously distributed): nominal 1.1 wt%;

d. Cladding: 304 stainless steel, nominal 0.020 inches thick; and

e. Identification: top pieces of fuel elements will have characteristic markings to allow visual identification of elements.

Basis. Material analysis of OSTR 30/20 fuel shows that the maximum weight percent of uranium in any fuel element is less than 30.5 percent, and the maximum enrichment of any fuel element is less than 20.0 percent. The minimum erbium content of any fuel element is greater than 1.0 percent. The hydrogen to zirconium ratio for all fuel elements is between 1.55 and 1.65. An element loaded with the maximum ^{235}U content and minimum erbium content would result in an increase in power density of no more than 2.4% over an element with nominal uranium and erbium loading. An increase in the local power density of 2.4% reduces the safety margin by, at most, 4%. The maximum hydrogen-to-zirconium ratio of 1.65 could result in a maximum stress under accident conditions in the fuel element cladding of about a factor of two greater than the value resulting from a hydrogen-to-zirconium ratio of 1.60. However, this increase in the cladding stress during an accident would not exceed the rupture strength of the cladding.

5.4 Fuel Storage

Applicability. This specification applies to the storage of reactor fuel at times when it is not in the reactor core.

Objective. The objective is to ensure that fuel that is being stored shall not become critical and shall not reach an unsafe temperature.

Specifications.

a. All fuel elements shall be stored in a geometrical array where the k-effective does not exceed 0.90 for all conditions of moderation and reflection.

b. Irradiated fuel elements and fuel devices shall be stored in an array that will permit sufficient natural convection cooling by water or air such that the temperature of the fuel element or fuel device will not exceed the safety limit.

Basis. The limits imposed are conservative and ensure safe storage (NUREG-1537).

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6 ADMINISTRATIVE CONTROLS

6.1 Organization

Individuals at the various management levels, in addition to being responsible for the policies and operation of the reactor facility, shall be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adhering to all requirements of the operating license, technical specifications, and federal regulations.

6.1.1 Structure

The reactor administration shall be related to the University as shown in Figure 1.

6.1.2 Responsibility

The following specific organizational levels, and responsibilities shall exist:

a. Vice President for Research (Level 1): The Vice President for Research is responsible for university center and institute organizations representing Oregon State University.

b. Radiation Center Director (Level 2): The Radiation Center Director reports to the Vice President for Research and is accountable for ensuring that all regulatory requirements, including implementation, are in accordance with all requirements of the USNRC and the Code of Federal Regulations.

c. Reactor Administrator (Level 3): The Reactor Administrator reports to the Radiation Center Director and is responsible for guidance, oversight, and technical support of reactor operations.

d. Senior Health Physicist (Level 3): The Senior Health Physicist reports to the Radiation Center Director and is responsible for directing the activities of health physics personnel, including implementation of the radiation safety program.

e. Reactor Supervisor (Level 3): The Reactor Supervisor reports to the Reactor Administrator and is responsible for directing the activities of the reactor operators and senior reactor operators and for the day-to-day operation and maintenance of the reactor.

f. Reactor Operator and Senior Reactor Operator (Level 4): The Reactor Operator and Senior Reactor Operator report to the Reactor Supervisor and are primarily involved in the manipulation of reactor controls, monitoring of instrumentation, and operation and maintenance of reactor related equipment.

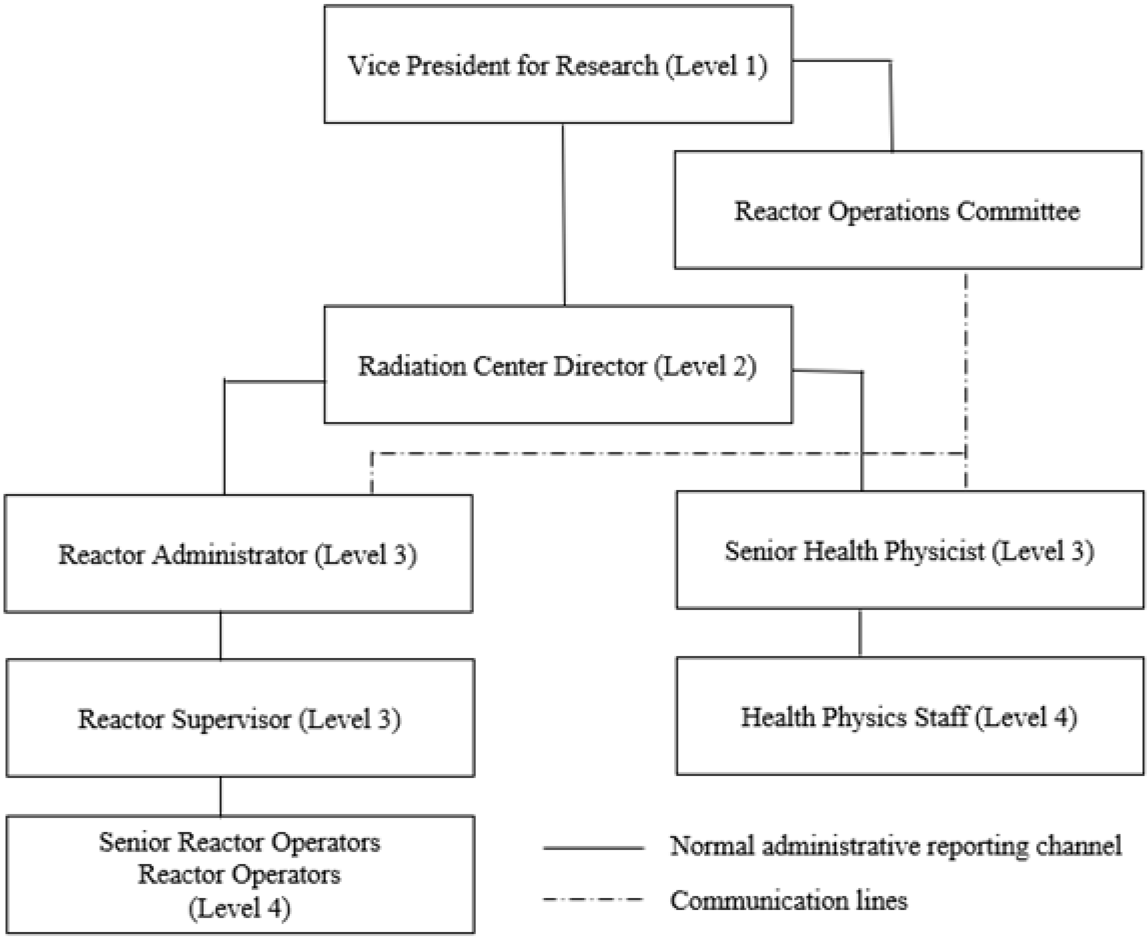

Figure 1 - Administrative Structure

6.1.3 Staffing

a. The minimum staffing when the reactor is not secured shall be:

   1. A reactor operator or the senior reactor operator on duty (Duty SRO) in the control room;

   2. A second person present in the Radiation Center Complex able to carry out prescribed instructions; and

   3. If neither of these two individuals is the Duty SRO, the Duty SRO shall be readily available on call. Readily available on call means an individual who:

      i. Has been specifically designated and the designation is known to the operator on duty;

      ii. Can be rapidly contacted by phone by the operator on duty; and

iii. Is capable of getting to the reactor facility within a reasonable time under normal conditions (e.g., 30 minutes or within a 15 mile radius).

b. A list of reactor facility personnel by name and telephone number shall be readily available in the control room for use by the operator. The list shall include:

1. Radiation Center Director
2. Reactor Administrator
3. Senior Health Physicist
4. Any Licensed Reactor or Senior Reactor Operator

c. Events requiring the direction of the Duty SRO:

1. Initial startup and approach to power of the day;
2. All fuel or control rod relocations within the reactor core region;
3. Relocation of any in-core experiment or irradiation facility with a reactivity worth greater than one dollar; and
4. Recovery from unplanned or unscheduled shutdown or significant power reduction.

6.1.4 Selection and Training of Personnel

The selection, training, and requalification of operations personnel should be in accordance with ANSI/ANS 15.4 – 2016, "Standard for the Selection and Training of Personnel for Research Reactors."

6.2 Review and Audit

The Reactor Operations Committee (ROC) shall have primary responsibility for review and audit of the safety aspects of reactor facility operations. Minutes, findings, or reports of the ROC shall be presented to Level 1 and Level 2 management within ninety (90) days of completion.

6.2.1 ROC Composition and Qualifications

An ROC of at least five (5) members knowledgeable in fields that relate to reactor engineering and nuclear safety shall review and evaluate the safety aspects associated with the operation and use of the facility. The ROC shall be appointed by Level 1 management.

6.2.2 ROC Rules

The operations of the ROC shall be in accordance with written procedures including provisions for:

a. Meeting frequency (at least annually);

b. Voting rules;

c. Quorums (5 members, no more than two voting members may be of the operating staff at any time);

d. Method of submission and content of presentation to the committee;

e. Use of subcommittees; and

f. Review, approval, and dissemination of minutes.

6.2.3 ROC Review Function

The responsibilities of the ROC, or designated Subcommittee thereof, include, but are not limited to, the following:

a. Review all changes made under 10 CFR 50.59;

b. Review of all new procedures and substantive changes to existing procedures;

c. Review of proposed changes to the technical specifications, license, or charter;

d. Review of violations of technical specifications, license, or violations of internal procedures or instructions having safety significance;

e. Review of operating abnormalities having safety significance;

f. Review of all events from reports required in sections 6.6.1 and 6.7.2 of these Technical Specifications;

g. Review of audit reports.

6.2.4 ROC Audit Function

The ROC or a Subcommittee thereof shall audit reactor operations at least annually. The annual audit shall include at least the following:

a. Facility operations for conformance to the technical specifications and applicable license or charter conditions;

b. The retraining and requalification program for the operating staff;

c. The results of action taken to correct those deficiencies that may occur in the reactor facility equipment, systems, structures, or methods of operation that affect reactor safety; and

d. The Emergency Response Plan and implementing procedures.

6.3 Radiation Safety

The Senior Health Physicist shall be responsible for implementation of the radiation safety program. The requirements of the radiation safety program are established in 10 CFR 20. The program should use the guidelines of the ANSI/ANS 15.11 – 2016, "Radiation Protection at Research Reactor Facilities".

6.4 Procedures

Written procedures shall be adequate to ensure the safety of operation of the reactor, but shall not preclude the use of independent judgment and action should the situation require such. Operating procedures shall be in effect for the following items:

a. Startup, operation, and shutdown of the reactor;

b. Fuel loading, unloading, and movement within the reactor;

c. Maintenance of major components of systems that could have an effect on reactor safety;

d. Surveillance checks, calibrations, and inspections required by the technical specifications or those that have an effect on reactor safety;

e. Radiation protection;

f. Administrative controls for operations and maintenance and for the conduct of irradiations and experiments that could affect reactor safety or core reactivity;

g. Shipping of radioactive materials; and

h. Implementation of the Emergency Response Plan.

Substantive changes to the above procedures shall be made only after review by the ROC. Except for radiation protection procedures, unsubstantive changes shall be approved prior to implementation by the Reactor Administrator and documented by the Reactor Administrator within 120 days of implementation. Unsubstantive changes to radiation protection procedures shall be approved prior to implementation by the Senior Health Physicist and documented by the Senior Health Physicist within 120 days of implementation.

Temporary deviations from the procedures may be made by the responsible Senior Reactor Operator in order to deal with special or unusual circumstances or conditions. Such deviations shall be documented and reported by the next working day to the Reactor Administrator.

6.5 Experiments Review and Approval

Approved experiments shall be carried out in accordance with established and approved procedures. Procedures related to experiment review and approval shall include:

a. All new experiments or class of experiments shall be reviewed by the ROC and approved in writing by the Level 2 or designated alternates prior to initiation; and

b. Substantive changes to previously approved experiments shall be made only after review by the ROC and approved in writing by the Level 2 or designated alternates. Minor changes that do not significantly alter the experiment may be approved by Level 3 or higher.

6.6 Required Actions

6.6.1 Actions to Be Taken in Case of Safety Limit Violation

In the event a safety limit (fuel temperature) is exceeded:

a. The reactor shall be shut down and reactor operation shall not be resumed until authorized by the USNRC;

b. An immediate notification of the occurrence shall be made to the Reactor Administrator, Radiation Center Director, and Chair of the ROC; and

c. A report, and any applicable follow-up report, shall be prepared and reviewed by the ROC. The report shall describe the following:

   1. Applicable circumstances leading to the violation including, when known, the cause and contributing factors;
   2. Effects of the violation upon reactor facility components, systems, or structures and on the health and safety of personnel and the public; and
   3. Corrective action to be taken to prevent recurrence.

6.6.2 Actions to Be Taken in the Event of an Occurrence of the Type Identified in Section 6.7.2 Other than a Safety Limit Violation

For all events that are required by regulations or Technical Specifications to be reported to the NRC by the following working day under Section 6.7.2, except a safety limit violation, the following actions shall be taken:

a. The reactor shall be secured and the Reactor Administrator and Director notified;

b. Operations shall not resume unless authorized by the Reactor Administrator and Director;

c. The Reactor Operations Committee shall review the occurrence at their next scheduled meeting; and

d. A report shall be submitted to the NRC in accordance with Section 6.7.2 of these Technical Specifications.

6.7 Reports

6.7.1 Annual Operating Report

An annual report shall be created and submitted by the Radiation Center Director to the USNRC by November 1 of each year consisting of:

a. A brief summary of operating experience including the energy produced by the reactor and the hours the reactor was critical;

b. The number of unplanned shutdowns, including reasons therefor;

c. A tabulation of major preventative and corrective maintenance operations having safety significance;

d. A brief description, including a summary of the safety evaluations, of changes in the facility or in procedures and of tests and experiments carried out pursuant to 10 CFR 50.59;

e. 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. The summary shall include to the extent practicable an estimate of individual radionuclides present in the effluent. If the estimated average release after dilution or diffusion is less than 25 percent of the concentration allowed or recommended, a statement to this effect is sufficient;

f. A summarized result of environmental surveys performed outside the facility; and

g. A summary of exposures received by facility personnel and visitors where such exposures are greater than 25 percent of that allowed.

6.7.2 Special Reports

In addition to the requirements of applicable regulations, and in no way substituting therefor, reports shall be made by the Radiation Center Director to the NRC as follows:

a. A report not later than the following working day by telephone and confirmed in writing by facsimile or email to the NRC Operations Center, to be followed by a written report that describes the circumstances of the event within 14 days to the NRC Document Control Desk of any of the following:

    1. Violation of the safety limit;

    2. Release of radioactivity from the site above allowed limits;

    3. Operation with actual safety system settings from required systems less conservative than the limiting safety system setting;

4. Operation in violation of limiting conditions for operation unless prompt remedial action is taken as permitted in Section 3;
5. A reactor safety system component malfunction that renders or could render the reactor safety system incapable of performing its intended safety function. If the malfunction or condition is caused by maintenance, then no report is required;
6. An unanticipated or uncontrolled change in reactivity greater than one dollar. Reactor trips resulting from a known cause are excluded;
7. Abnormal and significant degradation in reactor fuel or cladding, or both, coolant boundary, or confinement boundary (excluding minor leaks) where applicable; or
8. 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.

b. A report within 30 days in writing to the NRC, Document Control Desk, Washington, D.C. of:
   1. Permanent changes in the facility organization involving Level 1-2 personnel; and
   2. Significant changes in the transient or accident analyses as described in the Safety Analysis Report.

6.8 Records

6.8.1 Records to Be Retained for a Period of at Least Five Years or for the Life of the Component Involved if Less than Five Years

a. Normal reactor operation (but not including supporting documents such as checklists, log sheets, etc., which shall be maintained for a period of at least one year);
b. Principal maintenance activities;
c. Reportable occurrences;
d. Surveillance activities required by the Technical Specifications;
e. Reactor facility radiation and contamination surveys;
f. Experiments performed with the reactor;
g. Fuel inventories, receipts, and shipments;

h. Approved changes to the operating procedures; and
i. Reactor Operations Committee meetings and audit reports.

6.8.2 Records to Be Retained for at Least One Certification Cycle

Records of retraining and requalification of certified reactor operators and senior reactor operators shall be retained at all times the individual is employed or until the certification is renewed.

6.8.3 Records to Be Retained for the Lifetime of the Reactor Facility

a. Gaseous and liquid radioactive effluents released to the environs;
b. Offsite environmental monitoring surveys;
c. Radiation exposures for all personnel monitored;
d. Drawings of the reactor facility; and
e. Reviews and reports pertaining to a violation of the safety limit, the limiting safety system setting, or a limiting condition of operation.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 26 TO

RENEWED FACILITY OPERATING LICENSE NO. R-106

OREGON STATE UNIVERSITY

OREGON STATE UNIVERSITY TRIGA REACTOR

DOCKET NO. 50-243

1.0 INTRODUCTION

By letter dated June 17, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession Package No. ML20171A575), as supplemented by letters dated May 21, 2021 (ADAMS Accession No. ML21141A289) and January 19, 2022 (ADAMS Accession Package No. ML22019A297), the Oregon State University (OSU or the licensee) submitted a license amendment request (LAR) to its Appendix A to Renewed Facility Operating License No. R-106, "Technical Specifications and Basis for the Oregon State University TRIGA Reactor, Docket No. 50-243." Specifically, the licensee proposes to remove all TS requirements related to the fuel temperature measurement obtained from the use of the licensee's instrumented fuel element (IFE), and to allow pulse mode of operation without the IFE.

In its response to the U.S. Nuclear Regulatory Commission (NRC) staff request for additional information (RAI) (ADAMS Accession No. ML21258A073), the licensee requested a change to license condition (LC) 2.C.(1) of Renewed Facility Operating License No. R-106 to change the maximum pulse limit from a temperature limit of 830 degree Celsius (°C) to a reactivity insertion limit of $2.30 (ADAMS Accession No. ML22019A300).

Finally, in its LAR, Attachment A, the licensee requested numerous grammatical and format changes to improve the clarity and readability of the TSs (ML20171A577). As a result of the extensive nature of the proposed TS changes, which resulted in repagination of the TSs, the NRC staff is reissuing the TSs in its entirety as part of License Amendment No. 26.

2.0 REGULATORY EVALUATION

The NRC staff evaluated the proposed changes based on the regulations and guidance:

- Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," Section 50.36, "Technical specifications," which provides the requirements for TSs to be included in facility operating licenses, including research reactor licenses.

- 10 CFR 50.36(a)(1) requires that a summary statement of the bases or reasons for such specifications, other than those covering administrative controls, shall also be included in the application, but shall not become part of the TSs.

- 10 CFR 50.36(c)(1)(i)(A) requires that TSs include safety limits (SLs) for nuclear reactors that are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity.

- 10 CFR 50.36(c)(1)(ii)(A) requires that TSs include LSSSs for nuclear reactors for automatic protective devices related to those variables having significant safety functions. Where an LSSS is specified for a variable on which a safety limit has been placed, the setting must be chosen so that an automatic protective action will correct the abnormal situation before a safety limit is exceeded.

- 10 CFR 50.36(c)(2), "Limiting conditions for operation," requires that TSs include limiting conditions for operation that specify the lowest functional capability or performance levels of equipment required for safe operation of the facility, including radiation monitoring systems for gaseous process and effluent streams.

- 10 CFR 50.36(c)(3), "Surveillance requirements," requires that TSs include requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within SLs, and that the limiting conditions for operation will be met.

- 10 CFR 50.36(c)(5), "Administrative controls," requires that TSs include provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner.

- 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," which identifies licensing, regulatory, and administrative actions eligible for categorical exclusion from the requirement to prepare an environmental assessment or environmental impact statement.

- NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," Appendix 14.1, Format and Content of Technical Specifications for Non-Power Reactors;" Section 2.2, "Limiting Safety System Settings;" Section 3.2, "Reactor Control and Safety Systems;" and Section 4, "Surveillance Requirements" (ADAMS Accession No. ML042430055), which provide guidance to licensees preparing research reactor applications and TSs.

- NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria," Chapter 14, "Technical Specifications," (ADAMS Accession No. ML042430048), which provides guidance to the NRC staff for performing reviews of the license amendment request.

- American National Standards Institute/American Nuclear Society (ANSI/ANS)-15.1-2007 (Reaffirmed [R] 2013), "The Development of Technical Specifications for Research Reactors," which provides guidance, used by the NRC staff, on the parameters and operating characteristics that should be included in the TSs. Since the issuance of NUREG-1537 in 1996, ANSI/ANS-15.1-1990 was revised to the current version, which the NRC staff used for this review.

- ANSI/ANS-15.4-2016, "Selection and Training of Personnel for Research Reactors."

3.0 TECHNICAL EVALUATION

3.1 Background

The Oregon State TRIGA (Training, Research, Isotopes, General Atomics) Reactor (OSTR) is located on the OSU campus in Corvallis, Oregon. The OSTR is a natural convection, water-cooled, Mark-II TRIGA pool-type reactor built by General Atomics. The OSTR can be operated at a maximum steady-state thermal power level of 1.1 megawatt thermal (MW(t)), pulsed up to a peak power of about 2,500 MW(t), or operated in a square-wave mode.

By letter dated September 10, 2008, the NRC staff issued Renewed Facility Operating License No. R-106 for the Oregon State University TRIGA Reactor (ADAMS Accession No. ML082520047). The NRC staff document its review of the renewed license in "Safety Evaluation Report Related to the Renewal of the Operating License for the TRIGA Reactor at the Oregon State University" (ADAMS Accession No. ML082540035).

On June 18, 2019, the NRC issued License Amendment No. 25 (ADAMS Accession Package No. ML19011A340), that revised TS 2.2, "Limiting Safety System Setting," which added a measured steady-state reactor power level not in excess of 1.1 MW(t) as a limiting safety system setting (LSSS) when transient operation modes (i.e., square-wave and pulse modes) are precluded. The NRC staff concluded in its safety evaluation (SE) (ADAMS Accession No. ML19011A350), that limiting the power level in revised TS 2.2 to 1.1 MW(t) will ensure that the highest temperature in any fuel element will not exceed the TS 2.1, "Safety Limit - Fuel Element Temperature," limit of 1,150 °C (2,100 degrees Fahrenheit (°F)), and thus will maintain the fuel cladding integrity and prevent the release of any fission products.

To support the NRC staff's understanding of this LAR, the NRC staff conducted public meetings with the licensee on January 8, 2020, and March 18, 2020, regarding the proposed TS changes related to the IFE. The OSTR IFE is a single stainless-steel standard TRIGA fuel element that contains three thermocouples used for measuring fuel temperature near the centerline in the B-ring of the reactor core. The OSTR IFE provides both a fuel temperature measuring function and a reactor scram function.

During the January 8, 2020, public meeting, the licensee stated that a significant increase in the IFE temperature indication occurred after a reactor pulse was conducted in May 2018. The licensee presented a temperature information indicating that the IFE temperature had been increasing over a six-month period, and stated that the IFE can be a faulty instrument. Further, the licensee explained that the IFE was not needed to support safe operation of the reactor. The licensee's meeting presentation, and the NRC staff's meeting summary are publicly available in ADAMS Accession Nos. ML20035C743 and ML20035D328, respectively.

During the March 18, 2020, public meeting, the licensee presented information on the fuel element peak temperature as a function of pulse reactivity insertion, the uncertainty analysis related to the pulsing information, and data from several pulse reactivity insertions of $1.75 to indicate fuel temperature variance. The licensee's meeting presentation and the NRC staff's summary are publicly available under ADAMS Accession Nos. ML20114E061 and ML20114E106, respectively.

In its LAR, the licensee states that that the analysis already present in its SAR demonstrates that the OSTR can be operated safely without the need for an IFE in any mode of operation, and the maximum temperatures during steady-state operation cannot reach the TS 2.1 safety limit of 1150 °C, or the TS 2.2 limiting safety system setting of 510 °C, or the TS 3.1.4 pulsing limit of 830 °C.

The licensee proposes to remove TS requirements associated with the use or maintenance of the IFE, revise renewed facility operating license condition 2.C.(1), and change TSs that currently use the temperature measurement provided by the IFE to a reactivity limit of $2.30. As described in the NRC staff's LR SER, Section 4.2.1, "Reactor Fuel," the licensee uses an IFE, which is identical to a standard TRIGA fuel element, other than it contains thermocouples embedded in the fuel element to provide a temperature measurement signal (ADAMS Accession No. ML082540035). The IFE temperature measurement signal is used to initiate a scram, which, along with other redundant scram signals, helps to maintain the fuel element cladding integrity. The licensee proposes to replace the IFE fuel temperature limits provided in its LC and TSs with either a power level limit (i.e., 1.1 MWt) or a reactivity limit (i.e., $2.30).

The NRC staff evaluated the proposed changes using the guidance in NUREG-1537, Part 2, and ANSI/ANS-15.1-2007. In its review and evaluation of the request to remove the IFE requirements from TS, the NRC staff used information in the OSU license renewal safety analysis report (SAR) dated November 6, 2007 (ADAMS Accession No. ML080420546), as supplemented by letters dated February 11, 2008 (ADAMS Accession No. ML080730057), and June 20, 2008 (ADAMS Accession No. ML082350345). The NRC staff also used information from its SERs issued with its Order Modifying Facility Operating License No. R-106 to Convert from High- To Low-Enriched Uranium Fuel (Amendment No. 22) (ADAMS Accession No. ML082390775), and with its License Renewal of the Oregon State University TRIGA Reactor (ADAMS Accession No. ML082540035).

In the SE below, the NRC staff generally reproduced only those portions of the current and proposed TSs that are applicable to the NRC staff's evaluation of the licensee's proposed changes.

3.2 Proposed Change to License Condition 2.C.(1)

The proposed LC and TS changes are denoted below using ~~strikeout~~ to indicate text deletion and **bold** to indicate text addition.

Current LC 2.C.(1) states:

(1) <u>Maximum Power Level</u>

The licensee is authorized to operate the facility at steady-state power levels not in excess of 1.1 megawatts (thermal), and in the pulse mode, with reactivity insertions not resulting in fuel temperature in excess of 830 degrees Celsius.

The proposed LC 2.C.(1) states:

(2) <u>Maximum Power Level</u>

The licensee is authorized to operate the facility at steady-state power levels not in excess of 1.1 megawatts (thermal), and in the pulse mode, with reactivity insertions not ~~resulting in fuel temperature in excess of 830 degrees Celsius~~ **to exceed $2.30.**

In its LAR, "Pulse Mode Analysis," the licensee states that to predict the temperatures that would be expected during a pulse, the safety analysis report (SAR) describes a point reactor kinetics (PRK) approach utilizing a commonly used and accepted thermal hydraulics code (RELAP-3D). The licensee also states that the ability to model the pulse by RELAP-3D was found to be in good agreement with an PRK model developed by OSU independently and analyses performed by General Atomics. LAR Figure 4, "Pulse peak power and temperature in the hot channel as a function of reactivity inserted," shows the results of the pulse peak power and temperature as a function of reactivity, and a pulse temperature limit of 830 °C correlates to a reactivity insertion of $2.33. The licensee states that the chosen reactivity limit of $2.30 was based on the conservatism of its SAR analysis and relative insensitivity to reactivity changes, as indicated by the pulsing data over several years, presented in Figure 5, "Test pulse peak temperature over time;" Figure 6, "Test pulse peak power over time;" and Figure 7, "Test pulse integrated energy over time." Further, the licensee indicates that the average peak temperature of the test pulses was 247 °C ± 4, well below the limit of 830 °C.

In its response to RAI 1 (ADAMS Accession No. ML22019A299), the licensee states that the reactivity worth measurement was performed using the "pull method" and the measurement error was estimated to be less than 1 percent because the "pull method" uses an electronic timer directly connected to the fission chamber to measure the time it takes power to increase by a factor of four, which is then turned into period, which is then used to calculated reactivity. The timer has 1 millisecond (ms) resolution with minimal error (±0.5 ms, or 0.05 percent). The control rod height is measured from 0 to 100 percent withdrawn with 0.1 percent resolution with an error of approximately 0.05 percent. The total error of this method is estimated to be less than 1 percent. Note that the SAR's previously quoted 14 percent error was due to utilizing stopwatches and a paper chart recorder, which introduced significant human error.

In its response to RAI 2 (ADAMS Accession No. ML22019A299), the licensee provides information explaining changes in the pulse peak power and reactivity insertions over time and fuel usage (i.e., burn up). Generally, the licensee indicates that fuel burnup considerations resulted in more conservative reactivity and fuel temperature results. Further, the licensee indicates that the limiting core configuration (LCC) used the highest peaking factors possible in order to represent the most limiting core configuration.

In its response to RAI 3 (ADAMS Accession No. ML22019A299), the licensee indicates that the conservatisms in the analysis for the $2.30 pulse limit to fuel temperature include the highly

conservative Bernath correlation to determine the maximum power-per-element while keeping DNBR [departure from nucleate boiling] below 2. Additional conservativism was in the thermal-hydraulic model based on the geometric characteristics, such as use of the hot channel surrounded by fuel elements of equal power (see response to RAI 28 regarding Conversion Amendment (ADAMS Accession No. ML082350345)), and the inclusion of the largest epistemic uncertainties on geometric dimensions such as the gap and cladding thicknesses which would lead to higher temperatures within the fuel (see response to RAI 37 regarding Conversion Amendment (ADAMS Accession No. ML082350345)). The result was an analysis of the fuel element that produced the hottest conditions while taking into consideration all uncertainties.

In its response to RAI 4 (ADAMS Accession No. ML22019A299), the licensee indicates that the mechanical limit for the pulse reactivity was set to the licensee's administrative limit of $2.25.

The NRC staff's review included its SER Section 2.4.3, "Thermal-Hydraulic Design," accompanying letter "Issuance of Order Modifying License No. R-106 to Convert from High- To Low-Enriched Uranium Fuel (Amendment No. 22) – Oregon State University TRIGA Reactor," dated September 4, 2008 (ADAMS Accession No. ML082390775), which stated that General Atomics recommended that temperature of the fuel should not exceed 830 °C during pulse mode operation because the hydrogen gas can build up pressure that could cause fuel damage (note that the safety limit, which prevents fuel failure, is not changed). The performance of the pulse mode operation was analyzed with the RELAP5-3D computer code using the point kinetics function. Calculations show a temperature of 830 °C will be reached with a pulse reactivity insertion of $2.33 for the LEU core. Assuming the most limiting core configuration, the LEU ICIT [In-Core Irradiation Tube] core at MOL [middle of life], it is calculated that a reactivity insertion of $2.30 will result in a maximum fuel temperature of 819 °C.

The NRC staff reviewed the information provided in the licensee's LAR, RAI responses, and results of the NRC staff's License Renewal (LR) SER, and finds that the SAR analysis for reactivity versus fuel temperature remains valid for this application because the reactor analyses (neutron and thermal-hydraulic) included beginning of life (BOL), middle of life (MOL) and end of life (EOL) considerations as the fuel was used. The NRC staff also finds that the SAR LCC remains valid for use as the limiting core configuration based on the information provided in the SAR and LAR. Further, the licensee evaluated the reactivity measurement uncertainty for the control rod reactivity worth's and, based on the results provided in the LAR, the NRC agrees with the licensee's assessment of a value of one percent. The NRC staff finds that the licensee's use of an administrative limit of $2.25 for the pulse reactivity provides additional margin to the proposed LC limit of $2.30.

The NRC staff concludes that the thermal-hydraulic analysis for the OSTR adequately demonstrates that the reactor can operate at its licensed power level, and pulse to its limit of $2.30, with sufficient safety margins in regard to thermal-hydraulic conditions. The analyses were done with qualified calculational methods and reasonable assumptions.

Conclusion

Based on the discussion above, the NRC staff concludes that the licensee has demonstrated that a pulse limited to a reactivity insertion of $2.30 will not exceed the previously accepted limit of 830 °C recommended by General Atomics. As such, the NRC concludes that the proposed change to LC 2.C.(1) to replace the 830 °C limit with a reactivity limit of $2.30, is acceptable.

3.3 <u>Proposed Changes to Technical Specifications Needed to Support IFE Removal</u>

The licensee proposes the following TS changes to remove the IFE as a requirement:

Current TS 1.13, "Instrument Element," states:

> 1.13 **Instrumented Element:** An instrumented element is a special fuel element in which one or more thermocouples have been embedded for the purpose of measuring the fuel temperatures during reactor operation.

Proposed TS change – delete TS 1.13 in its entirety and renumbered TS Section 1.0, "Definitions," accordingly.

Because the NRC finds the proposed change to remove the IFE from the TSs acceptable, as discussed below, a definition for instrumented element is not needed. As such, the NRC finds that the licensee's proposed change to delete TS 1.13, is acceptable.

Current TS 2.2, "Limiting Safety System Setting," states:

> <u>Specifications.</u> The limiting safety system setting (LSSS) shall be equal to or less than 510°C (950°F) as measured in an instrumented fuel element. The instrumented fuel element shall be located in the B-ring. If transient operation modes (square wave and pulsing) are precluded, the LSSS instead shall not exceed 1.1 MW as measured by the calibrated power level channels.

Proposed TS 2.2 states:

> <u>Specifications.</u> The limiting safety system setting (LSSS) shall ~~be equal to or less than 510°C (950°F) as measured in an instrumented fuel element. The instrumented fuel element shall be located in the B-ring. If transient operation modes (square wave and pulsing) are precluded, the LSSS instead shall~~ not exceed 1.1 MW as measured by the calibrated power level channels.

The proposed change to TS 2.2 removes the requirement that the LSSS shall be equal to or less than 510 °C temperature as measured by the IFE, and removes the requirement that transient operation modes (square wave and pulsing) require an IFE.

<u>Steady-State Operation</u>

The NRC staff finds that the restriction on operation of the transient operation modes without an IFE limits the licensee to steady-state operation. Further, the incorporation of the power level limit (not to exceed 1.1 MW as measured by calibrated power level channels) into the TS 2.2 LSSS was implemented with the issuance of LA No. 25 to Renewed Facility Operating License No. R-106 (ADAMS Accession Package No. ML19011A340). In the SER issued with LA No. 25, the NRC staff described the acceptability of the use the steady-state power level limit of 1.1 MWt (ADAMS Accession No. ML19011A3611).

The NRC staff documented the acceptability of the licensee's neutronic and thermal-hydraulic methodology and calculated results in the NRC SER on the conversion of the OSTR from highly-enriched uranium (HEU) to low-enriched uranium (LEU) fuel, in its letter, "Issuance of Order Modifying License No. R-106 to Convert from High- to Low-Enriched Uranium Fuel

(Amendment No. 22) – Oregon State University TRIGA Reactor," dated September 4, 2008 (ADAMS Accession No. ML082390775). In the conversion SER, the NRC staff concluded that the methodology and results for both the neutronic and thermal-hydraulic analysis were acceptable, and that the proposed LSSS limit of 1.1 MW results in a maximum fuel centerline temperature of 458 °C (855 °F), well below the SL of 1,150 °C.

Based on the information above, the NRC staff finds that the proposed change to TS 2.2 to remove requirements related to the IFE that limited the licensee to steady-state operation and use a power limit level (not to exceed 1.1 MW) will help ensure that the TS 2.1 SL of 1,150 °C is maintained during steady-state operation.

Pulse Mode Operation

The NRC staff reviewed the reactivity limit of $2.30 in pulse mode and documented its review in Section 3.2, "Proposed Change to License Condition 2.C.(1)" of this SE.

Square Wave Operation

In its response to RAI 6 (ADAMS Accession No. ML22019A299), the licensee states that an IFE is not needed to protect the reactor as the square-wave involves operation of the reactor by raising reactor power from below 1 kW to full power of 1 MW by rapidly inserting less than $1.00's worth of reactivity. The licensee also explains that the IFE is not needed to provide a protective action during the square wave operation as the square wave reactivity is limited from below the initiation at 1 kilowatt (kW) and terminated at 1.0 MW (full power), which is less than a $1.00 of reactivity, and thus the transient is bounded by the pulse reactivity limit of $2.30. The licensee provides a peak fuel temperature of 448 °C for $1.50 insertion, from the Addendum, Table 4-31 (New) "Summary of LEU MOL ICIT Pulse Behavior (ADAMS Accession No. ML082350345), and also states that the IFE scram is much slower than the power channel scrams.

The NRC staff finds that the information provided by the licensee was previously reviewed and found acceptable as documented in the license renewal SER.

Current TS 3.1.4, "Pulse Mode Operation," states, in part:

> Specifications. The reactivity to be inserted for pulse operation shall be determined and limited by a mechanical block and electrical interlock on the transient rod, such that the maximum fuel element temperature shall not exceed 830°C.

Proposed TS 3.1.4 states:

> Specifications. The reactivity to be inserted for pulse operation shall be determined and limited by a mechanical block and electrical interlock on the transient rod, such that the maximum ~~fuel element temperature shall not exceed 830°C~~ **reactivity insertion shall not exceed $2.30**.

Because the NRC staff reviewed the reactivity limit of $2.30 in pulse mode and found it acceptable for the reasons documented in Section 3.2, "Proposed Change to License Condition 2.C.(1)" of this SE, the NRC staff finds the proposed change to TS 3.1.4 acceptable.

The current TS 3.2.2, “Reactor Measuring Channels,” Table 1, “Minimum Measuring Channels,” includes “Fuel Element Temperature” for all modes of operation, and item (3) that states:

> (3) The Fuel Element Temperature measuring channel is not required if transient operation modes (Square Wave and Pulse) are precluded, and if precluded, the Fuel Element Temperature measuring channel shall be considered removed from Table 1.

Proposed TS 3.2.2 deletes the ~~“Fuel Element Temperature”~~ and item (3):

> ~~(3) The Fuel Element Temperature measuring channel is not required if transient operation modes (Square Wave and Pulse) are precluded, and if precluded, the Fuel Element Temperature measuring channel shall be considered removed from Table 1.~~

The NRC staff reviewed the proposed change to remove the Fuel Element Temperature from TS 3.2.2, and finds that it is consistent with the licensee’s proposed changes eliminating the use of the IFE. Further, the NRC staff finds the reactivity limit of $2.30 in pulse mode acceptable for the reasons described in Section 3.2, “Proposed Change to License Condition 2.C.(1)” of this SE and thus the NRC staff finds the proposed change to TS 3.2.2 acceptable.

Current TS 3.2.3, “Reactor Safety System,” Table 2, “Minimum Reactor Safety Channels” includes a “Fuel Element Temperature” scram at 510 °C, and item (3) states:

> (3) The Fuel Element Temperature safety channel is not required if transient operation modes (Square Wave and Pulse) are precluded, and if precluded, the Fuel Element Temperature safety channel shall be considered removed from Table 2.

Proposed TS 3.2.3, Table 2, deletes the ~~“Fuel Element Temperature~~”, and item (3):

> ~~(3) The Fuel Element Temperature safety channel is not required if transient operation modes (Square Wave and Pulse) are precluded, and if precluded, the Fuel Element Temperature safety channel shall be considered removed from Table 2.~~

The NRC staff reviewed the proposed change to remove the provision requiring the IFE for transient operation modes, implemented in LA No. 25, and finds, based on the information described in Sections 3.2 and 3.3 of this SE, that the IFE is not required to support operation in any mode (steady-state, pulse, and square-wave). On this basis, the NRC staff finds that the proposed change is acceptable.

Current TS 3.2.3, “Reactor Safety System,” Table 3, “Minimum Interlocks,” states the function of the Transient Rod Cylinder Position as follows:

> Prevent pulse insertion of reactivity greater than that which would product a maximum fuel element temperature of 830°C.

The licensee proposes to move TS 3.2.3 Table 3 into a new TS 3.2.4, “Reactor Interlocks,” and replace the temperature limit of 830 °C with a reactivity limit of $2.30. The proposed TS 3.2.4 states:

> Prevent pulse insertion of reactivity greater than ~~that which would product a maximum fuel element temperature of 830°C~~ **$2.30**.

The NRC staff finds that the proposed change to TS 3.2.3 is consistent with the removal of the IFE, which the staff finds acceptable for the reasons described in Sections 3.2 and 3.3 of this SE. On this basis, the NRC staff finds the proposed change acceptable.

Current TS 4.2, “Reactor Safety System,” Specification f, that states:

f. a channel calibration of the fuel temperature measuring channel shall be performed annually.

Proposed TS 4.2, deletes Specification f as follows:

~~f. a channel calibration of the fuel temperature measuring channel shall be performed annually.~~

Current TS 4.2, items (1) and (2) that states:

(1) Requirements relating to the Fuel Element Temperature Channel (Section 4.2.e, Fuel Element Temperature SCRAM test, and Section 4.2.f, Fuel Element Temperature Measuring Channel calibration) may be deferred if transient operation modes (Square Wave and Pulse) are precluded. They shall be completed prior to declaring the Fuel Element Temperature Measuring Channel operable.

(2) For Section 4.2.e, the safety channel and interlocks from Table 2 and 3 that are only required for Square Wave and/or Pulse modes may be deferred if transient operation modes (Square Wave and Pulse) are precluded. They shall be completed prior to declaring the safety channel and interlocks operable.

Proposed TS 4.2, deletes items (1) and (2) as follows:

~~(1) Requirements relating to the Fuel Element Temperature Channel (Section 4.2.e, Fuel Element Temperature SCRAM test, and Section 4.2.f, Fuel Element Temperature Measuring Channel calibration) may be deferred if transient operation modes (Square Wave and Pulse) are precluded. They shall be completed prior to declaring the Fuel Element Temperature Measuring Channel operable.~~

~~(2) For Section 4.2.e, the safety channel and interlocks from Table 2 and 3 that are only required for Square Wave and/or Pulse modes may be deferred if transient operation modes (Square Wave and Pulse) are precluded. They shall be completed prior to declaring the safety channel and interlocks operable.~~

The NRC staff finds that the licensee’s proposed changes to TS 4.2.f and TS 4.2, items (1) and (2), eliminate surveillance requirements associated with the IFE, which is no longer needed to support the safe operation of the facility, as described above. Based on the NRC staff review of the licensee’s removal of the IFE, the licensee’s proposed changes to remove the TS surveillance requirements in TS 4.2.f, and TS 4.2, items (1) and (2), are acceptable.

Conclusion

The NRC staff reviewed the proposed changes to TSs described above, which eliminate the use of the IFE to support reactor operation. The NRC staff finds that the proposed TS changes acceptable based on the previously reviewed and accepted analyses in the NRC staff review of

the renewal of Facility Operating License No. R-106. The NRC staff finds that the licensee used approved methodology to calculate the peak fuel temperatures for steady-state, pulse and square wave operation, which demonstrate that the SL for steady-state (1,150 °C) and pulse (830 °C) operation are not exceeded. Further, square-wave operation is bounded by the pulse reactivity analysis limit of $2.30, and thus will not exceed the pulse limit of (830 °C), and is also acceptable. The NRC staff finds that the LSSS temperature limit of 1.1 MW, as measured by the calibrated power level channels, is acceptable in all modes of operation (steady-state, pulse, and square wave) and will help to ensure the integrity of the fuel cladding is maintained.

3.4 Evaluation of SAR Chapter 13, "Accident Analyses," Events

The NRC staff evaluated each section of the OSTR SAR Chapter 13 events to ensure acceptable methods and results with the removal of the IFE. A summary of the NRC staff's review is provided below.

Maximum Hypothetical Accident (MHA)

For the OSTR, the MHA has been defined as the cladding rupture of one highly irradiated fuel element with no radioactive decay followed by the instantaneous release of the noble gas and halogen fission products into the air.

Since the licensee did not request to change to what defines "one highly irradiated fuel element" in its LAR, the NRC staff determined this analysis remains applicable and acceptable.

Insertion of Excess Reactivity (ramp, step, startup, etc.)

The source of excess reactivity insertion is from control rod movement. Cold water injection is not limiting/credible and is not analyzed. The NRC staff finds that the insertion of excess reactivity events are redundant with those analyzed in SAR Chapter 4, "Reactor Description." Reactivity insertion events were reviewed and found acceptable as described in Sections 3.2 and 3.3 of this SE. The NRC staff finds that since these types of events are terminated by initiation of the power-based scram rather than the fuel temperature scram (see RAI responses 6d, 6e, and 7a), removal of the IFE has no effect on the analyses or the results. On this basis, the NRC staff determined that new pulse limit of $2.30 is acceptable.

Loss of Coolant (LOCA)

The licensee states in SAR Chapter 13, that "The loss of coolant accident was examined in NUREG/CR-2387. For a reactor such as the OSTR, this type of accident was not credible. The OSTR does have a piercing beam port, thus, making a LOCA possible, but the likelihood of such an accident is deemed to be very low probability. Even if such an accident were to occur, all prior analyses conclude that natural convective air cooling of the fuel will keep the maximum fuel temperature well below the temperature for cladding failure if the reactor operates at a maximum power level of 1.5 MW or below."

The NRC staff reviewed the LOCA analysis, including the licensee's response to RAI 54 (Oregon State University Response to Request for Additional Information Regarding Conversion Amendment, ADAMS Accession No. ML082350345), and conducted an audit. The NRC staff finds that the removal of the IFE has no impact on the LOCA analysis, methods or results. Furthermore, a reactor power limit of 1.1 MW retains the same initial stored energy, decay heat

load assumed, and radiological source term as described in the SAR. On this basis, the NRC staff finds that the methods and results of the LOCA analysis remain applicable and acceptable.

Loss of Coolant Flow

This event continues to be bounded by MHA and will not be impacted by the removal of the IFE. Therefore, the NRC staff finds that this analysis remains applicable and acceptable.

Mishandling or Malfunction of Fuel

This event continues to be bounded by MHA and will not be impacted by the removal of the IFE. Therefore, the NRC staff finds that this analysis remains applicable and acceptable.

Experiment Malfunction

Experiment malfunction includes improperly controlled experiments that could potentially result in damage to the reactor fuel. The credible mechanisms for damage are explosive forces, corrosion, and large reactivity changes.

This event continues to be bounded by MHA and will not be impacted by the removal of the IFE. Therefore, the NRC staff finds that this analysis remains applicable and acceptable.

Loss of Normal Electrical Power

The NRC staff finds that the loss of normal electrical power is not affected by the IFE removal since OSTR does not currently require emergency backup systems to safely maintain core cooling. Thus, the NRC staff finds that this event does not need to be analyzed as part of this amendment request.

External Events

The NRC staff review finds that the IFE removal does not affect any scenarios associated with the consequences of any external events, which include hurricanes, tornadoes, floods and seismic activity. Therefore, the NRC staff finds that this analysis remains applicable and acceptable.

Mishandling or Malfunction of Equipment

The NRC staff review finds that OSTR does not have any credible accident initiating events related to mishandling or malfunction of equipment. Additionally, there are no changes in this amendment identified that would make a new credible event to analyzed or bounded by SAR Chapters 4 and 13 analyses. Therefore, the NRC staff finds that this analysis remains applicable and acceptable.

Other Considerations Regarding Removal of the IFE

The NRC staff evaluated the removal of the IFE for potential effects on the Chapter 4 and Chapter 13 events and no impacts were found. The NRC staff also considered whether the removal of IFE creates potential accident scenarios not previously analyzed.

The NRC staff evaluated whether the removal of IFE created a potential accident scenario not previously analyzed, and whether the IFE was the termination initiator for the event. If so, the nature of the event could change drastically, making it credible where it was previously not, or elevate it to the MHA. The NRC staff review finds that no new potential accident scenarios or events were identified.

The NRC staff reviewed the removal of IFE to determine whether it removes any defense-in-depth against currently analyzed events:

- Reactivity insertion events are fast in nature and are terminated long before the fuel can heat up
- For DNBR related events, the IFE would only be useful for measuring the IFE temperature
- For radiological events, the IFE does not provide any useful function or indication
- For LOCA, the IFE may provide some useful long-term core temperature information but is not needed to maintain safety or reduce the consequences of any LOCA event

The NRC staff review finds that the IFE does not provide any defense-in-depth for currently analyzed events, and its removal would not affect the margin to safety or mitigate the consequence of an event. Thus, the NRC staff finds that no further investigation is needed.

The NRC staff's last consideration for the removal of IFE was to determine whether it removes defense-in-depth against any beyond design basis events. As part of its review, the NRC staff examined recent industry operating experience. There has been an event where a fuel element failed at another RTR due to insufficient cooling during operation. This type of event is considered not credible at OSTR, but it was considered as it relates to the removal of the IFE. The NRC staff determined the IFE would only provide a temperature indication for the insufficient cooling of the IFE, or flow blockage involving the IFE. This is supported by the response to RAI 7c. Even though the IFE could provide information related to pulse performance (abnormal vs normal), there are other indications available to the operator, such as peak pulse power and integrated energy.

While the IFE could indicate potential fuel element degradation (fuel swelling or expansion of the fuel/clad gap), the licensee is required by its TSs to inspect 20 percent of the core on an annual basis and the entire core on a 5-year period. The licensee visual inspections would identify any fuel element damage or deterioration. Additionally, the licensee also performs measurements of the fuel elements to identify any potential for swelling.

The NRC staff determined that the removal the IFE function from OSTR TS does not reduce the margin to safety for the any of the events currently part of the OSTR licensing basis. Furthermore, the NRC staff determined that the removal the IFE function from OSTR TS does not reduce the margin to safety for any event that may affect OSTR whether they are considered credible or not to the OSTR. The OSTR reactor protection system relies on 3 separate power channel scram functions, which were reviewed to ensure the functionality of the system, that the methods for determining setpoints were appropriate, and that the setpoints were conservatively set and were clearly defined, appropriate, and controlled. The NRC staff determined that the OSTR can operate safely with the IFE functionality removed.

3.5 Other Requested Changes to the Technical Specifications

The proposed TS changes are denoted using strikeout to indicate a deletion and **bold** to indicate an addition.

3.5.1 TS Section 1, “Definitions”

The licensee requested to change or delete multiple definitions in TS, Section 1, “Definitions,” and renumber the defined terms.

The current definition of “Channel” in TS Section 1, states:

> **Channel:** A channel is the combination of sensor, line, amplifier, and output devices which are connected for the purpose of measuring the value of a parameter.

The proposed definition of “Channel,” states:

> **Channel:** A channel is the combination of sensor, line, amplifier, and output devices ~~which~~ **that** are connected for the purpose of measuring the value of a parameter.

The licensee proposes to replace “which” with “that” in the definition of channel to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the proposed change corrects a minor grammatical error and meets the guidance in ANSI/15.1-2007 for the definition of “channel” in Section 1.3, “Definitions.” Because the proposed definition of channel meets the guidance in ANSI/ANS-15.1-2007, the NRC staff finds this change to the definition of channel is acceptable.

The current definition of “Channel Calibration” in TS Section 1, states:

> **Channel Calibration**: A channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip and shall include a Channel Test.

The proposed definition of “Channel Calibration,” states:

> **Channel Calibration**: A channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter ~~which~~ **that** the channel measures. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip**,** and shall **be deemed to** include a ~~C~~**c**hannel ~~T~~**t**est.

The licensee proposes to replace “which” with “that,” add a comma after “trip,” add “be deemed to,” and change the channel test to lower case in the definition of channel calibration to introduce a restrictive clause, to correct grammatical errors, and for consistency with the guidance in ANSI/ANS-15.1-2007. The NRC staff reviewed the proposed changes and finds that the changes meet the guidance in ANSI/ANS-15.1-2007. The NRC staff concludes these proposed changes are editorial. Because the proposed definition of channel calibration meets the guidance in ANSI/ANS-15.1-2007 and are editorial, the NRC staff finds these changes to the definition of channel calibration is acceptable.

The current definition of "Control Rod" in TS Section 1, states:

> **Control Rod:** A control rod is a device fabricated from neutron absorbing material or fuel or both which is used to establish neutron flux changes and to compensate for routine reactivity changes. A control rod may be coupled to its drive unit allowing it to perform a safety function when the coupling is disengaged. Types of control rods shall include:
>
> a. **Regulating Rod (Reg Rod):** The regulating rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section. Its position may be varied manually or by the servo-controller.
>
> b. **Shim/Safety Rod:** A shim safety rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section.
>
> c. **Transient Rod:** The transient rod is a control rod with scram capabilities that can be rapidly ejected from the reactor core to produce a pulse. It may have a voided-follower.

The proposed definition of "Control Rod," states:

> **Control Rod:** A control rod is a device fabricated from neutron absorbing material or fuel or both ~~which~~ **that** is used to establish neutron flux changes and to compensate for routine reactivity changes. A control rod may be coupled to its drive unit**,** allowing it to perform a safety function when the coupling is disengaged. Types of control rods shall include:
>
> a. **Regulating Rod ~~(Reg Rod)~~:** The regulating rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section. Its position may be varied manually or by the servo-controller.
>
> b. **Shim/Safety Rod:** A shim**/**safety rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section.
>
> c. **Transient Rod:** The transient rod is a control rod with scram capabilities that can be rapidly ejected from the reactor core to produce a pulse. It may have a ~~voided-follower~~ voided follower.

The licensee proposes to replace "which" with "that" in the TS definition of control rod to introduce a restrictive clause. The NRC staff reviewed this proposed change and determined that it does not alter the definition of control rod. The NRC staff concludes this proposed change editorial. Therefore, the NRC staff finds this change to the TS definition of control rod acceptable.

The licensee proposes to add a comma (,) after "unit" to correct the grammar in the TS definition of control rod. The NRC staff reviewed this proposed change and determined the change corrects a punctuation error that does not alter the definition of control rod. The NRC staff finds this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of control rod is acceptable.

The licensee proposes to remove "(Reg Rod)" because the term is slang and unnecessary for TS definition of shim/safety rod. The NRC staff reviewed the proposed change and determined the term "Reg Rod" is not otherwise stated in TS and does not alter the definition of regulating

rod. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS definition of control rod is acceptable.

The licensee proposes to add a forward slash (/) between shim and safety rod for consistency with the defined term "Shim/Safety Rod. The NRC staff reviewed the proposed change and determined the change corrects a punctuation error and does not alter the definition of shim/safety rod. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS definition of shim/safety rod is acceptable.

The licensee proposes to remove a hyphen (-) between voided and follower to correct the grammar in the TS definition of transient rod. The NRC staff reviewed this proposed change and determined the change corrects a punctuation error that does not alter the definition of transient rod. The NRC staff finds this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of transient rod is acceptable.

The current definition of "Excess Reactivity" in TS Section 1, states:

> **Excess Reactivity:** Excess reactivity is that amount of reactivity that would exist if all control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical (keff=1) at reference core conditions.

The proposed definition of "Excess Reactivity," states:

> **Excess Reactivity:** Excess reactivity is that amount of reactivity that would exist if all control rods were moved to the maximum reactive condition from the point where the reactor is exactly critical (keff = 1) at reference core conditions.

The licensee proposes to add a space before and after the equal symbol (=) to correct formatting and improve readability. The NRC staff reviewed this proposed change and determined that it is a change to formatting that does not alter the definition of excess reactivity. The NRC staff finds this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of excess reactivity is acceptable.

The current definition of "Experiment" in TS Section 1, states:

> **Experiment:** Any operation, hardware, or target (excluding devices such as detectors or foils) which is designed to investigate non-routine reactor characteristics or which is intended for irradiation within an irradiation facility. Hardware rigidly secured to a core or shield structure so as to be a part of their design to carry out experiments is not normally considered an experiment. Specific experiments shall include:
>
> a. **Secured Experiment:** A secured experiment is any experiment or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining forces must be substantially greater than those to which the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces which are normal to the operating environment of the experiment, or by forces which can arise as a result of credible malfunctions.
>
> b. **Unsecured Experiment:** An unsecured experiment is any experiment or component of an experiment that does not meet the definition of a secured experiment.

c. **Movable Experiment:** A movable experiment is one where it is intended that the entire experiment may be moved in or near the core or into and out of the core while the reactor is operating.

The proposed definition of "Experiment," states:

Experiment: An experiment is ~~A~~**a**ny operation, hardware, or target (excluding devices such as detectors or foils) ~~which~~ **that** is designed to investigate non-routine reactor characteristics or ~~which~~ **that** is intended for irradiation within an irradiation facility. Hardware rigidly secured to a core or shield structure so as to be a part of their design to carry out experiments is not normally considered an experiment. Specific experiments shall include:

a. **Secured Experiment:** A secured experiment is any experiment**, experimental apparatus,** or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining forces ~~must~~ **shall** be substantially greater than those to ~~which~~ **that** the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces which are normal to the operating environment of the experiment, or by forces ~~which~~ **that** can arise as a result of credible malfunctions.

b. **Unsecured Experiment:** An unsecured experiment is any experiment or component of an experiment that does not meet the definition of a secured experiment.

c. **Movable Experiment:** A movable experiment is one where it is intended that ~~the entire~~ **all or part of the** experiment may be moved in or near the core or into and out of the core while the reactor is operating.

The licensee proposes to add "An experiment is" to the beginning of the definition of experiment for consistent TS formatting. The NRC staff reviewed this change and determined the change ensures the TS formatting is consistent and does not substantively alter the definition of experiment. Additionally, the licensee proposes to replace "which" with "that" in the definition of experiment and secured experiment to introduce a restrictive clause. The NRC staff reviewed these proposed changes and determined that they are minor grammatical changes. The licensee proposes to add "experimental apparatus" to the definition of secured experiment. The NRC staff reviewed this change and determined adding "experimental apparatus" is consistent with the guidance in ANSI/15.1-2007 for the definition of "secured experiment" in Section 1.3, "Definitions." The licensee proposes to replace "must" with "shall" since must is not defined in TS and shall is defined. Shall is defined in the OSTR TS to denote a requirement. The NRC staff finds that this change is a minor grammatical change because must also denotes a requirement. The licensee proposes to replace "the entire" with "all or part of the" to describe movable experiment for consistency with the guidance in ANSI/15.1-2007. The NRC staff reviewed this change and determined by adding "all or part of the" to the definition of movable experiment is consistent with the definition of movable experiment in ANSI/ANS-15.1-2007.

Because the proposed definition of experiment, secured experiment, and movable experiment meets the guidance in ANSI/ANS-15.1-2007, makes minor grammatical changes, and ensures consistent formatting, the NRC staff finds these changes to the definitions acceptable.

The current definition of “Irradiation Facilities” in TS Section 1, states:

> **Irradiation Facilities:** Irradiation facilities shall mean beam ports, including extension tubes with shields, thermal columns with shields, vertical tubes, rotating specimen rack, pneumatic transfer system, sample holding dummy fuel elements and any other in-tank irradiation facilities.

The proposed definition of “Irradiation Facilities,” states:

> **Irradiation Facilities:** Irradiation facilities shall mean beam ports, including extension tubes with shields~~,~~**;** thermal columns with shields~~,~~**;** vertical tubes~~,~~**;** rotating specimen rack~~,~~**;** pneumatic transfer system~~,~~**;** ~~sample holding dummy fuel elements~~ and any other in-tank irradiation facilities.

The licensee proposes to replace commas (,) with semicolons (;) in the TS definition of irradiation facilities to correct the grammar in TS definition of irradiation facilities. The NRC staff reviewed the proposed change and determined that it is a minor punctuation change that improves readability and does not alter the meaning of the TS definition of irradiation facilities. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of irradiation facilities is acceptable.

Additionally, the licensee proposes to remove “sample holding dummy fuel elements” because this type of irradiation facility is no longer used at the OSTR. The NRC staff reviewed the proposed change and determined that since OSU no longer uses sample holding dummy fuel elements, this type of irradiation facility is not required to be described in the TS definition of irradiation facilities. Because OSU does not use sample holding dummy fuel elements, the NRC staff finds this change to TS definition irradiation facilities is acceptable.

The current definition of “Operable” in TS Section 1, states:

> **Operable:** A system or component shall be considered operable when it is capable of performing its intended function.

The proposed definition of “Operable,” states:

> **Operable:** ~~A system or component shall be considered operable when it~~ **Operable means a component or system** is capable of performing its intended function.

The licensee proposes to replace “A system or component shall be considered operable when it” with “Operable means a component or system” to make the definition consistent with the guidance in ANSI/ANS-15.1-2007, Section 1.3, “Definitions,” for the definition of operable. The NRC staff reviewed the proposed change and finds that the change meets the guidance in ANSI/ANS-15.1-2007 for the definition of operable. Because the proposed definition of operable meets the guidance in ANSI/ANS-15.1-2007, the NRC staff finds this change to the definition of operable is acceptable.

The current definition of “Operational Core” in TS Section 1, states:

> **Operational Core:** An operational core shall be a fuel element core which operates within the licensed power level and satisfies all the requirements of the Technical Specifications.

The proposed definition of “Operational Core,” states:

> **Operational Core:** An operational core shall be a fuel element core ~~which~~ **that** operates within the licensed power level and satisfies all the requirements of the Technical Specifications.

The licensee proposes to replace “which” with “that” in the TS definition of operational core to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the proposed change does not alter the interpretation of the TS definition of operational core. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of excess reactivity is acceptable.

The current definition of “Pulse Mode” in TS Section 1, states:

> **Pulse Mode:** Pulse mode shall mean any operation of the reactor with the mode selector switch in the pulse position.

The proposed definition of “Pulse Mode,” states:

> **Pulse Mode:** Pulse mode shall mean any operation of the reactor with the mode selector switch in ~~the~~ **a** pulse position.

The licensee proposes to replace “the” with “a” in the TS definition of pulse mode to clarify that the OSTR control console has two pulse positions. OSU stated in the LAR that the mode selector switch has both a high and low pulse position. The NRC staff used pertinent information in the OSTR renewal SAR, submitted to the NRC on October 5, 2004 (ADAMS Accession No. ML043270077), to support license renewal of the OSTR. The NRC staff reviewed the proposed change and notes the OSTR Renewal SAR states in Section 7.1, “Summary Description,” that the reactor operating mode is determined by a five-position mode switch and while in pulse high and pulse low mode positions, a large-step insertion of reactivity results in a short duration power pulse. In the OSTR Renewal SAR, Section 7.2.3.1, “Reactor Power Measurements,” the licensee states that the difference between pulse high and pulse low is the display scale of peak power and integrated energy and the pulsing channel is enabled when the mode switch is placed in either pulse position (i.e., high or low). The NRC staff finds that with the mode switch in either pulse high or pulse low, the reactor is operating in pulse mode. Because the pulse high and pulse low positions of the mode switch operate the reactor in pulse mode, the NRC staff finds this change to the TS definition of pulse mode is acceptable.

The current definition of “Radiation Center Complex” in TS Section 1, states:

> **Radiation Center Complex:** The physical area defined by the Radiation Center Building and the fence surrounding the north, west, and east sides of the Reactor Building.

The proposed definition of “Radiation Center Complex,” states:

> **Radiation Center Complex: The Radiation Center Complex is** ~~T~~**t**he physical area defined by the Radiation Center Building and the fence surrounding the north, west, and east sides of the Reactor Building.

The licensee proposes to add “The Radiation Center Complex is” and change “The” to lower case for consistent formatting in TS. The NRC staff reviewed this proposed change and

determined the change does not alter the interpretation of the TS definition of radiation center complex. The NRC staff finds this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of radiation center complex is acceptable.

The current definition of “Reactor Safety Systems” in TS Section 1, states:

> **Reactor Safety Systems**: Reactor safety systems are those systems, including their associated input channels, which are designed to initiate, automatically or manually, a reactor scram for the primary purpose of protecting the reactor.

The proposed definition of “Reactor Safety Systems,” states:

> **Reactor Safety Systems**: Reactor safety systems are those systems, including their associated input channels, ~~which~~ **that** are designed to initiate, automatically or manually, a reactor scram for the primary purpose of protecting the reactor.

The licensee proposes to replace “which” with “that” in the TS definition of reactor safety systems to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the proposed change does not alter the interpretation of the TS definition of reactor safety systems. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of reactor safety systems is acceptable.

The current definition of “Reactor Secured” in TS Section 1, states:

> **Reactor Secured:** The reactor is secured when:
>
> a. Either there is insufficient moderator available in the reactor to attain criticality or there is insufficient fissile material in the reactor to attain criticality under optimum available conditions of moderation and reflection; or,
>
> b. All of the following exist:
>
> 1. The four (4) neutron absorbing control rods are fully inserted as required by technical specifications
> 2. The reactor is shut down;
> 3. No experiments or irradiation facilities in the core are being moved or serviced that have, on movement or servicing, a reactivity worth exceeding the maximum value of one dollar; and
> 4. No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods.

The proposed definition of “Reactor Secured,” states

Reactor Secured: The reactor is secured when:

> a. Either there is insufficient moderator available in the reactor to attain criticality or there is insufficient fissile material **present** in the reactor to attain criticality under optimum available conditions of moderation and reflection; or,

b. All of the following exist:

1. The four (4) neutron absorbing control rods are fully inserted ~~as required by technical specifications~~;
2. ~~The reactor is shut down;~~ **The console key switch is in the "off" position and the key is removed from the console;**
3. No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods; and
4.~~3.~~ No experiments or irradiation facilities in the core are being moved or serviced that have, on movement or servicing, a reactivity worth exceeding the maximum value of ~~one dollar~~ **$0.50.**~~; and~~
~~4. No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods.~~

The licensee proposes to add "present" in the definition describing the fissile material in the reactor for consistency with ANSI/ANS-15.1-2007. The NRC staff reviewed the proposed change adding "present" and finds that it meets the guidance in ANSI/ANS-15.1-2007 for the definition of "Reactor Shutdown." The licensee also proposed to remove "as required by technical specifications" from item b.1 that describes the condition of the neutron absorbing rods because the phrase is redundant. The NRC staff reviewed this proposed change and determined that "as required by technical specifications" is not needed to describe the condition of the neutron absorbing control rods to define Reactor Secured. The licensee proposes to replace "the reactor is shut down." for item b.2 with "The console key switch is in the "off" position and the key is removed from the console;" for consistency with ANSI/ANS-15.1-2007. The NRC staff reviewed this proposed change and determined that this change meets the guidance in ANSI/ANS-15.1-2007 with the exception that the ANSI/ANS-15.1-2007 uses the term "lock" instead of "console" describing the condition of the key. The NRC staff reviewed this difference and determined that using the term "console" accurately describes the condition of the key for Reactor Secured for the OSTR. The licensee also proposed to move item b.4 to item b.3 and add "; and" to the end of the item. The NRC staff reviewed this proposed change and determined it is a format and minor editorial change and does not alter the interpretation of the TS definition of Reactor Secured.

The licensee proposes to replace "one dollar" with "$0.50." to be consistent with ANSI/ANS-15.1-2007. Further the licensee proposes to renumber item 3 to item 4 and remove "; and" at the end of the item. ANSI/ANS-15.1-2007, Section 1.3, "Definition – reactor secured," item 2(d), describes the reactivity limit on experiments are limited to the maximum value allowed for a single experiment or one $1.00 of reactivity, whichever is smaller. OSTR TS 3.8.1, "Reactivity Limits," specification a, states, in part, that the absolute value of the reactivity worth of any single unsecured experiment shall not exceed $0.50. The NRC staff reviewed this proposed change and determined that the maximum reactivity value of $0.50 is consistent with the guidance in ANSI/ANS-15.1-2007 and the OSTR TS 3.8.1. The NRC staff also determined that the renumbering of item 3 to item 4 and deleting "; and" is a formatting and minor editorial change to TS.

Because the proposed changes meet the guidance in ANSI/ANS-15.1-2007, make formatting and minor editorial changes, and are consistent with TS 3.8.1 limiting reactivity of an unsecure experiment to $0.50, the NRC staff finds the change to the definition of reactor secured is acceptable.

The current definition of “Reactor Shutdown,” in TS Section 1, states:

> **Reactor Shutdown:** The reactor is shut down when:
>
> a. It is subcritical by at least one dollar both in the reference core condition and for all allowed ambient conditions, with the reactivity worth of all installed experiments and irradiation facilities included; and
>
> b. The console key switch is in the “off” position and the key is removed from the console.

The proposed definition of “Reactor Shutdown,” states:

> **Reactor Shut Down:** The reactor is shut down ~~when:~~ **if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments and irradiation facilities included**.
>
> ~~a. It is subcritical by at least one dollar both in the reference core condition and for all allowed ambient conditions, with the reactivity worth of all installed experiments and irradiation facilities included; and~~
>
> ~~b. The console key switch is in the “off” position and the key is removed from the console.~~

The licensee proposes to remove items a, b, and “when” and add “if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments and irradiation facilities included” to make the definition consistent with the guidance in ANSI/ANS-15.1-2007, Section 1.3, “Definitions,” for the definition of “Reactor Shutdown.” Further the licensee proposes to change the defined term “Reactor Shutdown” to “Reactor Shut Down,” in order to be consistent with the wording (i.e., shut down) in the description in the guidance in ANSI/ANS-15.1-2007 for the definition of “Reactor Shutdown.” The NRC staff reviewed the proposed changes and finds that the changes meet the guidance in ANSI/ANS-15.1-2007 for the definition of “Reactor Shutdown.” The NRC notes that the licensee proposes to add former item b to the definition of Reactor Secured. Further, the NRC staff reviewed the proposed definition change using NUREG-1537, Part 2, Section 1.3, Definitions.” NUREG-1537, Part 2, states the definition of reactor shutdown as the following:

> **Reactor Shutdown.** The reactor is shut down if it is subcritical by at least 1 dollar both in the reference core condition and for all allowed ambient conditions with the reactivity worth of all installed experiments included.

The NRC staff notes that the definition of Reactor Shutdown as described in ANSI/ANS 15.1-2007 uses the term reference core condition. TS Section 1.3, “Reference Core Condition,” states, in part, the reference core condition is the reactivity condition of the core when at ambient temperature. The NRC staff finds that removal of “for all ambient conditions” is not needed in the definition of reactor shutdown because the ambient condition is described in the definition of referenced core condition. Because the proposed definition of “Reactor Shut Down” meets the guidance in ANSI/ANS-15.1-2007 and is consistent with the guidance in NUREG-1537, Part 2, with the exception that reference core condition states ambient conditions, the NRC staff finds this change to the TS definition is acceptable.

The current definition of “Reference Core Condition” in TS Section 1, states:

> **Reference Core Condition:** The reference core condition is the reactivity condition of the core when it is at ambient temperature (cold) and the reactivity worth of xenon is negligible (<0.30 dollars).

The proposed definition of “Reference Core Condition,” states:

> **Reference Core Condition:** The reference core condition is the reactivity condition of the core when it is at ambient temperature (cold) and the reactivity worth of xenon is negligible (~~<~~**less than $**0.30 ~~dollars~~).

The licensee proposes to replace the less than symbol (<) with “less than” and change reactivity parameter “dollars” to a symbol ($). The NRC staff reviewed the proposed change and determined the changes makes a minor grammatical change that improves clarity and does not alter the interpretation of the TS definition of reference core condition. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of reference core condition is acceptable.

The current definition of “Scram time” in TS Section 1, states:

> **Scram time:** Scram time is the elapsed time between reaching a limiting safety system set point and the instant that the slowest scrammable control rod reaches its fully-inserted position.

The proposed definition of “Scram time,” states:

> **Scram ~~t~~Time:** Scram time is the elapsed time between reaching a limiting safety system ~~set point~~ **setting** and the instant that the slowest scrammable control rod reaches its fully-inserted position.

The licensee proposes to capitalize “Time” in the defined term scram time for format consistency with the TS. Additionally, the licensee proposes to replace “set point” with “setting” to describe terms consistently in the TS. The NRC staff reviewed the proposed changes and determined that they do not alter the interpretation of the TS definition of scram time. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of scram time is acceptable.

The current definition of “Should, Shall, and May” in TS Section 1, states:

> **Should, Shall, and May:** The word “shall” is used to denote a requirement; the word “should” is used to denote a recommendation; and the word “may” to denote permission, neither a requirement nor a recommendation.

The proposed definition of “Should, Shall, and May,” states:

> **Shall, Should, and May:** The word “shall” is used to denote a requirement; the word “should” is used to denote a recommendation; and the word “may” **is used** to denote permission, neither a requirement nor a recommendation.

The licensee proposes to change the defined term "Should, Shall, and May" to "Shall, Should, and May" and add "is used" to make the definition consistent with the guidance in ANSI/ANS-15.1-2007, Section 1.3, "Definitions," for the definition of "Shall, Should, and May." The NRC staff reviewed the proposed changes and finds that the change meets the guidance in ANSI/ANS-15.1-2007 for the definition of "Shall, Should, and May." Because the proposed definition of "Shall, Should, and May" meets the guidance in ANSI/ANS-15.1-2007, the NRC staff finds this change to the TS definition is acceptable. Additionally, the reordering of the terms "Should, Shall, and May" To "Shall, Should, and May" is editorial and does not change the interpretation of the definition. For this reason, the NRC staff finds the reordering of the terms acceptable.

The current definition of "Shutdown Margin" in TS Section 1, states:

> **Shutdown Margin:** Shutdown margin shall mean the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems and will remain subcritical without further operator action, starting from any permissible operating condition with the most reactive rod is in its most reactive position.

The proposed definition of "Shutdown Margin," states:

> **Shutdown Margin:** Shutdown margin ~~shall mean~~ **is** the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems ~~and will remain subcritical without further operator action, starting from any permissible operating condition with the most reactive rod is in its most reactive position~~ **starting from any permissible operating condition and with the most reactive rod in its most reactive position, and that the reactor will remain subcritical without further operator action**.

The licensee proposes to replace "shall mean" with "is" and "and will remain subcritical without further action, starting from any permissible operating condition with the most reactive rod is in its most reactive position" with "starting from any permissible operating condition and with the most reactive rod in its most reactive position, and that the reactor will remain subcritical without further operator action" to make the definition consistent with the guidance in ANSI/ANS-15.1-2007, Section 1.3, "Definitions," for the definition of "Shutdown Margin." The NRC staff review the proposed changes and finds that the change meets the guidance in ANSI/ANS-15.1-2007 for the definition of shutdown margin. The NRC staff also reviewed the proposed TS definition for shutdown margin using the guidance in NUREG-1537, Part 1, Appendix 14.1, Section 1.3, "Definitions," that states the following:

> **Shutdown margin.** Shutdown margin is the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems starting from any permissible operating condition. It should be assumed that the most reactive scrammable rods and all non-scrammable rods are in their most reactive position and that the reactor will remain subcritical without further operator action.

The NRC staff notes that all control rods in the OSTR are capable of being scrammed, as defined in the TS definition, "Control Rod." Therefore, the NRC staff finds that the proposed definition meets the intent of the NUREG-1537 definition of shutdown margin. Because the proposed definition of "Shutdown Margin" meets the guidance in ANSI/ANS-15.1-2007 and the

intent of the guidance in NUREG-1537, the NRC staff finds this change to the TS definition of shutdown margin is acceptable.

The current definition of “Square-Wave Mode” in TS Section 1, states:

> **Square-Wave Mode (S.-W. Mode):** The square-wave mode shall mean any operation of the reactor with the mode selector switch in the square-wave position.

The proposed definition of “Square-Wave Mode,” states:

> **Square-Wave Mode (S.-W. Mode):** ~~The s~~**S**quare-wave mode shall mean any operation of the reactor with the mode selector switch in the square-wave position.

The licensee proposes to remove “The” and capitalize the beginning of “square-wave mode” in the TS definition of square-wave mode for format consistency with the definitions of pulse mode and steady-state mode. The NRC staff reviewed the proposed change and determined that it does not alter the interpretation of the TS definition of square-wave mode. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the TS definition of square-wave mode is acceptable.

The current definition of “Steady-State Mode (S.-S Mode),” in TS Section 1, states:

> **Steady-State Mode (S.-S. Mode):** Steady-state mode shall mean operation of the reactor with the mode selector switch in the steady-state position.

The proposed definition of “Steady-State Mode (S.-S Mode),” states:

> **Steady-State Mode (S.-S. Mode):** Steady-state mode shall mean operation of the reactor with the mode selector switch in the steady-state **or automatic** position.

The licensee proposes to add “or automatic” to the TS definition of steady-state mode to clarify that the mode selector switch is most often set to “automatic” when the reactor is operating at a steady-state power. The OSTR Renewal SAR, Section 4.1, “Summary Description,” states that the reactor can be operated in a steady-state mode by either manual or automatic control. The NRC staff evaluated the proposed change and finds that the change adequately describes steady-state operation of the reactor. Therefore, the NRC staff finds this change to add “or automatic” to the definition of steady-state mode acceptable.

The licensee proposes to remove the following definitions in TS Section 1:

> **1.1 Audit:** An audit is a quantitative examination of records, procedures or other documents after implementation from which appropriate recommendations are made.
>
> **1.26 Review:** A review is a qualitative examination of records, procedures or other documents prior to implementation from which appropriate recommendations are made.

The licensee states in the LAR that these definitions are not required by or included in ANSI/ANS-15.1-2007. Further, the licensee emphasizes that these existing definitions are not consistent with their usage in Section 6 of the TS or Section 6.2.3 and 6.2.4 of ANSI/ANS-15.1-2007. The licensee states that the requirements in Section 6 of the TS are clear enough without explicitly defining these terms.

The NRC staff review the proposed change to remove the definitions of "Audit" and "Review" from Section 1 of the TS. The NRC reviewed Section 1.3, "Definitions," of ANSI/ANS-15.1-2007 and Section 1.3, Definitions," of NUREG -1537, Part 2 and finds that the terms "Audit" and "Review" are not explicitly defined. TS 6.2.3, "ROC Review Function" explicitly specifies the review function of the Reactor Oversight Committee (ROC). Additionally, TS 6.2.4, "ROC Audit Function," explicitly specifies the audit function of the ROC. Because TS 6.2.3 and TS 6.2.4 specify both the review and audit function of the ROC, the NRC finds that the terms "Audit" and "Review" are not needed to clarify their meaning. Therefore, the NRC staff finds this change to remove the definitions of "Audit and "Review" acceptable. Additionally, the NRC staff finds that the renumbering of the remaining definitions in Section 1 of the TS due to the removal of the definition of "Audit" and "Review" is editorial in nature and therefore acceptable.

3.5.2 TS Section 2, "Safety Limits and Limiting Safety System Setting"

The licensee proposes to change the title of TS Section 2 from "Safety Limits and Limiting Safety System Setting" to "Safety Limit and Limiting Safety System Setting" because only a single fuel temperature safety limit is specified in TS 2.1. The NRC staff finds this proposed change to the title of TS Section 2 is editorial, and therefore is acceptable.

TS 2.1, "Safety Limit-Fuel Element Temperature"

The current TS 2.1 states:

> Specifications. The temperature in a TRIGA® fuel element shall not exceed 2,100° F (1,150° C) under any mode of operation.

The proposed TS 2.1 states:

> Specifications. The temperature in a TRIGA® fuel element shall not exceed 1150°C (2100°F) under any mode of operation.

The licensee proposes to delete the commas (,) from the temperature values and reverse the order of the two temperatures to implement consistent formatting in the TS. The NRC staff reviewed these proposed changes to TS 2.1 and determined they do not alter the existing specification for the temperature limit for TRIGA fuel elements under any mode of operation. The NRC staff concludes the proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 2.1 acceptable.

TS 2.2, "Limiting Safety System Settings"

The current TS 2.2 states:

> Applicability. This specification applies to the scram settings which prevent the safety limit from being reached.

The proposed TS 2.2 states:

> Applicability. This specification applies to the scram settings ~~which~~ **that** prevent the safety limit from being reached.

The licensee proposes to replace “which” with “that” in the applicability of TS 2.2 to introduce a restrictive clause. The NRC staff reviewed this proposed change to TS 2.2 and determined the change does not alter the existing applicability and objective for scram settings that prevent the safety limit from being reached. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 2.2 is acceptable.

Further, the licenses proposed to remove the “s” from safety limits to clarify that only a single safety limit exists. TS 2.1 states a single temperature limit for TRIGA fuel. The NRC staff reviewed this proposed change to TS 2.2 and determined the change does not alter the existing objective of TS 2.2 to prevent the safety limit from being reached. The NRC staff concludes this proposed change and improves clarity of the TS. Therefore, the NRC staff finds this change to TS 2.2 is acceptable.

3.5.3 TS Section 3, “Limiting Conditions of Operation”

The licensee proposes to change the title of TS Section 3 from “Limiting Conditions of Operation” to “Limiting Conditions of Operations” for consistency with Section 3 of ANS/ANS-15.1-2007. The NRC staff finds this proposed change to the title of TS Section 3 is editorial and consistent with ANS/ANS-15.1-2007, and therefore is acceptable.

TS 3.1.1, “Steady-state Operation”

The current TS 3.1.1 states:

> Objective. The objective is to assure that the fuel temperature safety limit shall not be exceeded during steady-state operation.

The proposed TS 3.1.1 states:

> Objective. The objective is to ~~assure~~ **ensure** that the fuel temperature safety limit shall not be exceeded during steady-state operation.

The licensee proposes to replace “assure” with “ensure” to correct word usage. The NRC staff reviewed the proposed change to TS 3.1.1 and determined the change does not alter the existing objective of TS 3.1.1 requiring that the fuel temperature safety limit shall not be exceeded during steady-state operation. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.1.6 is acceptable.

TS 3.1.2, “Shutdown Margin”

The current TS 3.1.2 states:

> Objective. The objective is to assure that the reactor can be shut down at all times and to assure that the fuel temperature safety limit shall not be exceeded.
>
> Specifications. The reactor shall not be operated unless the following conditions exist:

The shutdown margin provided by control rods shall be greater than $0.55 with:

a. Irradiation facilities and experiments in place and the total worth of all non-secured experiments in their most reactive state;

b. The most reactive control rod fully-withdrawn; and

c. The reactor in the reference core condition.

The proposed TS 3.1.2 states:

Objective. The objective is to ~~assure~~ **ensure** that the reactor can be shut down at all times and to ~~assure~~ **ensure** that the fuel temperature safety limit shall not be exceeded.

Specifications. The reactor shall not be operated unless the following conditions exist:

The shutdown margin provided by control rods shall be ~~greater than~~ **at least** $0.55 with:

a. Irradiation facilities and experiments in place and the total worth of all ~~non-secured~~ **unsecured** experiments in their most reactive state;

b. The most reactive control rod fully withdrawn; and

c. The reactor in the reference core condition.

The licensee proposes to replace "assure" with "ensure" in the objective of TS 3.1.2 to correct word usage. The NRC staff reviewed this proposed change to TS 3.1.2 and determined that the change does not alter the existing objective of TS 3.1.2 requiring that the reactor can be shut down at all times and that the fuel temperature safety limit shall not be exceeded during steady-state operation. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the objective of TS 3.1.2 is acceptable.

The licensee proposes to replace "greater than" with "at least" in TS 3.1.2 to clarify that $0.55 units of reactivity is the minimum value of shutdown margin. The NRC staff reviewed the proposed change to TS 3.1.2 using NUREG-1537, Part 2, Section 3.1(2), "Shutdown Margin," that states, in part, that the value of shutdown margin should be large enough to be readily determined experimentally, for example greater than or equal to $0.50. The NRC staff finds that a minimum shutdown margin of at least $0.55 can be easily determined by the licensee and is of a sufficient amount of shutdown reactivity to give reasonable assurance that the licensee will be able to shut down the reactor under the conditions stated in TS 3.1.2. Because the proposed shutdown margin is greater than $0.50, the NRC staff finds the change to replace "greater than" with "at least" in TS 3.1.2 is acceptable.

The licensee proposes to replace "non-secured" with "unsecured" in TS 3.1.2.a to make a grammatical correction. The NRC staff notes that "unsecured experiment" is defined in the OSTR TS as follows:

Unsecured Experiment: An unsecured experiment is any experiment or component of an experiment that does not meet the definition of a secured experiment.

The term “non-secured experiment” is not defined in the OSTR TS. The NRC staff reviewed the proposed change and determined the change clarifies the type of experiments in their most reactive state are used to determine the shutdown margin. Because the proposed change clarifies the type of experiment used to determine shutdown margin, the NRC staff finds this change to TS 3.1.2.b acceptable.

The licensee proposes to delete the hyphen between “fully” and “withdrawn” in TS 3.1.2.b to make a grammatical correction. The NRC staff reviewed the proposed change to TS 3.1.2.b and finds that the proposed change does not alter TS 3.1.2.b requiring that shutdown margin provided with the most reactive control rod fully withdrawn. Therefore, the NRC staff finds the proposed editorial change to TS 3.1.2.b is acceptable.

TS 3.1.3, “Core Excess Reactivity”

The current TS 3.1.3 states:

> Objective. The objective is to assure that the reactor can be shut down at all times and to assure that the fuel temperature safety limit shall not be exceeded.

The proposed TS 3.1.3 states:

> Objective. The objective is to ~~assure~~ **ensure** that the reactor can be shut down at all times and to ~~assure~~ **ensure** that the fuel temperature safety limit shall not be exceeded.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 3.1.3 to correct word usage. The NRC staff reviewed the proposed change to TS 3.1.3 and determined the proposed change does not alter the existing objective of TS 3.1.3 requiring that the reactor can be shutdown at all times and the temperature safety limit shall not be exceeded. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.1.3 is acceptable.

TS 3.1.4, “Pulse Mode Operation”

The current TS 3.1.4 states:

> Applicability. This specification applies to the energy generated in the reactor as a result of a pulse insertion of reactivity.
>
> Objective. The objective is to assure that the fuel temperature safety limit shall not be exceeded.
>
> Specifications. The reactivity to be inserted for pulse operation shall be determined and limited by a mechanical block and electrical interlock on the transient rod, such that the maximum fuel element temperature shall not exceed 830°C.

The proposed TS 3.1.4 states:

> Applicability. This specification applies to the energy generated in the reactor as a result of a pulse **or square-wave** insertion of reactivity.
>
> Objective. The objective is to ~~assure~~ **ensure** that the fuel temperature safety limit shall not be exceeded.
>
> Specifications. The reactivity to be inserted for pulse **mode or square-wave mode** operation shall be determined and limited by a mechanical block and electrical interlock on the transient rod, such that the maximum fuel element temperature shall not exceed 830°C.

The licensee proposes to add “or square-wave” to the applicability of TS 3.1.4. Additionally, the licensee proposes to add “mode or square-wave mode” to the specification to require the mechanical block and electrical interlock for the transient rod apply to square-wave mode of operation. The licensee states in the LAR that TS 3.2.3, “Reactor Safety System,” Table 3, “Minimum Interlocks,” requires this interlock (i.e., Transient Rod Cylinder Position Interlock) described in TS 3.1.4 be operable for square-wave operation mode.

The NRC staff reviewed the proposed addition to the applicability and specification of TS 3.1.4. The NRC notes that in square-wave mode, the transient control rod is rapidly raised to quickly increase reactor power level up to the steady-state power limit. TS 3.1.1, “Steady-state Operation,” states that during steady-state operations, the reactor power level shall not exceed 1.1 MW. TS 3.2.3, Table 3, requires that the Transient Rod Cylinder Position Interlock be operable for square-wave mode operation. As specified in Table 3, the function of the Transient Rod Cylinder Position interlock prevents a reactivity insertion that would result in a maximum fuel element temperature of greater than 830 degrees C. The NRC staff finds that by requiring inserted reactivity to be determined and limited using the mechanical block and electrical interlock during square-wave mode will help prevent the maximum fuel temperature from exceeding 830 degrees C. Therefore, the NRC staff finds that these changes to the applicability and specifications of TS 3.1.4 are acceptable.

The licensee proposes to change the title of TS 3.1.4 from “Pulse Mode Operation” to “Pulse and Square-Wave Mode Operation” because the interlock described in TS 3.1.4 is required in both pulse and square-wave modes of operation. The NRC staff finds that the proposed change to the title of TS 3.1.4 is editorial, and therefore is acceptable.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 3.1.4 to correct word usage. The NRC staff reviewed this proposed change to TS 3.1.4 and determined the change does not alter the existing objective of TS 3.1.4 requiring that the temperature safety limit shall not be exceeded. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.1.4 is acceptable.

TS 3.1.6, “Fuel Parameters”

The current TS 3.1.6 states:

> Specifications. The reactor shall not operate with damaged fuel elements, except for the purpose of locating damaged fuel elements. A fuel element shall be considered damaged and must be removed from the core if:

The proposed TS 3.1.6 states:

> <u>Specifications</u>. The reactor shall not operate with damaged fuel elements, except for the purpose of locating damaged fuel elements. A fuel element shall be considered damaged and ~~must~~ **shall** be removed from the core if:

The licensee proposes to replace "must" with "shall" in the specifications of TS 3.1.6 because "must" is an undefined term in the OSTR TS and the "shall" is defined in the OSTR TSs. The current OSTR TSs, Section 1, "Definitions," states the term "shall" is used to denote a requirement. The NRC staff reviewed the proposed change to TS 3.1.6 and determined that replacing "must" with the defined term "shall" does not alter the existing TS 3.1.6 requirement that a fuel element be removed form the core that is considered damage. The NRC staff concludes this proposed change is editorial because both terms denote a requirement. Therefore, the NRC staff finds this change to TS 3.1.6 is acceptable.

<u>TS 3.2.1, "Control Rods"</u>

The licensee proposes to add a "s" to "Specification" in TS 3.2.1 for consistent formatting throughout the TSs. The NRC staff reviewed this proposed change and determined that this proposed change is editorial, and therefore is acceptable.

<u>TS 3.2.2, "Reactor measuring Channels"</u>

The current TS 3.2.2 states:

> <u>Applicability</u>. This specification applies to the information which shall be available to the reactor operator during reactor operation.
>
> <u>Objective</u>. The objective is to specify the minimum number of measuring channels that shall be available to the operator to assure safe operation of the reactor.
>
> <u>Specifications</u>. The reactor shall not be operated in the specified mode unless the minimum number of measuring channels listed in Table 1 are operable

The proposed TS 3.2.2 states

> <u>Applicability</u>. This specification applies to the information ~~which~~ **that** shall be available to the reactor operator during reactor operation.
>
> <u>Objective</u>. The objective is to specify the minimum number of measuring channels that shall be available to the operator to ~~assure~~ **ensure** safe operation of the reactor.
>
> <u>Specifications</u>. The reactor shall not be operated in the specified mode unless the minimum number of measuring channels listed in Table 1 are ~~operable~~ **operating**.

The licensee proposes to replace "which" with "that" in the applicability of TS 3.2.2 to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined the change does not alter the existing applicability of TS 3.2.2 requiring that the reactor can be shutdown at all times and the temperature safety limit shall not be exceeded. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.2.2 is acceptable.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 3.2.2 to correct word usage. The NRC staff reviewed the proposed change and determined the change does not alter the existing objective of TS 3.2.2 requiring a minimum number of measuring channels available to the operator. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.2.2 is acceptable.

The licensee proposes to replace “operable” with “operating” in TS 3.2.2 to correct word usage. The OSTR TS defines the term operating as follows:

> **1.17 Operating**: Operating means a component or system is performing its intended function.

The proposed change would require the measuring channels list in TS 3.2.2, Table 1, to be performing its intended function to operate the reactor in the specified mode of operation. The measuring channels in TS 3.2.2, Table 1, provide the operator an indication of reactor power. The NRC staff reviewed the proposed change and determined that the change to use the TS defined term “operating” accurately describes that condition of measuring channels to provide an indication of reactor power to the operator. Therefore, the NRC staff finds this change to TS .2.2 is acceptable.

TS 3.2.2, Table 1, “Minimum Measuring Channels”

The current TS 3.2.2, Table 1, states:

Table 1 - Minimum Measuring Channels

Measuring Channel	Effective Mode		
	S.-S.	Pulse	S.-W.
Fuel Element Temperature	1	1	1
Linear Power Level	1	-	1
Log Power Level	1	-	1
Power Level	2	-	2
Nvt-Circuit	-	1	-

The proposed TS 3.2.2, Table 1, states:

Table 1 - Minimum Measuring Channels

Measuring Channel	Effective Mode		
	S.-S.	Pulse	S.-W.
~~Fuel Element Temperature~~	~~1~~	~~1~~	~~1~~
Linear Power Level	1	-	1
Log Power Level	1	-	1
~~Power Level~~	~~2~~	-	~~2~~
Safety Power Level	**1**	**-**	**1**
Percent Power Level	**1**	**-**	**1**
Nvt-Circuit	-	1	-

The NRC staff's review of the removal of the Fuel Element Temperature measuring channel for steady-state, pulse, and square-wave mode is documented in Section 3.1 of this SE. The NRC staff concluded in Section 3.1 of this SE that the removal of the Fuel Element Temperature measuring channel is acceptable. Therefore, the NRC staff finds that the proposed conforming change to TS 3.2.2, Table 1 to remove Fuel Element Temperature is acceptable.

The licensee proposes to replace "Power Level" with "Safety Power Level" and "Percent Power Level" in the Table 1 of TS 3.2.2 to clarify the name of each power level measuring channel. The NRC staff reviewed these proposed changes to Table 1 and determined that the changes do not alter the requirement to have two power level measuring channels operable in steady-state and square-wave mode to ensure safe operation of the reactor. The NRC staff concludes these proposed changes are editorial and improve clarity. Therefore, the NRC staff finds these changes to Table 1 acceptable.

The current TS 3.2.2, Table 1, item (1), states:

(1) Any single Linear Power Level, Log Power Level or Power Level measuring channel may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration.

The proposed TS 3.2.2, Table 1, item (1), states:

(1) Any single ~~Linear Power Level, Log Power Level or Power Level~~ measuring channel **(except the Nvt-Circuit)** may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration. **Note that the Linear Power Level and Log Power Level are connected to the same detector and both become inoperable when performing a channel check, test, or calibration."**

The licensee proposes to delete "Linear Power Level, Log Power Level or Power Level" and add "(except the Nvt-Circuit)" in TS 3.2.2, Table 1, to clarify that item (1) applies to all measuring channels with the exception of the Nvt-Circuit. The NRC staff finds that the Nvt-Circuit is a

single measuring channel and the only measuring channel required for pulse mode operation as shown in TS 3.2.2, Table 1, and its inclusion in TS 3.2.2, Table 1, item (1) is acceptable.

The licensee proposes to add “Note that the Linear Power Level and Log Power Level are connected to the same detector, and both become inoperable when performing a channel check, test, or calibration,” to TS 3.2.2, item (1) to clarify that both the linear and log power level will be inoperable (i.e., power level indication not available to the operator) during the performance of channel check, test, or calibration. The NRC staff notes TS 3.2.2, Table 1, requires two independent and redundant power level measuring channels (i.e., designated as Safety and Percent Power as described in the proposed change to TS 3.2.2, Table 1 above) be operable for steady-state and square-wave modes of operation to provide the operator indications of power level. Because two power level indications are available to the operator as required by TS 3.2.2, Table 1, the NRC staff finds this change to TS 3.2.2, Table 1, item (1) is acceptable.

The current TS 3.2.2, Table 1, item (2), states:

(2) If any required measuring channels becomes inoperable while the reactor is operating for reasons other than that identified in Technical Specification 3.2.2 (1) above, the channel shall be restored to operation within 5 minutes or the reactor shall be immediately shutdown.

The proposed TS 3.2.2, Table 1, item (2), states:

(2) If any required measuring channels becomes inoperable while the reactor is operating for reasons other than that identified in ~~Technical Specification 3.2.2 (1) above~~ **footnote (1)**, the channel shall be restored to operation within 5 minutes or the reactor shall be immediately ~~shutdown~~ **shut down**.

The licensee proposes to replace “Technical Specification 3.2.2 (1) above” with “footnote (1)” for grammatical correction for consistency. The NRC staff reviewed the proposed change to TS 3.2.2, Table 1, and determined that the change does not alter the requirement of restoring measuring channels other than the reasons on TS 3.2.2, Table 1, footnote (1). The NRC staff concludes these proposed changes are editorial and increase clarity. Therefore, the NRC staff finds this change to TS 3.2.2, Table 1 is acceptable.

The licensee proposes to replace “shutdown’ with “shut down” in TS 3.2.2, item (2) for grammatical correction for consistency. The NRC staff reviewed the proposed changes to TS 3.2.2, item (2) and determined the change does not alter the requirement if a channel is not restored to operation within 5 minutes. Therefore, the NRC staff concludes this change is editorial and finds this change to TS 3.2.2, item (2) is acceptable.

<u>TS 3.2.3, “Reactor Safety Systems and Interlocks”</u>

The current TS 3.2.3 states:

3.2.3 Reactor Safety System and Interlocks

<u>Applicability</u>. This specification applies to the reactor safety system channels.

Objective. The objective is to specify the minimum number of reactor safety system channels that shall be available to the operator to assure safe operation of the reactor.

Specifications. The reactor shall not be operated unless the minimum number of safety channels described in Table 2 and interlocks described in Table 3 are operable.

Table 2 - Minimum Reactor Safety Channels

Safety Channel	Function	Effective Mode		
		S.-S.	Pulse	S.-W.
Fuel Element Temperature	SCRAM @ 510°C	1	-	1
Power Level	SCRAM @ 1.1 MW(t) or less	2	-	2
Console Scram Button	SCRAM	1	-	1
Preset Timer	Transient rod SCRAM @ ≤ 15 sec after a pulse	-	1	-
High Voltage	SCRAM @ ≥ 25% of nominal operating voltage	1	1	1

Table 3 - Minimum Interlocks

Interlock	Function	Effective Mode		
		S.-S.	Pulse	S.-W.
Wide-Range Log Power Level Channel	Prevents control rod withdrawal @ less than 2 cps	1	-	-
Transient Rod Cylinder	Prevents application of air unless fully-inserted	1	-	-
1 kW Pulse Interlock	Prevents pulsing above 1 kW	-	1	-
Shim, Safety, and Regulating Rod Drive Circuit	Prevents simultaneous manual withdrawal of two rods	1	-	1
Shim, Safety, and Regulating Rod Drive Circuit	Prevents movement of any rod except transient rod	-	1	-
Transient Rod Cylinder Position	Prevent pulse insertion of reactivity greater than that which would produce a maximum fuel element temperature of 830°C .	-	1	1

(1) Any single Linear Power Level, Log Power Level or Power Level safety channel or interlock may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration.

(2) If any required safety channel or interlock becomes inoperable while the reactor is operating for reasons other than that identified in Technical Specification 3.2.3 (1) above, the channel shall be restored to operation within 5 minutes or the reactor shall be immediately shutdown.

(3) The Fuel Element Temperature safety channel is not required if transient operation modes (Square Wave and Pulse) are precluded, and if precluded, the Fuel Element Temperature safety channel shall be considered removed from Table 2.

The proposed TS 3.2.3 states:

3.2.3 Reactor Safety Systems

Applicability. This specification applies to the reactor safety system**s** ~~channels~~.

Objective. The objective is to specify the minimum number of reactor safety system**s** ~~channels~~ that shall be available to the operator to ~~assure~~ **ensure** safe operation of the reactor.

Specifications. The reactor shall not be operated **in the specified mode** unless the minimum number of safety **systems** ~~channels~~ described in Table 2 ~~and interlocks described in Table 3~~ are ~~operable~~ operating.

Table 2 - Minimum Reactor Safety ~~Channels~~ Systems

Safety **System** ~~Channel~~	Function	Effective Mode		
		S.-S.	Pulse	S.-W.
~~Fuel Element Temperature~~	~~SCRAM @ 510°C~~	~~1~~	-	~~1~~
Safety Power Level	SCRAM @ 1.1 MW~~(t)~~ or less	**1**~~2~~	-	**1**~~2~~
Percent Power Level	**SCRAM @ 1.1 MW or less**	**1**		**1**
~~Console Scram Button~~ **Manual Scram**	SCRAM **(button on console)**	1	**1**	1
Preset Timer	Transient rod SCRAM @ ≤ 15 sec after a pulse	-	1	-
High Voltage	SCRAM @ ≥ 25% of nominal operating voltage	1	1	1

(1) ~~Any single Linear Power Level, Log Power Level or Power Level~~ **The Safety Power** channel ~~or interlock~~ **or the Percent Power channel** may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration.

(2) If any required safety channel ~~or interlock~~ becomes inoperable while the reactor is operating for reasons other than that identified in ~~Technical Specification 3.2.3~~ **(1)** ~~above~~, the channel shall be restored to operation within 5 minutes or the reactor shall be immediately ~~shutdown~~ **shut down**.

(3) ~~The Fuel Element Temperature safety channel is not required if transient operation modes (Square Wave and Pulse) are precluded, and if precluded, the Fuel Element Temperature safety channel shall be considered removed from Table 2.~~

The licensee proposes to revise the title of TS 3.2.3 from “Reactor Safety System and Interlocks” to “Reactor Safety Systems” for clarity regarding the differences between safety systems and interlocks. The licensee is proposing to separate TS 3.2.3 Table 2 and Table 3 into two separate TS. TS 3.2.3 will address the safety systems requirements in Table 2 and newly proposed TS 3.2.4 will address interlocks requirements in Table 3. The NRC staff reviewed and found acceptable TS 3.2.4, Table 3 below. The NRC staff reviewed the proposed change to the title of TS 3.2.3 and determined the change accurately describes that TS 3.2.3 applies to only safety systems. The NRC staff concludes this conforming proposed change is editorial. Therefore, the NRC staff finds this change to the title of TS 3.2.3 is acceptable.

The licensee proposes to add an “s” to system and delete “channels” in the applicability, and objective of TS 3.2.3 and replace “channels” with “systems” in the specification of TS 3.2.3 because not all items in TS 3.2.3, Table 2, meet the TS definition of a “safety channel” and all items meet the TS definition of “safety system.” In addition, the licensee proposes to replace “Channels” with “Systems” in the title of TS 3.2.3 Table 2 and in the first column of Table 2 because not all the items meet the definition of a “safety channel.” Reactor safety system is defined in the TS as follows:

> **1.22 Reactor Safety Systems**: Reactor safety systems are those systems, including their associated input channels, which are designed to initiate, automatically or manually, a reactor scram for the primary purpose of protecting the reactor.

Based on the current TS definition of reactor safety system, The NRC staff determined that “safety systems” accurately describes the items listed in TS 3.2.3, Table 2. Therefore, the NRC staff finds these changes to the applicability, objective, and specification of TS 3.2.3 and TS Table 2 title and first column acceptable.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 3.2.3 to correct word usage. The NRC staff reviewed this proposed change and determined the change does not alter the existing objective of TS 3.2.3 that specifies the minimum number of safety systems available to the operator. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the objective of TS 3.2.3 is acceptable.

The licensee proposes to add “in the specified mode” to TS 3.2.3 to clarify the intent of Table 2. The NRC staff reviewed this proposed change and determined the change clarifies the requirement that certain reactor safety systems be required for reactor operation in the specified mode. Because the change clarifies the reactor safety systems required for reactor operation in specific modes, the NRC staff finds this change to TS 3.2.3 acceptable.

The licensee proposes to remove “and interlock describe in Table 3” from TS 3.2.3 because Table 3 will be relocated to newly proposed TS 3.2.4, “Reactor Interlocks”. The NRC staff evaluated proposed TS 3.2.4 below. Since the interlocks in Table 3 are relocated to TS 3.2.4,

the NRC staff determined that this change is editorial. Therefore, the NRC staff finds this change to TS 3.2.3 is acceptable.

The licensee proposes to replace “operable” with “operating” in TS 3.2.3 to correct word usage. The OSTR TS defines the term operating as follows:

> **1.17 Operating**: Operating means a component or system is performing its intended function.

The licensee states that the proposed change would require the safety systems listed in TS 3.2.3, Table 2, to be performing its intended function to operate the reactor in the specified mode of operation. The safety systems in TS 3.2.3, Table 2, provide a protective function (i.e., reactor scram) to ensure safe operation of the OSTR. The NRC staff reviewed the proposed change and determined that the change to use the TS defined term “operating” accurately describes that condition of safety systems to provide a protective function to ensure safe operation of the OSTR. Therefore, the NRC staff finds this change to TS 3.2.3 is acceptable.

The NRC staff's review of the removal of the Fuel Element Temperature safety channel for steady-state, pulse, and square-wave mode is documented in Section 3.2 of this SE. The NRC staff concluded in Section 3.2 of this SE that the removal of the Fuel Element Temperature safety channel is acceptable.

The licensee proposes to replace “Power Level” with “Safety Power Level” and “Percent Power Level” in Table 2 of TS 3.2.3 to clarify the name of each power level safety channel with the same safety function to scram the reactor at 1.1 megawatts. The NRC staff reviewed these proposed changes to Table 2 and determined that the changes do not alter the requirement to have two power level safety channels operable to scram at 1.1 megawatts in steady-state and square-wave mode to ensure safe operation of the reactor. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 3.2.3, Table 2 are acceptable.

The licensee proposes to remove “(t)” in TS 3.2.3, Table 2, since the OSTR is a non-power reactor, it is clear that all power values refer to thermal power. The NRC staff reviewed the proposed change and determined the change does not alter the existing high-power setpoint value trip at 1.1 megawatts. The NRC staff agrees that all power values refer to thermal power and the proposed change provides consistency with other TS limits. Therefore, the NRC staff finds these changes to TS 3.2.3, Table 2 are acceptable.

The licensee proposes to replace “Console Scram Button” with “Manual Scram” and add “(button on console)” to TS 3.2.3, Table 2, to clarify the safety system and function, respectively. The NRC staff reviewed the proposed change and determined the change does not alter the requirement for the operability of the manual protective function initiated from the console. Therefore, the NRC staff concludes this change is editorial. Therefore, the NRC staff finds this change to TS 3.2.3, Table 2, is acceptable

Additionally, the licensee proposes to add “1” to require the manual scram operable for pulse mode of operations. The NRC staff reviewed this change and determined the change to require the manual scram for pulse operation will ensure the operator is able to scram the reactor after a pulse if the preset timer fails providing a defense-in-depth protective function. Because

requiring the manual scram be operable for pulse mode of operation provides a defense-in-depth protective function, the NRC staff finds this change to TS 3.2.3, Table 2, acceptable.

The licensee proposes to replace “Any single Linear Power Level, Log Power Level or Power Level” with “The Safety Power channel or the Percent Power channel” and remove “or interlock” from TS 3.2.3, Table 2, item (1). Because the licensee relocated the requirements for interlocks to newly proposed TS 3.2.4, the NRC staff finds the change to remove “or interlock” from TS 3.2.3, Table 2, acceptable. The NRC staff finds that adding “The Safety Power channel or the Percent Power channel” to TS 3.2.3, item (1) provides consistency with the name designation changes of the power level safety channels in Table 2. Therefore, the NRC finds this change to TS 3.2.3, item (1) acceptable.

The licensee proposes to remove TS 3.2.3, Table 2, item 3. The NRC staff’s review of the removal of the Fuel Element Temperature safety channel for steady-state, pulse, and square-wave mode is documented in Section 3.2 of this SER. The NRC staff concluded this change is acceptable. The licensee’s proposed change to TS 3.2.3, Table 2, item 3 is a conforming editorial change, and, thus, acceptable.

The licensee proposes to remove “and interlock” from TS 3.2.3, item 2 because the requirements for interlocks will be relocated to newly proposed TS 3.2.4. The NRC staff evaluated proposed TS 3.2.4 below. Since the interlocks in TS 3.2.3, Table 3 are relocated to TS 3.2.4, the NRC staff determined that this change is editorial. Therefore, the NRC staff finds this change to TS 3.2.3, item 2, is acceptable.

The licensee proposes to replace “shutdown’ with “shut down” in TS 3.2.3, item (2) for grammatical correction for consistency. The NRC staff reviewed the proposed changes to TS 3.2.3, item (2) and determined the change does not alter the requirement if a channel is not restored to operation within 5 minutes. Therefore, the NRC staff concludes this change is editorial. Therefore, the NRC staff finds this change to TS 3.2.3, item (2) is acceptable.

The licensee proposes to replace “Technical Specification 3.2.3 (1) above” with “(1)” in TS 3.2.3, item (2) for grammatical correction for consistency. The NRC staff reviewed the proposed change to TS 3.2.2, Table 2, and determined that the change does not alter the requirement of restoring safety channels other than the reasons on TS 3.2.3, Table 2, footnote (1). The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.2.3, Table 2 is acceptable.

TS 3.2.4, “Reactor Interlocks”

The newly proposed TS 3.2.4, which relocates and revises Table 3 of TS 3.2.3, states:

3.2.4 Reactor Interlocks

Applicability. This specification applies to the reactor safety system interlocks.

Objective. The objective is to specify the minimum number of reactor safety interlocks that shall be available to the operator to ensure safe operation of the reactor.

Specifications. The reactor shall not be operated in the specified mode unless the minimum number of interlocks described in Table 3 are operable.

Table 3 – Minimum Reactor Interlocks

Interlock	Function	Effective Mode		
		S.-S.	Pulse	S.-W.
Wide-Range Log Power Level Channel	Prevents control rod withdrawal @ less than 2 cps	1	-	-
Transient Rod Cylinder	Prevents application of air unless fully inserted	1	-	-
1 kW Pulse Interlock	Prevents pulsing above 1 kW	-	1	-
Shim, Safety, and Regulating Rod Drive Circuit	Prevents simultaneous manual withdrawal of two rods	1	-	1
Shim, Safety, and Regulating Rod Drive Circuit	Prevents movement of any rod except transient rod	-	1	-
Transient Rod Cylinder Position	Prevent pulse insertion of reactivity greater than **$2.30** ~~that which would produce a maximum fuel element temperature of 830°C~~	-	1	1

(1) Any single interlock may be inoperable while the reactor is operating for the purpose of performing a channel check, test, or calibration.
(2) If any required interlock becomes inoperable while the reactor is operating for reasons other than that identified in footnote (1) above, the interlock shall be restored to operation within 5 minutes or the reactor shall be immediately shut down.

The licensee proposes to separate the reactor interlocks from the reactor safety system requirements in TS 3.2.3 for clarity. The licensee proposes a new TS 3.2.4 that would include the reactor interlocks requirements currently in TS 3.2.3 and TS 3.2.3 Table 3, "Minimum Reactor Interlocks." The NRC staff reviewed the proposed new TS 3.2.4 and notes that the interlock designation and minimum number of operable interlocks in the effective mode are identical compared to Table 3 in the current TS 3.2.3. However, the licensee proposes two changes related to the function of the interlocks in TS 3.2.4, Table 3.

The license proposes to remove a hyphen (-) in "fully-inserted" in Table 3 to make a grammatical correction. Additionally, the licensee proposes to change the table format to center the information within Table 3. The NRC staff reviewed these proposed changes and determined the changes are to punctuation and formatting and do not alter the limiting condition of operation for the minimum required interlocks in a specificized mode within Table 3. Because the proposed changes do not alter the limiting condition of operation, the NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to Table 3 are acceptable.

Additionally, the licensee proposes to remove "that which would produce a maximum fuel element temperature of 830°C." and add "$2.30" because the limit should be based on the limit on reactivity insertion consistent with the change to remove the Fuel Element Temperature,

which the NRC staff reviewed and found acceptable as described in Section 3.2 of this SE. Therefore, the NRC staff concludes that this conforming change is acceptable.

<u>TS 3.3, "Reactor Primary Tank Water"</u>

The current TS 3.3 states:

> <u>Objective</u>. The objective is to assure that there is an adequate amount of water in the reactor tank for fuel cooling and shielding purposes, and that the bulk temperature of the reactor tank water remains sufficiently low to guarantee reactor tank integrity.
>
> <u>Specifications</u>. The reactor primary water shall exhibit the following parameters:
>
> a. The tank water level shall be greater than 14 feet above the top of the core;
>
> b. The bulk tank water temperature shall be less than 120°F (49°C); and
>
> c. The conductivity of the tank water shall be less than 5 μmhos/cm.

The proposed TS 3.3 states:

> <u>Objective</u>. The objective is to ~~assure~~ **ensure** that there is an adequate amount of water in the reactor tank for fuel cooling and shielding purposes, and that the ~~bulk~~ temperature of the reactor tank water remains sufficiently low to guarantee reactor tank integrity.
>
> <u>Specifications</u>. The reactor primary water shall exhibit the following parameters:
>
> a. The tank water level shall be ~~greater than~~ **at least** 14 feet above the top of the core;
>
> b. The ~~bulk~~ tank water temperature shall ~~be less than~~ **not exceed 49°C (120°F)**; and
>
> c. The conductivity of the tank water shall ~~be less than~~ **not exceed** 5 μmhos/cm.

The licensee proposes to replace "assure" with "ensure" in the objective of TS 3.3 to correct word usage. The NRC staff reviewed the proposed change to TS 3.3 and finds that the proposed change does not alter the existing objective of TS 3.3 that there is an adequate amount of water in the reactor tank for fuel cooling and shielding. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to the objective of TS 3.3 is acceptable.

The licensee proposes to replace "greater than" with "at least" in TS 3.3.a because the thermal hydraulic analysis uses a minimum water level of 14 feet. The NRC staff reviewed this proposed change to TS 3.3 and finds that by changing the tank water limit from "greater than 14 feet" to "at least 14 feet" above the core continues to ensure sufficient water for effective fuel cooling and to ensure that radiation levels at the top of the reactor are within acceptable levels. Therefore, the NRC staff finds this change to TS 3.3.a acceptable.

The licensee proposes the remove “bulk” in the objective and TS 3.3.b in describing the temperature of the reactor tank to avoid confusion with the bulk shield tank. The NRC staff reviewed this proposed change and determined that removing “bulk” does not alter the existing objective and requirement of TS 3.3.b to limit reactor tank water temperature to ensure tank integrity. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.3.b is acceptable.

The licensee proposes to replace “be less than” with “not exceed” and switch the temperature scale from °F to °C in TS 3.3.b to describe the reactor tank water temperature limit because the SAR thermal hydraulic analysis uses a maximum temperature of 49 °C. The NRC staff reviewed the proposed change and notes that the licensee analyzed 49 °C as the water coolant inlet temperature from the reactor tank in the OSTR renewal SAR, Section 4.7.1, “Analysis of Steady State Operation.” Further, the NRC renewal SER, Section 2.5.2, “Results of Thermal-Hydraulic Analysis,” states that the steady-state analysis was done at a water inlet temperature of 49 °C. The NRC staff concluded previously in the NRC renewal SER that the thermal-hydraulic analysis for the OSTR conversion will result in no significant decrease in safety margins in regard to thermal-hydraulic conditions. Because the 49 °C limit was analyzed in the thermal-hydraulic analysis in the OSTR Renewal SAR and the NRC staff concluded previously in the NRC renewal SER that the 49 °C reactor water tank temperature limit is acceptable, the NRC staff finds this change to TS 3.3.b is acceptable.

The licensee proposes to replace “be less than” with “not exceed” in TS 3.3.c to describe the electrical conductivity limit of the reactor tank water. The NRC staff reviewed the proposed change using NUREG-1537, Parts 1 and 2. NUREG-1537, Part 1, Section 3.3, “Coolant Systems,” states acceptable ranges have traditionally been less than or equal to 5 micromhos per centimeter for electrical conductivity. The acceptance criteria in NUREG-1537, Part 2, Section 5.2, “Primary Coolant System,” states that experience at non-power reactors shows that primary coolant water conditions of electrical conductivity less than or equal to 5 mircomhos per centimeter can usually be attained with the filter and demineralizer system. The NRC staff concludes that applying a conductivity limit of less than or equal to 5 mircomhos will be effective in controlling corrosions in aluminum and stainless-steel systems within the reactor tank and provide reasonable assurance that water quality will be maintained. Because the proposed change to TS 3.3.c conductivity limit to less than or equal to 5 microohms is consistent with the guidance of NUREG-1537 and will continue to provide reasonable assurance that water quality will be maintained to minimize the potential for corrosion of system in the reactor tank, the NRC staff finds this change to TS 3.3.c is acceptable.

TS 3.5, “Ventilation System”

The current TS 3.5 states:

> Objective. The objective is to assure that the ventilation system shall be in operation to mitigate the consequences of possible releases of radioactive materials resulting from reactor operation.

The proposed TS 3.5 states:

> Objective. The objective is to ~~assure~~ **ensure** that the ventilation system shall be in operation to mitigate the consequences of possible releases of radioactive materials resulting from reactor operation.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 3.5 to correct word usage. The NRC staff reviewed the proposed change and determined the change does not alter the existing objective of TS 3.5 requiring that the ventilation system shall be in operation to mitigate the consequences of possible releases of radioactive materials resulting from reactor operation. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.5 is acceptable.

TS 3.7.1, “Radiation Monitoring Systems”

The current TS 3.7.1 states:

> Applicability. This specification applies to the radiation monitoring information which must be available to the reactor operator during reactor operation.
>
> Objective. The objective is to specify the minimum radiation monitoring channels that shall be available to the operator to assure safe operation of the reactor.

The proposed TS 3.7.1 states:

> Applicability. This specification applies to the radiation monitoring information ~~which~~ **that** must be available to the reactor operator during reactor operation.
>
> Objective. The objective is to specify the minimum radiation monitoring channels that shall be available to the operator to ~~assure~~ **ensure** safe operation of the reactor.

The licensee proposes to replace “which” with “that” in the applicability of TS 3.7.1 to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined the change does not alter the existing applicability of TS 3.7.1 requiring that the TS applies to the radiation monitoring information that is available to the operator during reactor operation. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.7.1 is acceptable.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 3.7.1 to correct word usage. The NRC staff reviewed the proposed change and determined the change does not alter the existing objective of TS 3.7.1 to specify the minimum radiation monitoring channels that shall be available to the operator. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.7.1 is acceptable.

Further, the licensee proposes to change TS 3.7.1, Table 4, “Minimum Radiation Monitoring Channels,” to reformat Table 4 information from left to centered justification for readability. The NRC staff reviewed the proposed change and determined the change does not alter the minimum radiation monitoring channels that are required to be operable during reactor operation. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.7.1, Table 4, is acceptable.

TS 3.8, “Limitations on Experiments”

The licensee proposes to change the title for Section 3.8 from “Limitations on Experiments” to “Experiments.” The NRC staff reviewed the proposed change to the title of Section 3.8 and finds the change is editorial and consistent with the title of Section 3.8 in ANSI/ANS 15-1-2007. Therefore, the NRC staff finds that the proposed change to the title of Section 3.8 is acceptable.

TS 3.8.1, "Reactivity Limits"

The current TS 3.8.1 states:

> Objective. The objective is to prevent damage to the reactor or excessive release of radioactive materials in the event of an experiment failure.
>
> Specifications. The reactor shall not be operated unless the following conditions governing experiments exist:
>
> a. The absolute value of the reactivity worth of any single unsecured experiment shall be less than $0.50; and
>
> b. The sum of the absolute values of the reactivity worths of all experiments shall be less than $2.30.

The proposed TS 3.8.1 states:

> Objective. The objective is to prevent damage to the reactor ~~or excessive release of radioactive materials~~ **due to excessive reactivity insertion** in the event of an experiment failure.
>
> Specifications. The reactor shall not be operated unless the following conditions governing experiments exist:
>
> a. The absolute value of the reactivity worth of any single unsecured experiment shall ~~be less than~~ **not exceed** $0.50; and
>
> b. The sum of the absolute values of the reactivity worths of all experiments shall ~~be less than~~ **not exceed** $2.30.

The licensee proposes to replace "or excessive release of radioactive materials" with "due to excessive reactivity insertion" in the objective of TS 3.8.1 because the reactivity limits for experiments in TS 3.8.1 prevent inadvertent pulsing and do not prevent or limit the release.

ANSI/ANS-15.1-2007, Section 1.2.2, "Format," states that the objective is a statement that indicates the purpose of the specifications. TS 3.8.1.a and TS 3.8.1.b is to limit the effect that experiments have on reactor reactivity. The NRC staff reviewed the proposed change and finds that the change adequately describes the purpose of TS 3.8.1 to prevent damage to the reactor caused by the insertion of excess reactivity resulting from an experiment failure and is, therefore, consistent with the guidance provided in ANSI/ANS-15.1-2007, Section 1.2.2. Because the proposed change adequately describes the purpose of TS 3.8.1 and is consistent with ANSI/ANS-15.1-2007, the NRC staff finds this change to TS 3.8.1 acceptable.

The licensee proposes to replace "be less than" to not exceed" in TS 3.8.1.a because the analysis uses $0.50 units of reactivity as the maximum acceptable worth for a single unsecured experiment in the reactor. The NRC staff notes that in the NRC renewal SER, Section 10.3, "Experimental Limits," that the reactivity limit of $0.50 for a single unsecured experiment is designed to prevent reactor prompt criticality (i.e., $1.00) from occurring since an unsecured experiment may inadvertently move during reactor operation. The NRC staff reviewed the

proposed change and determined that the change continues to prevent prompt reactor criticality. Because the proposed change maintains the experimental reactivity limit below prompt criticality thereby ensuring the reactor is operated in a safe condition, the NRC staff finds this change to TS 3.8.1.a is acceptable.

The licensee proposes to replace “be less than” to “not exceed” in TS 3.8.1.b because the analysis uses $2.30 units of reactivity as the maximum acceptable worth for all experiments in the reactor. In letter dated June 20, 2008 (ADAMS Accession No. ML082350345), the licensee provided additional information to the NRC staff for the HEU/LEU conversion of the OSTR. In response to RAI 55, item (8), the licensee stated that the TS 3.1.8.b experiment limit is designed to prevent an inadvertent pulse from exceeding the recommended limit on pulsing and that a maximum reactivity insertion of $2.30 will ensure that fuel temperature will not exceed 830 °C. Because the maximum reactivity insertion of $2.30 prevents fuel temperature from exceeding 830 °C, the NRC staff finds the proposed change to replace “be less than” to “not to exceed” in TS 3.8.1.b is acceptable.

<u>TS 3.8.2, “Materials”</u>

The current TS 3.8.2 states:

> <u>Specifications</u>. The reactor shall not be operated unless the following conditions governing experiments exist:
>
> a. Explosive materials, such as gunpowder, TNT, nitroglycerin, or PETN, in quantities greater than 25 milligrams shall not be irradiated in the reactor or irradiation facilities. Explosive materials in quantities less than 25 milligrams may be irradiated provided the pressure produced upon detonation of the explosive has been calculated and/or experimentally demonstrated to be less than half the design pressure of the container; and

The proposed TS 3.8.2 states:

> <u>Specifications.</u> The reactor shall not be operated unless the following conditions governing experiments exist:
>
> a. Explosive materials, such as gunpowder, TNT, nitroglycerin, or PETN, in quantities greater than 25 milligrams shall not be irradiated in the reactor or irradiation facilities. Explosive materials in quantities ~~less than~~ **up to** 25 milligrams may be irradiated provided the pressure produced upon detonation of the explosive has been calculated and/or experimentally demonstrated to be less than half the design pressure of the container; and

The licensee proposes to replace “less than” with “up to” to describe the limit for explosive materials because the SAR shows that quantities of explosive material up to including 25 milligrams can be safely irradiated under the requirements of TS 3.8.2.a.

The NRC staff reviewed the proposed change and notes that the licensee analyzed an explosive quantity limit of 25 milligrams in the OSTR renewal SAR, Section 13.2.6.2, “Accident Analysis and Determination of Consequences.” The OSTR renewal SAR states that the analysis

concludes that an explosive limit of 25 milligrams of TNT-equivalent is consider a safe limit for irradiation in the reactor. In the NRC renewal SER, Section 10.3, Experimental Limits," the NRC staff concluded that the 25 milligrams limit is safe provided proper container material with appropriate diameter and wall thickness. Additionally, the NRC staff notes that the 25 milligrams explosive limit is a long-standing limit discussed in Regulatory Guide 2.2, "Development of Technical Specifications for Experiments in Research Reactors," issued November 1973. Because the 25 milligrams limit was analyzed in the OSTR Renewal SAR and the NRC staff concluded previously in the License Renewal SER that the 25 milligrams explosive limit is safe, the NRC staff finds this change to TS 3.8.2.a is acceptable.

<u>TS 3.8.3, "Failures and Malfunctions"</u>

The current TS 3.8.3 states:

> <u>Objective</u>. The objective is to prevent damage to the reactor or excessive release of radioactive materials in the event of an experiment failure.
>
> <u>Specifications</u>. Where the possibility exists that the failure of an experiment under normal operating conditions of the experiment or reactor, credible accident conditions in the reactor, or possible accident conditions in the experiment could release radioactive gases or aerosols to the reactor bay or the unrestricted area, the quantity and type of material in the experiment shall be limited such that the airborne radioactivity in the reactor bay or the unrestricted area will not result in exceeding the applicable dose limits in 10 CFR 20, assuming that:
>
> a. 100% of the gases or aerosols escape from the experiment;
>
> b. Each experiment containing fissile material shall be controlled such that the total inventory of I-131 escaping from the experiment shall not exceed 0.0141 curies;
>
> c. If the effluent from an irradiation facility exhausts through a holdup tank which closes automatically on high radiation level, at least 10% of the gaseous activity or aerosols produced will escape;
>
> d. If the effluent from an irradiation facility exhausts through a filter installation designed for greater than 99% efficiency for 0.3 micron particles, at least 10% of these aerosols can escape; and
>
> e. For materials whose boiling point is above 130 °F and where vapors formed by boiling this material can escape only through an undisturbed column of water above the core, 10% of these vapors can escape.

The proposed TS 3.8.3 states:

> <u>Objective</u>. The objective is to prevent ~~damage to the reactor or~~ excessive release of radioactive materials in the event of an experiment failure.
>
> <u>Specifications</u>. Where the possibility exists that the failure of an experiment under normal operating conditions of the experiment or reactor, credible accident conditions in the reactor, or possible accident conditions in the experiment could release radioactive gases

or aerosols to the reactor bay or the unrestricted area, the quantity and type of material in the experiment shall be limited such that the airborne radioactivity in the reactor bay or the unrestricted area will not result in exceeding the applicable dose limits in 10 CFR 20, assuming that:

a. 100% of the gases or aerosols escape from the experiment;

b. Each experiment containing fissile material shall be controlled such that the total inventory of ~~I-131~~ **^{131}I** escaping from the experiment shall not exceed 0.0141 curies;

c. If the effluent from an irradiation facility exhausts through a holdup tank ~~which~~ **that** closes automatically on high radiation level, at least 10% of the gaseous activity or aerosols produced will escape;

d. If the effluent from an irradiation facility exhausts through a filter installation designed for greater than 99% efficiency for 0.3 micron particles, at least 10% of these aerosols can escape; and

e. For materials whose boiling point is above 130°F and where vapors formed by boiling this material can escape only through an undisturbed column of water above the core, 10% of these vapors can escape.

The licensee proposes to delete “damage to the reactor or” in the objective of TS 3.8.3 because the specifications address releases but do not contain any specifications that prevent damage to the reactor. The NRC staff reviewed the proposed change to TS 3.8.3 and determined that the change adequately describes the purpose of TS 3.8.3 to specify the quantity and type of material in the experiment to be limited such that the airborne radioactivity in the reactor bay or the unrestricted area will not result in exceeding the applicable dose limits in 10 CFR Part 20. Because the proposed change adequately describes the purpose of TS 3.8.3, the NRC staff finds this change to TS 4.3 is acceptable.

The licensee proposes to change “I-131” to “^{131}I” in TS 3.8.3.b for consistency throughout the TSs. The NRC staff finds that the proposed change is a standard format to identify iodine-131 and that the change is editorial. Therefore, the NRC staff finds this change to TS 3.8.3.b is acceptable.

The licensee proposes to replace “which” with “that” in TS 3.8.3.c to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the change does not alter the TS 3.8.3.c assumption that if an effluent from an irradiation facility exhaust through a holdup tank closes automatically, at least 10 percent of the gaseous activity or aerosols will escape. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.8.3.c is acceptable.

The licensee proposes to remove a space between “130” and “°F” in TS 3.8.3.e. The NRC staff reviewed the proposed change to TS 3.8.3.e and determined the change does not alter the requirement for the material boiling point limit. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 3.8.3.e is acceptable.

TS 3.10.1, “Permissible In-Core Target Lattice Positions”

The current TS 3.10.1 states:

> Specification. Permissible target locations are core positions G32, G33, G34. Targets shall not be placed in any other core lattice positions.

The proposed TS 3.10.1 states:

> Specification**s**. Permissible target locations are core positions G32, G33, **and** G34. Targets shall not be placed in any other core lattice positions.

The licensee proposes to add a “s” to “Specification” in TS 3.10.1 for consistent formatting throughout the TSs. Additionally, the licensee proposes to add “and” to make a grammatical correction. The NRC staff reviewed the proposed changes and finds that the changes are editorial and do not alter the permissible target locations in the core. Therefore, the NRC staff finds the proposed changes to TS 3.10.1 acceptable.

TS 3.10.2, “Pulse or Square Wave Mode Operation with Targets Located in Any Core Lattice Positions”

The current TS 3.10.2 states:

> Objective. The objective is to prevent all pulse activity while targets are present in any core lattice position.
>
> Specification. The reactor shall not be operated in pulse mode or square wave mode while targets are present in any core lattice position.

The proposed TS 3.10.2 states:

> Objective. The objective is to prevent all pulse **and square wave** activity while targets are present in any core lattice position.
>
> Specification**s**. The reactor shall not be operated in pulse mode or square wave mode while targets are present in any core lattice position.

The licensee proposes to add “and square wave” to the objective of TS 3.10.2 to prevent square wave mode of operation while targets are present in any core lattice position. The NRC staff reviewed the proposed change and finds that adding “and square wave” to the objective of TS 3.10.2 makes the objective consistent with the specification that requires the reactor not to be operated in square wave mode while targets are present in any core lattice. Because the proposed change adequately describes the purpose of TS 3.10.2, the NRC staff finds this change to TS 4.3 is acceptable

Additionally, the licensee proposes to add a “s” to “Specification” in TS 3.10.2 for consistent formatting throughout the TSs. The NRC staff reviewed the proposed change to TS 3.10.2 and finds that the proposed change is editorial and therefore is acceptable.

TS 3.10.3, "Allowed Target Storage Locations"

The licensee proposes to add a "s" to "Specification" in TS 3.10.3 for consistent formatting throughout the TSs. The NRC staff reviewed the proposed change to TS 3.10.3 and finds that the proposed change is editorial and therefore is acceptable.

TS 3.10.4, "Target Fabrication Requirements"

The licensee proposes to add a "s" to "Specification" in TS 3.10.4 for consistent formatting throughout the TSs. The NRC staff reviewed the proposed change to TS 3.10.4 and finds that the proposed change is editorial and therefore is acceptable.

TS 3.10.5, "Mo-99 Target Irradiation"

The current TS 3.10.5 states:

> Applicability. This specification applies to the irradiation of Mo-99 demonstration targets.
>
> Objective. The objective is to ensure that the time that the Mo-99 demonstration targets are irradiated is limited by reactor power history.
>
> Specification. The Mo-99 demonstration targets shall be irradiated in a core lattice position for no more than 7.15-MW days (MWD).

The proposed TS 3.10.5 states:

> Applicability. This specification applies to the irradiation of ~~Mo-99~~ **^{99}Mo** demonstration targets.
>
> Objective. The objective is to ensure that the time that the ~~Mo-99~~ **^{99}Mo** demonstration targets are irradiated is limited by reactor power history.
>
> Specification**s**. The ~~Mo-99~~ **^{99}Mo** demonstration targets shall be irradiated in a core lattice position for no more than 7.15-MW days (MWD).

The licensee proposes to change "Mo-99" to "^{99}Mo" and add an "s" to "Specification" in TS 3.10.5 to make the OSTR TS format consistent. The NRC staff notes the ^{99}Mo is a recognizable and standard format to identify molybdenum-99. The NRC staff reviewed this proposed change and finds the change does to do not alter TS 3.10.5 that limits target irradiation to no more than 7.15 megawatt-days and, therefore, is an editorial change. Further, the NRC staff determined that adding a "s" to "Specification" is an editorial change. Because these proposed changes are editorial, the NRC staff finds these changes to TS 3.10.5 are acceptable.

3.5.4 TS 4. “Surveillance Requirements”

TS 4.0, “General”

The current TS 4.0 states:

Applicability. This specification applies to the surveillance requirements of any system related to reactor safety.

Objective. The objective is to verify the proper operation of any system related to reactor safety.

Specifications.

a. Surveillance requirements may be deferred during reactor shutdown (except Technical Specifications 4.3.a and 4.3.e); however, they shall be completed prior to reactor startup unless reactor operation is required for performance of the surveillance. Such surveillance shall be performed as soon as practicable after reactor startup. Scheduled surveillance, which cannot be performed with the reactor operating, may be deferred until a planned reactor shutdown.

b. Any additions, modifications, or maintenance to the ventilation system, the core and its associated support structure, the pool or its penetrations, the pool coolant system, the rod drive mechanism or the reactor safety system shall be made and tested in accordance with the specifications to which the systems were originally designed and fabricated or to specifications reviewed by the Reactor Operations Committee. A system shall not be considered operable until after it is successfully tested.

The proposed TS 4.0 states:

Applicability. This specification applies to ~~the~~ **all** surveillance requirements ~~of any system related to~~ **for required** reactor ~~safety~~ **systems**.

Objective. The objective is to ~~verify the proper operation of any system related to reactor safety~~ **ensure that all required reactor systems are operable when the reactor is operating**.

Specifications.

a. Surveillance requirements may be deferred during reactor shutdown (except Technical Specifications 4.3.a and 4.3.e); however, they shall be completed prior to reactor startup unless reactor operation is required for performance of the surveillance. Such surveillance shall be performed as soon as practicable after reactor startup. Scheduled surveillance~~, which~~ **that** cannot be performed with the reactor operating~~,~~ may be deferred until a planned reactor shutdown.

b. Any additions, modifications, or maintenance to the ventilation system, the core and its associated support structure, the pool or its penetrations,

> the pool coolant system, the rod drive mechanism, or the reactor safety systems shall be made and tested in accordance with the specifications to which the systems were originally designed and fabricated or to specifications reviewed by the Reactor Operations Committee. A system shall not be considered operable until after it is successfully tested.

The licensee proposes to replace “the” with “all” in the applicability of TS 4.0 to specify that that the requirements of TS 4.0.a and b apply to all surveillance requirements. Further, the licensee proposes to replace “of any system related to reactor safety” with “for required reactor systems” because the term “related to reactor safety” is not clearly defined. ANSI/ANS-15.1-2007, Section 1.2.2, “Format,” states that the TS applicability is a statement that indicates which components are involved and when they are involved.

The NRC staff reviewed the proposed change to the applicability of TS 4.0 and finds that the change to replace “the” with “all” specifies that the requirements of TS 4.0.a and TS 4.0.b apply to all surveillance requirements in Section 4 of the OSTR TS. TS 4.0.a requires that certain surveillance requirements be deferred depending on the reactor operating condition (i.e., operating, shutdown) and specifies when the surveillance must be completed. TS 4.0.b requires that changes to certain reactor systems are controlled to their original design and fabrication specifications and that any new specifications are reviewed by the Reactor Operations Committee. Because the proposed change adequately describes which surveillance requirements apply to TS 4.0 and is, therefore, consistent with the guidance in ANSI/ANS-15.1-2007, the NRC staff finds this change to the applicability of TS 4.0 acceptable.

The NRC staff reviewed the proposed change to the applicability of TS 4.0 and finds that the change to replace “of any system related to reactor safety” with “for required reactor systems” specifies which components are involved in TS 4.0. The NRC staff finds that the proposed change clarifies that the required reactor systems, as specified in the OSTR TS, are applicable to TS 4.0.a and TS 4.0.b. Because the proposed change adequately specifies which components apply to TS 4.0 and is, therefore, consistent with the guidance in ANSI/ANS-15.1-2007, the NRC staff finds this change to the applicability of TS 4.0 is acceptable.

The licensee proposes to replace “verify the proper operation of any system related to reactor safety” with “ensure that all required reactor systems are operable when the reactor is operating” in the objective of TS 4.0 to include terms that are defined in Section 1, “Definitions,” of the OSTR TS. The NRC staff reviewed the definition of “Operable” in Section 3.5 of this SE and concluded the definition is acceptable. ANSI/ANS-15.1-2007, Section 1.2.2, “Format,” states that the objective is a statement that indicates the purpose of the specifications. The NRC staff reviewed this proposed change to the objective of TS 4.0 and finds that the changes adequately describe the purpose of TS 4.0.a and TS 4.0.b. Because the proposed change adequately describes the purpose of TS 4.0 and is consistent with ANSI/ANS-15.1-2007, the NRC staff finds this change to TS 4.0 is acceptable.

The licensee proposes to replace “, which” with “that” in the objective of TS 4.0.a to correct word usage. The NRC staff reviewed the proposed change and determined the change does not alter TS 4.3.a that scheduled surveillances may be deferred until a planned reactor shutdown water level and water temperature monitoring systems are operating. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.0.a is acceptable.

The licensee proposes to add a comma (,) after "rod drive mechanism" in TS 4.0.b to make a grammatical correction. The NRC staff reviewed this proposed change and determined the change corrects a punctuation error that does not alter the surveillance requirement of TS 4.0.b that requires additions, modifications, or maintenance to certain reactor systems are conducted and tested in accordance with original design and fabrication specifications or to specifications reviewed by the Reactor Operations Committee. The NRC staff concludes this proposed change is editorial and increases clarity. Therefore, the NRC staff finds this change to TS 4.0.a is acceptable.

The licensee proposes to add a "s" to "reactor safety system" in TS 4.0.b to clarify the reactor has multiple safety systems. Reactor safety systems is defined by the OSTR TS 1.19, "Reactor Safety Systems," as those systems, including their associated input channels that are designed to initiate a reactor scram for protecting the reactor. Because the proposed change is for consistency with a defined term in the OSTR TS, the NRC staff finds this change to TS 4.0.b is acceptable.

<u>TS 4.1, "Reactor Core Parameters"</u>

The current TS 4.1. states:

> <u>Objective</u>. The objective is to verify that the reactor does not exceed the authorized limits for power, shutdown margin, core excess reactivity, specifications for fuel element condition and verification of the total reactivity worth of each control rod.

The proposed TS 4.1 states:

> <u>Objective</u>. The objective is to verify that the reactor does not exceed the authorized limits for power, shutdown margin, **and** core excess reactivity~~,~~**; to verify that** specifications for fuel element condition **are met;** and ~~verification of~~ **to verify** the total reactivity worth of each control rod.

The licensee proposes several changes to the objective of TS 4.1 to make grammatical corrections and for clarity. The licensee proposes changes to the following:

- Add an "and" before core excess reactivity
- Remove a comma (,) and add "; to verify that" before specifications for fuel element condition
- Add "are met;" after fuel element condition
- Remove "verification of" and add "to verify" before the total reactivity worth of each control rod

ANSI/ANS-15.1-2007, Section 1.2.2, "Format," states that the objective is a statement that indicates the purpose of the specifications. TS 4.1 applicability states that these specifications apply to the surveillance requirements for the reactor core parameters. The specifications of TS 4.1 require surveillances for the power level monitoring channel, control rod reactivity worth, shutdown margin, core excess reactivity, and fuel element inspection. The NRC staff reviewed the proposed changes and determined the changes adequately describe the purpose of TS 4.1 to ensure that certain reactor core parameters and conditions are verified by performing the surveillance requirements specified in TS 4.1 a through e. Because the proposed changes

adequately describe the purpose of TS 4.1 and are consistent with ANSI/ANS-15.1-2007, the NRC staff finds these changes to the objective of TS 4.1 acceptable.

<u>TS 4.2, "Reactor Control and Safety Systems"</u>

The current TS 4.2 states:

> <u>Objective</u>. The objective is to verify performance and operability of those systems and components which are directly related to reactor safety.
>
> <u>Specifications</u>.
>
> a. The control rods and drives shall be visually inspected for damage or deterioration biennially.
>
> b. The scram time shall be measured annually.
>
> c. The transient rod drive cylinder and associated air supply system shall be inspected, cleaned and lubricated as necessary, semi-annually.
>
> d. A channel check of each of the reactor safety system channels for the intended mode of operation shall be performed prior to each day's operation or prior to each operation extending more than one day.
>
> e. A channel test of each item in Table 2 and 3 in section 3.2.3 shall be performed semi-annually.

The proposed TS 4.2 states:

> <u>Objective</u>. The objective is to verify performance and operability of those systems and components ~~which~~ **that** are directly related to reactor safety.
>
> <u>Specifications</u>.
>
> a. The control rods and drives shall be visually inspected for damage or deterioration biennially.
>
> b. The scram time shall be measured annually.
>
> c. The transient rod drive cylinder and associated air supply system shall be inspected, cleaned**,** and lubricated as necessary, semi-annually.
>
> d. A channel check of each of the reactor safety system channels for the intended mode of operation shall be performed prior to each day's operation or prior to each operation extending more than one day.
>
> e. A channel test of each item in Table 2 ~~and 3~~ in section 3.2.3 **and Table 3 in section 3.2.4** shall be performed semi-annually.

The licensee proposes to replace "which" with "that" in the objective of TS 4.2 to correct word usage. The NRC staff reviewed the proposed change and finds that the change does not alter the existing objective of TS 4.2 to verify performance and operability of systems and

components that are related to reactor safety. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.2 is acceptable.

The licensee proposes to add a comma (,) after "cleaned" in TS 4.2.c to make a grammatical correction. The NRC staff reviewed this proposed change and determined the punctuation change increases clarity and does not alter the surveillance requirement of TS 4.2.c that requires the transient rod drive cylinder and its air supply system be inspected, cleaned, and lubricated semiannually. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.2.c is acceptable.

The licensee proposes to remove "and 3" that refers to Table 3, "Minimum Interlocks," of TS 3.2.3 and adding" and Table 3 in section 3.2.4" because the table was relocated from TS 3.2.3 to a newly proposed TS 3.2.4. The NRC staff reviewed the proposed TS 3.2.4, in Section 3.3 of this SE and determined it is acceptable. The NRC staff concludes this proposed conforming change continues to reference the interlocks requiring a semiannual channel test. Because the proposed change continues to reference the interlock requiring a semiannual channel test, the NRC staff finds this change is acceptable.

TS 4.3, "Reactor Primary Tank Water"

The current TS 4.3 states:

> Objective. The objective is to assure that the reactor tank water level and the bulk water temperature monitoring systems are operating, and to verify appropriate alarm settings.

The proposed TS 4.3 states:

> Objective. The objective is to ~~assure~~ **ensure** that the reactor tank water level and ~~the bulk~~ **reactor tank** water temperature monitoring systems are operating~~, and~~ to verify appropriate alarm ~~settings~~ **systems, and to verify that the reactor water conductivity is within the limit**.

The licensee proposes to replace "assure" with "ensure" in the objective of TS 4.3 to correct word usage. The NRC staff reviewed the proposed change and determined the change does not alter the existing objective of TS 4.3 that the reactor tank water level and water temperature monitoring systems are operating. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.3 is acceptable.

The licensee proposes to replace "the bulk" with "reactor tank" in the objective of TS 4.3 for clarity to prevent confusion between the bulk shield tank and the reactor tank. ANSI/ANS-15.1-2007, Section 1.2.2, "Format," states that the objective is a statement that indicates the purpose of the specifications. The NRC staff notes that TS 4.3 applicability states that these specifications apply to the surveillance requirements for the reactor tank water. The NRC staff reviewed the proposed change and finds that the change adequately describes the purpose of TS 4.3 to ensure that the reactor tank water level and temperature monitoring systems are operating and is, therefore, consistent with the guidance provided in ANSI/ANS-15.1-2007, Section 1.2.2. Because the proposed change adequately describes the

purpose of TS 4.3 and is consistent with ANSI/ANS-15.1-2007, the NRC staff finds this change to TS 4.3 is acceptable.

The licensee proposes to replace “and to verify appropriate alarm settings” with “to verify appropriate alarm systems, and to verify that the reactor water conductivity is within the limit” to include the requirements to monitor conductivity. TS 4.3, specifications a through d, are surveillance requirements to verify the reactor tank water level and temperature monitoring systems are operating. TS 4.3, specification e, requires the reactor tank water conductivity be measured monthly. The NRC staff reviewed these proposed changes and finds that these changes adequately describe the purpose for the surveillance requirements specified in TS 4.3, specifications a through e and is, therefore, consistent with the guidance provided in ANSI/ANS-15.1-2007, Section 1.2.2. Because the proposed change adequately describes the purpose of TS 4.3 and is consistent with ANSI/ANS-15.1-2007, the NRC staff finds this change to TS 4.3 is acceptable.

TS 4.5, “Ventilation System”

The current TS 4.5 states:

> Objective. The objective is to assure the proper operation of the ventilation system in controlling releases of radioactive material to the unrestricted area.

The proposed TS 4.5 states:

> Objective. The objective is to ~~assure~~ **ensure** the proper operation of the ventilation system in controlling releases of radioactive material to the unrestricted area.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 4.5 to correct word usage. The NRC staff reviewed the proposed change and determined the change does not alter the existing objective of TS 4.5 for the proper operation of the ventilation system in controlling releases of radioactive material to the unrestricted area. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.7 is acceptable.

TS 4.7, “Radiation Monitoring System”

The current TS 4.7 states:

> Objective. The objective is to assure that the radiation monitoring equipment is operating properly and to verify the appropriate alarm settings.

The proposed TS 4.7 states:

> Objective. The objective is to ~~assure~~ **ensure** that the radiation monitoring equipment is operating properly and to verify the appropriate alarm settings.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 4.7 to correct word usage. The NRC staff reviewed this proposed change and determined the change does not alter the objective of TS 4.7 that the radiation monitoring equipment is operating properly and verifying the alarm settings. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.7 is acceptable.

<u>TS 4.8, "Experimental Limits"</u>

The current TS 4.8 states:

> <u>Objective</u>. The objective is to prevent the conduct of experiments which may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.
>
> <u>Specifications</u>.
>
> a. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before reactor operation with said experiment.
>
> b. An experiment shall not be installed in the reactor or its irradiation facilities unless a safety analysis has been performed and reviewed for compliance with Section 3.8 by the Reactor Operations Committee in full accord with Section 6.2.3 of these Technical Specifications, and the procedures which are established for this purpose.

The proposed TS 4.8 states:

> <u>Objective</u>. The objective is to prevent the ~~conduct~~ **performance** of experiments ~~which~~ **that** may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.
>
> <u>Specifications</u>.
>
> a. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before reactor operation with said experiment.
>
> b. An experiment shall not be installed in the reactor or its irradiation facilities unless a safety analysis has been performed and reviewed for compliance with Section 3.8 by the Reactor Operations Committee in full accord with Section 6.2.3 ~~of these Technical Specifications~~, and the procedures ~~which~~ **that** are established for this purpose.

The licensee proposes to replace "conduct" with "performance" in the objective of TS 4.8 to correct word usage for increased clarity. Additionally, the licensee proposes to replace "which" with "that" in the objective of TS 4.8 to introduce a restrictive clause. The NRC staff reviewed the proposed changes and determined that the objective continues to adequately describe the surveillance requirement for experiments installed in the reactor and its irradiation facilities. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to the objective of TS 4.8 are acceptable.

The licensee proposes to remove "of these Technical Specifications" in TS 4.8.b to remove a redundant phrase. The NRC staff reviewed the proposed change and determined the change does not alter the surveillance requirement that a safety analysis is performed and reviewed by

the Reactor Operations Committee. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.8.b is acceptable.

The licensee proposes to replace “which” with “that” in TS 4.8.b to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the change does not alter the surveillance requirement to establish procedures for the review of experiments to ensure the requirements of TS Section 3.8, “Experiments,” are met. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 4.8.b is acceptable.

3.5.5 TS 5.0 “Design Features”

TS 5.1, “Site and Facility Description”

The licensee proposes to add two registered trademark symbols (®) after “TRIGA” in TS 5.1 to make TS formatting consistent. The NRC staff reviewed this proposed change and determined the change adding a registered trademark symbol does not alter any design features of TS 5.1. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds these changes to TS 5.1 are acceptable.

TS 5.2, “Reactor Coolant System”

The current TS 5.2 states:

> Objective. The objective is to assure that coolant water shall be available to provide adequate cooling of the reactor core and adequate radiation shielding.
>
> Specifications.
>
> a. The reactor core shall be cooled by natural convective water flow.
>
> b. The tank water inlet and outlet pipes to the heat exchanger and to the demineralizer shall be equipped with siphon breaks not less than 14 feet above the top of the core.
>
> c. A tank water level alarm shall be provided to indicate loss of coolant if the tank level drops 6 inches below normal level.
>
> d. A bulk tank water temperature alarm shall be provided to indicate high bulk water temperature if the temperature exceeds 120°F (49°C).

The proposed TS 5.2 states:

> Objective. The objective is to ~~assure~~ **ensure** that coolant water shall be available to provide adequate cooling of the reactor core and adequate radiation shielding.
>
> Specifications.
>
> a. The reactor core shall be cooled by natural convective water flow.

b. The tank water inlet and outlet pipes to the heat exchanger and to the demineralizer shall be equipped with siphon breaks not less than 14 feet above the top of the core.

c. A tank water level alarm shall be provided to indicate loss of coolant if the tank level drops **more than** 6 inches below normal level.

d. A ~~bulk~~ tank water temperature alarm shall be provided to indicate high ~~bulk~~ water temperature if the temperature exceeds ~~120°F (49°C)~~ **49°C (120°F)**.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 5.2 to correct word usage. The NRC staff reviewed this proposed change and determined that the proposed change does not alter the objective of TS 5.2 to provide adequate reactor core cooling and radiation shielding. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.2 is acceptable.

The licensee proposes to add “more than” to describe the tank water level alarm limit because the basis for the water alarm limit of no more than 6 inches provides a timely warning to the reactor operator. The NRC staff notes reactor water level is controlled to provide a minimum level of radiation shielding and that the alarm alerts the reactor operator to take appropriate action, such as shutting down the reactor and responding to the cause of the water level decrease. The NRC staff reviewed the proposed change and determined that the proposed change to require an alarm at more than 6 inches below normal tank level continues to notify the reactor operator in a timely manner to take appropriate action to ensure adequate radiation shielding. Because the reactor tank water level alarm continues to alert the operator in a timely manner, the NRC staff finds this change to TS 5.2.c is acceptable.

The licensee proposes to remove “bulk” to describe the tank water temperature alarm in TS 5.2.d to avoid confusion between the bulk shield tank and the reactor tank. The NRC staff reviewed this proposed change and determined the change that does not alter the design feature to require a water temperature alarm in the reactor tank to alarm if the temperature exceeds 120 °C (49 °C). Because the change does not alter the design feature requiring a temperature alarm in the reactor tank, the NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.2 is acceptable.

The licensee proposes to switch the order of the temperature limit in TS 5.2.d to indicate that the binding temperature limit is in degrees Celsius. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.2.d is acceptable.

TS 5.3.1, “Reactor Core”

The current TS 5.3.1 states:

Objective. The objective is to assure that provisions are made to restrict the arrangement of fuel elements and experiments so as to provide assurance that excessive power densities shall not be produced.

Specifications.

a. The core assembly shall consist of TRIGA® fuel elements.

b. The fuel shall be arranged in a close-packed configuration except for single element positions occupied by in-core experiments, irradiation facilities, graphite dummies, aluminum dummies, stainless steel dummies, control rods, and startup sources.

The proposed TS 5.3.1 states:

Objective. The objective is to ~~assure~~ **ensure** that provisions are made to restrict the arrangement of fuel elements and experiments so as to provide assurance that excessive power densities shall not be produced.

Specifications.

a. The core assembly shall consist of TRIGA® fuel elements.

b. The fuel shall be arranged in a close-packed configuration except for single element positions occupied by in-core experiments, irradiation facilities, graphite ~~dummies~~ **reflector elements**, aluminum dummies, ~~stainless steel dummies,~~ control rods, and startup sources.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 5.3.1 to correct word usage. The NRC staff reviewed this proposed change and determined that the change does not alter the objective of TS 5.3.1 to restrict the arrangement of fuel elements and experiments to limit power density. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.3.1 is acceptable.

The licensee proposes to change graphite “dummies” to “reflector elements” in TS 5.3.1.b to clarify the wording of the core configuration. In its review and evaluation of this proposed TS 5.3.1.b change, the NRC staff used pertinent information in the OSTR fuel conversion safety analysis report (SAR) dated November 6, 2007 (ADAMS Accession No. ML080420546), as supplemented by letters dated February 11, 2008 (ADAMS Accession No. ML080730057), and June 20, 2008 (ADAMS Accession No. ML082350345).

The NRC staff documented its review of the OSTR’s SAR in the NRC safety evaluation report (SER) on the conversion of the OSTR from highly-enriched uranium (HEU) to low-enriched uranium (LEU) fuel, which was appended to the letter, “Issuance of Order Modifying License No. R-106 to Convert from High- to Low-Enriched Uranium Fuel (Amendment No. 22) – Oregon State University TRIGA Reactor (TAC No. MD7360),” dated September 4, 2008 (ADAMS Accession No. ML082390775). The NRC staff reviewed the OSTR conversion SAR, Table 4-1, “Core Components for HEU FLIP and LEU 30/30 Core,” that indicates the OSTR LEU reactor core will contain stainless steel graphite reflector elements. The NRC’s conversion SER states in Section 2.1, “Summary of Reactor Facility Changes,” that aluminum clad graphite reflector assemblies will be replaced as part of the conversion with stainless-steel clad graphite reflector elements. In reviewing both OSU’s conversion SAR and the NRC’s conversion SER, the NRC staff could not find the term graphite dummies except as specified in TS 5.3.1.b. In reviewing OSU’s SAR and the NRC’s SER, the NRC staff concludes that graphite dummies stated in TS 5.3.1.b are the same component as the graphite reflector elements as stated in OSTR’s conversion SAR and the NRC’s conversion SER. Because graphite dummies are the same component in the core as the graphite reflector elements, the NRC staff finds this change to TS 5.3.1.b is acceptable.

The licensee proposes to remove “stainless steel dummies” in TS 5.3.1.b because the OSTR no longer utilizes stainless steel dummies. The NRC staff reviewed this proposed change using the information in the OSTR SAR, Section 1.3, “General description of the Facility,” that states significant features of the reactor include irradiation facilities such as sample holding dummy fuel elements. The NRC’s license renewal SER “Safety Evaluation Report Related to the Renewal of the Operating License for the TRIGA Reactor at the Oregon State University” (ADAMS Accession No. ML082540035), Section 4.1, “Summary Description,” states that the OSTR has a number of different irradiation facilities including five sample-holding (dummy) fuel elements for special in-core irradiations. Neither the OSTR SAR nor NRC SER identify the material composition of the dummy fuel elements. Additionally, the NRC’s SER, Section 4.5.1, “Normal Operating Conditions,” states that TS 5.3.1.b will control water holes in the reactor core to control power peaking in fuel elements. The NRC staff finds that proposed TS 3.5.1.b continues to control water holes, using graphite and aluminum dummies, to limit power peaking in fuel elements. Because the use of graphite and aluminum dummies will control water holes in the reactor core, thereby continuing to limit power peaking in the fuel elements, the NRC staff finds this change to TS 5.3.1.b is acceptable.

<u>TS 5.3.2, “Control Rods”</u>

The current TS 5.3.2 states:

> <u>Objective</u>. The objective is to assure that the control rods are of such a design as to permit their use with a high degree of reliability with respect to their physical and nuclear characteristics.
>
> <u>Specifications</u>.
>
> a. The shim, safety, and regulating control rods shall have scram capability and contain borated graphite, B4C powder or boron, with its compounds in solid form as a poison, in aluminum or stainless steel cladding. These rods may incorporate fueled followers which have the same characteristics as the fuel region in which they are used.
>
> b. The transient control rod shall have scram capability and contain borated graphite or boron, with its compounds in a solid form as a poison in an aluminum or stainless steel cladding. The transient rod shall have an adjustable upper limit to allow a variation of reactivity insertions. This rod may incorporate an aluminum- or air-follower.

The proposed TS 5.3.2 states:

> <u>Objective</u>. The objective is to ~~assure~~ **ensure** that the control rods are of such a design as to permit their use with a high degree of reliability with respect to their physical and nuclear characteristics.

Specifications.

a. The shim, safety, and regulating control rods shall have scram capability and contain borated graphite, B4C powder**,** or boron, with its compounds in solid form as a poison, in aluminum or stainless steel cladding. These rods may incorporate fueled followers ~~which~~ **that** have the same characteristics as the fuel region in which they are used.

b. The transient control rod shall have scram capability and contain borated graphite or boron, with its compounds in a solid form as a poison in an aluminum or stainless steel cladding. The transient rod shall have an adjustable upper limit to allow a variation of reactivity insertions. This rod may incorporate an aluminum or air follower.

The licensee proposes to replace “assure” with “ensure” in the objective of TS 5.3.2 to correct word usage. The NRC staff reviewed this proposed change and determined that the change does not alter the objective of TS 5.3.2 describing the physical and nuclear characteristics of the control rods. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.3.2 is acceptable.

The licensee proposes to add a comma (,) after “powder” in TS 5.3.2.a to make a grammatical correction. The NRC staff reviewed this proposed punctuation change and determined the change increases clarity and does not alter the design feature that TS 5.3.2.a requires the shim, safety, and regulating control rods to contain borated graphite, boron-carbide (B_4C) powder, or boron. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.3.2.a is acceptable.

The licensee proposes to replace “which” with “that” in TS 5.3.2.a to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the proposed change does not alter the design feature that the shim, safety, and regulating rod may incorporate fuel followers having the same characteristics as the fuel region. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.3.2.a is acceptable.

Additionally, the license proposes to remove hyphens (-) in “aluminum- or air-follower” in TS 5.3.2.b to make a grammatical correction. The NRC staff reviewed this proposed change and determined the change corrects a punctuation error that does not alter the design feature of the transient rod to incorporate an aluminum or air follower in TS 5.3.2.b. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 5.3.2.b are acceptable.

TS 5.3.3, “Reactor Fuel”

The licensee proposes to change the specification bullet formatting from numerical to alphabetical in TS 5.3.3 to make TS formatting consistent. The NRC staff reviewed this proposed change to and determined that this formatting change does not alter the design feature of TS 5.3.3 that describes the characteristics of unirradiated fuel elements. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 5.3.3 are acceptable.

TS 5.4, "Fuel Storage"

The current TS 5.4 states:

> Objective. The objective is to assure that fuel which is being stored shall not become critical and shall not reach an unsafe temperature.
>
> Specifications.
>
> a. All fuel elements shall be stored in a geometrical array where the k-effective is less than 0.9 for all conditions of moderation.
>
> b. Irradiated fuel elements and fuel devices shall be stored in an array which will permit sufficient natural convection cooling by water or air such that the temperature of the fuel element or fueled device will not exceed the safety limit.

The proposed TS 5.4 states:

> Objective. The objective is to ~~assure~~ **ensure** that fuel ~~which~~ **that** is being stored shall not become critical and shall not reach an unsafe temperature.
>
> Specifications.
>
> a. All fuel elements shall be stored in a geometrical array where the k-effective ~~is less than~~ **does not exceed** 0.9 for all conditions of moderation **and reflection**.
>
> b. Irradiated fuel elements and fuel devices shall be stored in an array ~~which~~ **that** will permit sufficient natural convection cooling by water or air such that the temperature of the fuel element or fuel~~ed~~ device will not exceed the safety limit.

The licensee proposes to replace "assure" with "ensure" in the objective of TS 5.4 to correct word usage. Additionally, the licensee proposes to replace "which" with "that" in the to introduce a restrictive clause. The NRC staff reviewed these proposed changes and determined that the changes increase clarity and do not alter the objective of TS 5.4 describing the storage of fuel. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 5.4 are acceptable.

The licensee proposes to replace "is less than" with "does not exceed" in TS 5.4.a to describe the k-effective limit for the storage of fuel elements. Further, the licensee proposes to add "and refection" to describe the fuel storage conditions. The licensee proposes these changes to be consistent with ANSI/ANS-15.1-2007, Section 5.4, "Fissionable material storage." The NRC staff reviewed these proposed changes using the guidance in NUREG-1537, Part 2, Section 5, Design Features" and ANSI/ANS-15.1-2007, Section 5.4. NUREG-1537, Part 1, Section 5, states that the NRC staff accepts the guidance in ANS/ANSI-15.1, Section 5. ANSI/ANS-15.1-2007 states that fuel not in the reactor core is required to be stored in a geometrical array with a k-effective of no greater than 0.90 for all conditions and reflection. The NRC staff notes that since the issuance of NUREG-1537 in 1996, ANSI/ANS-15.1-1990 was revised and the current version is ANSI/ANS-15.1-2007. The guidance in ANSI/ANS-15.1-1990,

Section 5.4, is identical to the guidance in ANSI/ANS-15.1-2007. The NRC staff finds that the storage of fuel with a k-effective of no greater than 0.9 for all conditions of reflection will continue to ensure that fuel elements are safely stored. Because these proposed changes to TS 5.4.a will continue to ensure that all fuel elements are stored in safe conditions and is consistent with the guidance in ANSI/ANS-15.1-2007, the NRC staff finds these changes acceptable.

The licensee proposes to replace "which" with "that" in TS 5.4.b to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined the change does not alter the design feature to prevent criticality of stored reactor fuel. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 5.4.b is acceptable.

3.5.6 TS 6 "Administrative Controls"

TS 6.1.2, "Responsibility"

The current TS 6.1.2 states:

The following specific organizational levels, and responsibilities shall exist:

a. Vice-President for Research (Level 1): The Vice-President for Research is responsible for university center and institute organizations representing Oregon State University.

b. Radiation Center Director (Level 2): The Radiation Center Director reports to the Vice-President for Research and is accountable for ensuring that all regulatory requirements, including implementation, are in accordance with all requirements of the USNRC and the Code of Federal Regulations.

c. Reactor Administrator (Level 3): The Reactor Administrator reports to the Radiation Center Director and is responsible for guidance, oversight, and technical support of reactor operations.

d. Senior Health Physicist (Level 3): The Senior Health Physicist reports to the Radiation Center Director and is responsible for directing the activities of health physics personnel, ADD including implementation of the radiation safety program.

The proposed TS 6.1.2 states:

The following specific organizational levels~~,~~ and responsibilities shall exist:

a. Vice President for Research (Level 1): The Vice-President for Research is responsible for university center and institute organizations representing Oregon State University.

b. Radiation Center Director (Level 2): The Radiation Center Director reports to the Vice-President for Research and is accountable for ensuring that all regulatory

requirements, including implementation, are in accordance with all requirements of the USNRC and the Code of Federal Regulations.

c. Reactor Administrator (Level 3): The Reactor Administrator reports to the Radiation Center Director and is responsible for guidance, oversight, and technical support of reactor operations.

d. Senior Health Physicist (Level 3): The Senior Health Physicist reports to the Radiation Center Director and is responsible for directing the activities of health physics personnel, including implementation of the radiation safety program.

The licensee proposes to remove a comma (,) after “levels” in TS 6.1.2 to make a grammatical correction. The NRC staff reviewed this proposed change and determined the change corrects a punctuation error that does not alter the administrative control of TS 6.1.2. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.1.2 is acceptable.

Additionally, the license proposes to remove a hyphen (-) in “Vice-President” in TS 6.1.2.a and TS 6.1.2.b to make a grammatical correction. The NRC staff reviewed this proposed change and determined the punctuation change does not alter the administrative control of TS 6.1.2.a and 6.1.2.b. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.1.2.a and TS 6.1.2.b are acceptable.

The licensee proposes to add a comma (,) after “personnel” in TS 6.1.2.d to make a grammatical correction. The NRC staff reviewed this proposed change and determined the change corrects a minor punctuation error that does not alter the administrative control of TS 6.1.2.d. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.1.2.d is acceptable.

<u>TS 6.1.2, “Figure 1 – Administrative Structure”</u>

The licensee proposes to add “Senior Reactor Operators” as Level 4 operating staff in TS 6.1.2, Figure 1, “Administrative Structure,” to correct an inconsistency with TS 6.1.2.f that includes senior reactor operators as Level 4 operating staff.

The current TS 6.1.2.f states:

f. Reactor Operator and Senior Reactor Operator (Level 4): The Reactor Operator and Senior Reactor Operator report to the Reactor Supervisor and are primarily involved in the manipulation of reactor controls, monitoring of instrumentation, and operation and maintenance of reactor related equipment.

The NRC staff evaluated the changes to TS 6.1.2, Figure 1 using the guidance in ANSI/ANS-15.1-2007, Section 6.1.1 that describes the Level 4 organization as the operating staff, such as senior reactor operators and reactor operators. The NRC staff finds that adding “Senior Reactor Operators” to the Level 4 organizational structure organizational structure in TS 6.1.2, Figure 1 is consistent with the guidance because Level 4 accurately describes the operating staff, the reporting lines of the Level 4 are unchanged, and senior reactor operators’ activities would continue to report to the reactor supervisor (Level 3). Because the changes to TS 6.1.2, Figure 1 are consistent with guidance and provide administrative controls relating to

organization, management, review, and reporting that are necessary to assure operation of the facility in a safe manner as required by 10 CFR 50.36(c)(5), the NRC staff finds the proposed change acceptable.

TS 6.1.3, “Staffing”

The current TS 6.1.3 states:

a. The minimum staffing when the reactor is operating shall be:

   1. A reactor operator or the Reactor Supervisor in the control room;

   2. A second person present in the Radiation Center Complex able to carry out prescribed instructions; and

   3. If neither of these two individuals is the Reactor Supervisor, the Reactor Supervisor shall be readily available on call. Readily available on call means an individual who:

      i. Has been specifically designated and the designation is known to the operator on duty;

      ii. Can be rapidly contacted by phone by the operator on duty; and

      iii. Is capable of getting to the reactor facility within a reasonable time under normal conditions (e.g., 30 minutes or within a 15-mile radius).

b. A list of reactor facility personnel by name and telephone number shall be readily available in the control room for use by the operator. The list shall include:

   1. Radiation Center Director

   2. Reactor Administrator

   3. Senior Health Physicist

   4. Any Licensed Reactor or Senior Reactor Operator

c. Events requiring the direction of the Reactor Supervisor:

   1. Initial startup and approach to power of the day;

   2. All fuel or control-rod relocations within the reactor core region;

The proposed TS 6.1.3 states:

a. The minimum staffing when the reactor is ~~operating~~ **not secured** shall be:

1. A reactor operator or the ~~Reactor Supervisor~~ **senior reactor operator on duty (Duty SRO**) in the control room;

2. A second person present in the Radiation Center Complex able to carry out prescribed instructions; and

3. If neither of these two individuals is the ~~Reactor Supervisor~~ **Duty SRO**, the ~~Reactor Supervisor~~ **Duty SRO** shall be readily available on call. Readily available on call means an individual who:

   i. Has been specifically designated and the designation is known to the operator on duty;

   ii. Can be rapidly contacted by phone by the operator on duty; and

   iii. Is capable of getting to the reactor facility within a reasonable time under normal conditions (e.g., 30 minutes or within a 15 mile radius).

b. A list of reactor facility personnel by name and telephone number shall be readily available in the control room for use by the operator. The list shall include:

1. Radiation Center Director

2. Reactor Administrator

3. Senior Health Physicist

4. Any Licensed Reactor or Senior Reactor Operator

c. Events requiring the direction of the ~~Reactor Supervisor~~ **Duty SRO**:

1. Initial startup and approach to power of the day;

2. All fuel or control rod relocations within the reactor core region;

The licensee proposes to change “operating” to “not secured” in TS 6.1.3 to align with the ANSI/ANS-15.1 definition. The NRC staff evaluated the change to TS 6.1.3.a using the guidance in ANSI/ANS-15.1-2007 (R2013), Section 6.1.3, “Staffing,” that states when the reactor is not secured there shall, at a minimum, be a licensed reactor operator in the control room. The licensee proposes a revision to the definition of “Reactor Secured” in Section 3.5 of this SE. The NRC staff concluded that the definition of “Reactor secured” was consistent with the guidance in ANSI/ANS-15.1-2007 (2013). The NRC staff finds that the proposed change to

replace “operating” with “not secured” is consistent with the guidance and continues to require a licensed operator be in the control room when the reactor is not secured. Therefore, the NRC staff finds this change to TS 6.1.3.a is acceptable.

The licensee proposes to change “Reactor Supervisor” to “senior reactor operator on duty (Duty SRO)” in TS 6.1.3 to correct terminology consistent with OSU’s procedures. The NRC staff evaluated the change to TS 6.1.3.a.1 using the guidance in ANSI/ANS-15.1-2007 (R2013), Section 6.1.3, “Staffing,” that states the minimum staffing when the reactor is not secured is that there shall be a licensed reactor operator in the control room. ANSI/ANS-15.1-2007 (R2013), Section 1.3, “Definitions,” defines senior reactor operator as an individual who is licensed to direct the activities of reactor operators and that the individual is also a reactor operator. The NRC staff finds that the proposed change to replace “Reactor Supervisor” with “senior reactor operator on duty (Duty SRO)” is consistent with the guidance and continues to require a licensed operator be in the control room when the reactor is not secured. Therefore, the NRC staff finds this change to TS 6.1.3.a.1 is acceptable.

The NRC staff evaluated the proposed change to TS 6.1.3.a.3 using the guidance in ANSI/ANS-15.1-2007 (R2013) Section 6.1.3, “Staffing.” Section 6.1.3.(1)(c) of the guidance states that the minimum staffing when the reactor is not secured is that there shall be a designated senior reactor operator that shall be readily available on call. The NRC staff finds that the proposed change is consistent with the guidance and the change continues to maintain the minimum staffing when the reactor is operating with a reactor operator in the control room and a second person present at the OSU Radiation Center that is not a senior reactor operator, that a senior reactor operator be readily available on call. Therefore, the NRC staff finds this change to TS 6.1.3.a.3 is acceptable.

The NRC staff evaluated the proposed change to TS 6.1.3.c using the guidance in ANSI/ANS-15.1-2007 (R2013) Section 6.1.3, “Staffing.” Section 6.1.3.(3) of the guidance states that events requiring the presence of the senior reactor operator at the facility are initial startup and approach to power, all fuel or control-rod relocations within the core region, relocation of any equipment with reactivity worth greater than 1 dollar (unit of reactivity), and recovery from unplanned or unscheduled shutdowns or significant power reduction. The NRC staff finds that the proposed change is consistent with the guidance and the change continues to require that a senior reactor operator direct events at the facility. Therefore, the NRC staff finds this change to TS 6.1.3.c is acceptable.

The license proposes to remove hyphens (-) in “15-mile” in TS 6.1.3.a.3.iii and in “control-rod” in TS 6.1.3.c to make grammatical corrections. The NRC staff reviewed these proposed changes and determined the change corrects minor punctuation errors that do not alter the administrative controls of TS 6.1.3. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.1.3.a.3.iii and TS 6.1.3.c are acceptable.

The licensee proposes to change the indentation of the specifications listed in TS 6.1.3.b to match the indentation of the specifications listed in TS 6.1.3.a and TS 6.1.3.c for consistency. The NRC staff concludes this proposed formatting change is editorial. Therefore, the NRC staff finds this change to TS 6.1.3.b is acceptable.

<u>TS 6.1.4, “Selection and Training of Personnel”</u>

The current TS 6.1.4 states:

> The selection, training and requalification of operations personnel should be in accordance with ANSI/ANS 15.4 – 1988; R1999, “Standard for the Selection and Training of Personnel for Research Reactors.”

The proposed TS 6.1.4 states:

> The selection, training**,** and requalification of operations personnel should be in accordance with ANSI/ANS 15.4 – ~~1988; R1999~~ **2016**, “Standard for the Selection and Training of Personnel for Research Reactors.”

The licensee proposes to add a comma (,) after “training” in TS 6.1.4 to make a grammatical correction. The NRC staff reviewed this proposed change and determined the change increases clarity and does not alter the administrative control of TS 6.1.4. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.1.4 is acceptable.

Additionally, the licensee proposes to change the referenced guidance in TS 6.1.4 from ANSI/ANS-15.4-1988; R1999 to ANSI/ANS-15.4-2016 to use the current standard. The NRC staff notes that TS 6.1.4 states that the selection, training, and requalification of operations personnel should be in accordance with ANSI/ANS-15.4-1988; R1999. TS 1.29, “Definitions,” states that the definition of “should” is used to denote a recommendation. NUREG-1537, Part 1, Appendix 14.1, Section 6.1.4, “Selection and Training of Personnel,” states that ANSI/ANS-15.4-1988 provides additional guidance for non-power reactors. The NRC staff finds that the administrative control for the selection, training, and requalification of operations personnel in accordance with ANSI/ANS-15.4-2016 would continue to help ensure safe operation of the facility. Therefore, the NRC staff finds that the proposed change to update the referenced guidance to ANSI/ANS-15.4-2016 in TS 6.1.4 is acceptable.

<u>TS 6.2, “Review and Audit”</u>

The current TS 6.2 states:

> The Reactor Operations Committee (ROC) shall have primary responsibility for review and audit of the safety aspects of reactor facility operations. Minutes, findings or reports of the ROC shall be presented to Level 1 and Level 2 management within ninety (90) days of completion.

The proposed TS 6.2 states:

> The Reactor Operations Committee (ROC) shall have primary responsibility for review and audit of the safety aspects of reactor facility operations. Minutes, findings**,** or reports of the ROC shall be presented to Level 1 and Level 2 management within ninety (90) days of completion.

The licensee proposes to add a comma (,) after “findings” in TS 6.2 to make a grammar correction. The NRC staff reviewed this proposed change and determined the change increases

clarity and does not alter the administrative control of TS 6.2. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.2 is acceptable.

<u>TS 6.2.1, “ROC Composition and Qualifications”</u>

The current TS 6.2.1 states:

> An ROC of at least five (5) members knowledgeable in fields which relate to reactor engineering and nuclear safety shall review and evaluate the safety aspects associated with the operation and use of the facility. The ROC shall be appointed by Level 1 management.

The proposed TS 6.2.1 states:

> An ROC of at least five (5) members knowledgeable in fields ~~which~~ **that** relate to reactor engineering and nuclear safety shall review and evaluate the safety aspects associated with the operation and use of the facility. The ROC shall be appointed by Level 1 management.

The licensee proposes to replace “which” with “that” in TS 6.2.1 to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the change to TS 6.2.1 does not alter the administrative control that requires the Reactor Oversight Committee (ROC) to consist of at least 5 members knowledgeable in reactor engineering and nuclear safety. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.2.1 is acceptable.

<u>TS 6.2.3, “ROC Review Function”</u>

The current TS 6.2.3, items a and c, state:

> The responsibilities of the ROC, or designated Subcommittee thereof, include, but are not limited to, the following:
>
> a. Review all changes made under 10 CFR 50.59
>
> c. Review of proposed changes to the technical specifications, license or charter;

The proposed TS 6.2.3, items a and c, state:

> The responsibilities of the ROC, or designated Subcommittee thereof, include, but are not limited to, the following:
>
> a. Review all changes made under 10 CFR 50.59**;**
>
> c. Review of proposed changes to the technical specifications, license**,** or charter;

The licensee proposes to add a semicolon (;) at the end of TS 6.2.3.a for consistency throughout the TSs. Additionally, the licensee proposes to add a comma (,) after “license” in TS 6.2.3.c to correct grammar. The NRC staff reviewed the proposed changes and finds the changes increase clarity and internal consistency in the TS and do not alter any administrative controls in TS 6.2.3. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.2.3 are acceptable.

TS 6.2.4, "ROC Audit Function"

The licensee proposes to capitalize the first word for each specification of TS 6.2.4 for consistency throughout the TSs. The NRC staff reviewed the proposed changes and determined the formatting changes increase internal consistency in the TS and do not alter the administrative controls of TS 6.2.4. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.2.4 are acceptable.

TS 6.3, "Radiation Safety"

The licensee proposes to change the version of guidance referenced in TS 6.3 from ANSI/ANS-15.11-1993; R2004 to ANSI/ANS 15.11-2016 to use the current standard. The NRC staff notes that TS 6.3 states the radiation safety program should use the guidance in ANSI/ANS-15.11-1993; R2004. TS 1.29, "Definitions," states that the definition of "should" is used to denote a recommendation. NUREG-1537, Part 1, Appendix 14.1, Section 6.3, "Radiation Safety," states that additional guidance for radiation safety program at non-power reactors may be found in ANSI/ANS-15.11. The NRC staff finds that the administrative control for recommending the use of the guidance in ANSI/ANS 15.11-2016 for the implementation of the radiation safety program would continue to help ensure adequate radiation protection at the facility. Therefore, the NRC staff finds that the proposed change to update the referenced guidance to ANSI/ANS-15.4-2016 in TS 6.3 is acceptable.

TS 6.4, "Procedures"

The current TS 6.4 states:

> Written operating procedures shall be adequate to assure the safety of operation of the reactor, but shall not preclude the use of independent judgment and action should the situation require such. Operating procedures shall be in effect for the following items:
>
> a. Startup, operation and shutdown of the reactor;
>
> b. Fuel loading, unloading, and movement within the reactor;
>
> c. Maintenance of major components of systems that could have an effect on reactor safety;
>
> d. Surveillance checks, calibrations, and inspections required by the technical specifications or those that have an effect on reactor safety;
>
> e. Radiation protection;
>
> f. Administrative controls for operations and maintenance and for the conduct of irradiations and experiments that could affect reactor safety or core reactivity;
>
> g. Shipping of radioactive materials;
>
> h. Implementation of the Emergency Response Plan.

Substantive changes to the above procedures shall be made only after review by the ROC. Except for radiation protection procedures, unsubstantive changes shall be approved prior to implementation by the Reactor Administrator and documented by the Reactor Administrator within 120 days of implementation. Unsubstantive changes to radiation protection procedures shall be approved prior to implementation by the SHP and documented by the Senior Health Physicist within 120 days of implementation.

Temporary deviations from the procedures may be made by the responsible senior reactor operator in order to deal with special or unusual circumstances or conditions. Such deviations shall be documented and reported by the next working day to the Reactor Administrator.

The proposed TS 6.4 states:

Written operating procedures shall be adequate to ~~assure~~ **ensure** the safety of operation of the reactor, but shall not preclude the use of independent judgment and action should the situation require such. Operating procedures shall be in effect for the following items:

a. Startup, operation**,** and shutdown of the reactor;

b. Fuel loading, unloading, and movement within the reactor;

c. Maintenance of major components of systems that could have an effect on reactor safety;

d. Surveillance checks, calibrations, and inspections required by the technical specifications or those that have an effect on reactor safety;

e. Radiation protection;

f. Administrative controls for operations and maintenance and for the conduct of irradiations and experiments that could affect reactor safety or core reactivity;

g. Shipping of radioactive materials; **and**

h. Implementation of the Emergency Response Plan.

Substantive changes to the above procedures shall be made only after review by the ROC. Except for radiation protection procedures, unsubstantive changes shall be approved prior to implementation by the Reactor Administrator and documented by the Reactor Administrator within 120 days of implementation. Unsubstantive changes to radiation protection procedures shall be approved prior to implementation by the ~~SHP~~ **Senior Health Physicist** and documented by the Senior Health Physicist within 120 days of implementation.

Temporary deviations from the procedures may be made by the responsible ~~s~~**S**enior ~~r~~**R**eactor ~~o~~**O**perator in order to deal with special or unusual circumstances or conditions. Such deviations shall be documented and reported by the next working day to the Reactor Administrator.

The licensee proposes to replace “assure” with “ensure” in TS 6.4 to correct word usage. The NRC staff reviewed this proposed change and determined that the change to TS 6.4 does not alter the administrative control requirement to require adequate procedures for the safe operation of the reactor. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.4 is acceptable.

The licensee proposes to add a comma (,) after “operation” to correct the grammar in TS 6.4.a. The NRC staff reviewed this proposed change and determined the change increases clarity and does not alter the administrative control of TS 6.4.a. The NRC staff finds this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.4.a is acceptable.

The licensee proposes to add “and” at the end of TS 6.4.g to correct consistency throughout the TSs. The NRC staff reviewed this proposed change and determined that this change increases clarity and does not alter the administrative control of TS 6.4.g. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.4.g is acceptable.

The licensee proposes to define the acronym SHP as “Senior Health Physicist” in the second paragraph of TS 6.4 for clarity and correct consistency. The NRC staff reviewed this proposed change and determined that this change to define SHP as senior health physicist in TS increases clarity and does not alter the existing administrative controls of TS 6.4. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.4 is acceptable.

The licensee proposes to capitalize “senior reactor operator” in the last paragraph of TS 6.4 to correct consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that the change makes a formatting change that does not alter the administrative control of TS 6.4. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.4 is acceptable.

TS 6.6.1, “Actions to Be taken in Case of Safety Limit Violation”

The current TS 6.6.1 states:

In the event a safety limit (fuel temperature) is exceeded:

a. The reactor shall be shut down and reactor operation shall not be resumed until authorized by the USNRC;

b. An immediate notification of the occurrence shall be made to the Reactor Administrator, Radiation Center Director and Chairperson, ROC; and

c. A report, and any applicable followup report, shall be prepared and reviewed by the ROC. The report shall describe the following:

   1. applicable circumstances leading to the violation including, when known, the cause and contributing factors;

   2. effects of the violation upon reactor facility components, systems, or structures and on the health and safety of personnel and the public; and

3. corrective action to be taken to prevent recurrence.

The proposed TS 6.6.1 states:

In the event a safety limit (fuel temperature) is exceeded:

a. The reactor shall be shut down and reactor operation shall not be resumed until authorized by the USNRC;

b. An immediate notification of the occurrence shall be made to the Reactor Administrator, Radiation Center Director**,** and Chair~~person,~~ **of the** ROC; and

c. A report, and any applicable follo**w-up** report, shall be prepared and reviewed by the ROC. The report shall describe the following:

   1. ~~a~~**A**pplicable circumstances leading to the violation including, when known, the cause and contributing factors;

   2. ~~e~~**E**ffects of the violation upon reactor facility components, systems, or structures and on the health and safety of personnel and the public; and

   3. ~~c~~**C**orrective action to be taken to prevent recurrence.

For TS 6.6.1.b, the licensee proposes to add a comma (,) after "Director" for consistent formatting throughout the TSs. Additionally, the licensee proposes to delete "person," and add "of the" to correct the terminology consistent with OSU's procedures. The NRC staff reviewed theses proposed changes to TS 6.6.1.b and determined that the change to add a comma after Director does not alter the administrative controls of TS 6.6.1.b. Additionally, the NRC finds that the "Chairperson, ROC" and the "Chair of the ROC" are equivalent titles and refers to an individual within the licensee's Reactor Oversite Committee that is required to be immediately notified in the event the temperature safety limit of the fuel is exceeded. On this basis, the NRC staff concludes theses proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.6.1.b are acceptable.

The licensee proposes to change "followup" to "follow-up" in TS 6.6.1.c to make a grammar correction. The NRC staff reviewed this proposed change and determined that the proposed change to corrects a minor grammatical error that does not alter the administrative control requirement for the actions to be taken in the event a safety limit is exceeded. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.6.1.c is acceptable.

Additionally, the licensee proposes to capitalize the beginning of TS 6.6.1.c.1, TS 6.6.1.c.2, and TS 6.6.1.c.3 for consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that capitalizing the beginning of TS 6.6.1.c.1 through TS 6.6.1.c.3 makes a formatting change that does not alter the administrative control to prepare and submit a report in the event a safety limit is exceeded. The NRC staff finds these proposed changes to are editorial. Therefore, the NRC staff finds these changes to TS 6.6.1.c.1 through TS 6.6.1.c.3 are acceptable.

<u>TS 6.6.2, "Actions to Be Taken in the Event of an Occurrence of the Type Identified in Section 6.7.2 Other than a Safety Limit Violation</u>

The current TS 6.6.2 states:

> For all events which are required by regulations or Technical Specifications to be reported to the NRC within 24 hours under Section 6.7.2, except a safety limit violation, the following actions shall be taken:

The proposed TS 6.6.2 states:

> For all events ~~which~~ **that** are required by regulations or Technical Specifications to be reported to the NRC ~~within 24 hours~~ **by the following working day** under Section 6.7.2, except a safety limit violation, the following actions shall be taken:

The licensee proposes to replace "which" with "that" in TS 6.6.2 to introduce a restrictive clause. The NRC staff reviewed the proposed change and determined that the change does not alter the administrative control requirement to report events to the NRC. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.6.2 is acceptable.

The licensee proposes to delete "within 24 hours" and add "by the following working day" in TS 6.6.2 for consistency with the requirements of TS 6.7.2. TS 6.7.2, "Special Report," states, in part, that reports made by the Radiation Center Director to the NRC shall be made no later than the following working day by telephone for the events specified in TS 6.7.2. The NRC staff review the proposed change to TS 6.6.2 using the guidance in ANSI/ANS-15.1-2007 (R2013)[1]. Section 6.7.2, "Special reports," of ANSI/ANS-15.1-2007 (R2013) states, in part, that the following schedule for special reports shall be incorporated in the specifications:

> (1) There shall be a report not later than the following working day by telephone and confirmed in writing by facsimile or similar conveyance to licensing authorities, to be followed by a written report that describes the circumstances of the event within 14 days of any of the following:

The NRC staff determines that the proposed change to delete "within 24 hours" and add "by the following working day" is consistent with the reporting guidance in ANSI/ANS-15.1-2007 (R2013). Additionally, the NRC finds that the proposed change to TS 6.6.2 to add "by the following working day" is consistent with TS 6.7.2 that requires a report no later than the following working day to the NRC Operations Center. Therefore, the NRC staff finds these changes are acceptable.

Because the changes to TS 6.6.2 are consistent with guidance and provide administrative controls relating to organization, management, review, and reporting that are necessary to assure operation of the facility in a safe manner as required by 10 CFR 50.36(c)(5), the NRC staff finds the proposed change acceptable.

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[1] Extracted from American National Standard ANSI/ANS-15.1-2007 with the permission of the publisher, the American Nuclear Society.

Additionally, the licensee proposes to capitalize the beginning of TS 6.6.2.a, TS 6.6.2.b, TS 6.6.2.c, and TS 6.6.2.d for consistency throughout the TSs. The NRC staff reviewed this proposed change and determined that it is a formatting change that does not alter the existing administrative control for actions to be taken in the event of an occurrence identified in TS 6.7.2. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.6.2.a through TS 6.6.2.d are acceptable.

<u>TS 6.7.1, "Annual Operating Report"</u>

The licensee proposes to change "therefore" to "therefor" in TS 6.7.1.b to correct word usage. The NRC staff reviewed the proposed change and determined that the change corrects a minor grammatical error that does not alter the existing administrative control requirement to report the number of unplanned shutdowns, including the reasons. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.7.1.b is acceptable.

Additionally, the licensee proposes to capitalize the beginning of TS 6.7.1.a, TS 6.7.1.b, TS 6.7.2.c, TS 6.7.2.d, TS 6.7.2.e, TS 6.7.2.f, and TS 6.7.2.g for consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that the change to capitalize the beginning of TS 6.7.1.a through TS 6.7.1.g is a formatting change that does not alter the existing administrative control to create and submit an annual operating report. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.7.1.a through TS 6.7.1.g are acceptable.

<u>TS 6.7.2, "Special Reports"</u>

The licensee proposes to add "or email" to TS 6.7.2.a as a method of written communications to confirm reporting made to the NRC Operations Center by telephone.

The NRC staff review the proposed change to TS 6.7.2.a using the guidance in ANSI/ANS-15.1-2007 (R2013)[2]. Section 6.7.2 of ANSI/ANS-15.1-2007 (R2013) states that the following schedule for special reports shall be incorporated in the specifications:

> (1) There shall be a report not later than the following working day by telephone and confirmed in writing by facsimile or similar conveyance to licensing authorities, to be followed by a written report that describes the circumstances of the event within 14 days of any of the following:

The NRC staff finds that email is a similar method of conveyance as a facsimile. The NRC staff also finds that email is an acceptable method to confirm reporting made to the NRC Operations Center by telephone. Therefore, the NRC staff finds the proposed change to add "or email" to TS 6.7.2.a is acceptable.

The licensee proposes to change "therefore" to "therefor" in TS 6.7.2 to correct word usage. The NRC staff reviewed the proposed change and determined that the change corrects a minor grammatical error that does not alter the existing administrative control requirement for reports

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[2] Extracted from American National Standard ANSI/ANS-15.1-2007 with the permission of the publisher, the American Nuclear Society.

made by the Radiation Center Director to the NRC. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.7.2 is acceptable.

The licensee also proposes to capitalize the beginning of TS 6.7.2.a, TS 6.7.2.a.1, TS 6.7.2.a.2, TS 6.7.2.a.3, TS 6.7.2.a.4, TS 6.7.2.a.5, TS 6.7.2.a.6, TS 6.7.2.a.7, TS 6.7.2.a.8, TS 6.7.2.b, and TS 6.7.2.b.2.c, for consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that capitalizing the beginning of TS 6.7.2.a, TS 6.7.2.a.1 through TS 6.7.2.a.8, and TS 6.7.2.b.2 is a formatting change that does not alter the administrative controls. The NRC staff concludes these proposed changes are editorial. Therefore, the NRC staff finds these changes to TS 6.7.2 are acceptable.

TS 6.8.1, "Records to be Retained for a Period of at Least Five Years or for the Life of the Component Involved if Less than Five Years

The licensee proposes to capitalize "be" in the title of TS 6.8.1 for consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that capitalizing "be" in the title of TS 6.8.1 is a formatting change that does not alter the administrative control. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.8.1 is acceptable.

The licensee also proposed to capitalize the beginning of TS 6.8.1.a, TS 6.8.1.b, TS 6.8.1.c, TS 6.8.1.d, TS 6.8.1.e, TS 6.8.1.f, TS 6.8.1.g, and TS 6.8.1.h for consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that capitalizing the beginning of TS 6.8.1.a through TS 6.8.1.h is a formatting change that does not alter the administrative control. The NRC staff concludes these proposed changes to TS 6.8.1 are editorial. Therefore, the NRC staff finds these changes to TS 6.8.1 are acceptable.

TS 6.8.2, "Records to be Retained for at Least One Certification Cycle

The licensee proposes to capitalize "be" in the title of TS 6.8.2. The NRC staff reviewed the proposed change and determined that capitalizing "be" in the title of TS 6.8.2 is a formatting change that does not alter the administrative control. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.8.2 is acceptable.

TS 6.8.3, Records to be Retained for the Lifetime of the Reactor Facility

The licensee proposes to capitalize "be" in the title of TS 6.8.3 for consistency throughout the TSs. The NRC staff reviewed the proposed change and determined that capitalizing "be" in the title of TS 6.8.3 is a formatting change that does not alter the administrative control. The NRC staff concludes this proposed change is editorial. Therefore, the NRC staff finds this change to TS 6.8.3 is acceptable.

Conclusion

Based on the information above, the NRC staff finds that the proposed TS changes are consistent with the guidance provided in NUREG-1537 and ANSI/ANS-15.1-2007 (R2013). The NRC staff also finds that the TSs, as revised, meet 10 CFR 50.36(c)(2) requirements by specifying the lowest functional capability or performance levels of equipment required for safe operation of the facility, 10 CFR 50.36(c)(3) requirements by stating requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, and 10 CFR 50.36(c)(5) requirements by specifying administrative controls

relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner. On this basis, the NRC staff finds the proposed changes acceptable.

Technical Specifications Bases Changes

Consistent with 10 CFR 50.36(a)(1), the licensee provides revised basis statements for the proposed TSs. The NRC staff concludes that the TS bases explains the reasons for the proposed TSs.

4.0 ENVIRONMENTAL CONSIDERATION

The proposed amendment would change requirements with respect to installation or use of a facility component. Pursuant to 10 CFR 51.22(b), no environmental assessment or environmental impact statement is required for any action within the category of actions listed in 10 CFR 51.22(c), for which the Commission has declared to be a categorical exclusion by finding that the action does not individually or cumulatively have a significant effect on the human environment. The proposed TS changes that would be authorized by the amendment are evaluated below.

4.1 Regulatory Evaluation

This amendment revises License Condition 2.C.(1) from a temperature limit to a reactivity limit and revises various OSU TSs to remove the requirements related to the fuel temperature measurement obtained from the licensee's instrumented fuel element (IFE). Additionally, this amendment implements a number of grammatical, editorial, and formatting changes to improve the clarity and readability of the TSs. The issuance of this amendment meets the requirements for the categorical exclusion under 10 CFR 51.22(c)(9) and (10) provided that:

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

Pursuant to 10 CFR 50.92, "Issuance of amendment," paragraph (c), the Commission may make a final determination that a license amendment involves no significant hazards consideration if operation of the facility, in accordance with the amendment, would not:

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

As discussed in Section 3 of this safety evaluation, the proposed changes to use power level of 1.1 MW(t) and pulse reactivity of $2.30 as limiting conditions versus the temperature measurement provided by the IFE does not affect any accident previously evaluated. This amendment does not change the licensed power level, fission product inventory, or design features and does not change any potential release paths from the facility. The previously evaluated accident that could be affected by this amendment is the failure of the fuel element cladding if the SL were exceeded. This accident scenario was previously evaluated in the 2007 conversion SAR by postulating the maximum hypothetical accident (MHA). The evaluation of other categories of postulated fission product release accidents at the OSTR show that the MHA is bounding. The postulated MHA assumes that the release of fission products from a TRIGA fuel element to the unrestricted environment results in radiological consequences that bound all credible fission product release accidents. The removal of surveillances associated with the IFE does not increase the probability of an accident because this equipment is not required

for safety during steady-state operation. Additionally, the proposed use of a power level as the LSSS is more restrictive than using the LSSS as measured by the IFE and does not increase the probability of an accident. Therefore, the NRC staff finds that this amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

The proposed changes do not create the possibility of a new or different accident from those previously evaluated, including the MHA, because the proposed changes replace a fuel temperature measurement with a power level limit of 1.1 MW(t) and a pulse reactivity of $2.30, and do not affect steady-state, pulse or square-wave operations. These TS changes do not authorize installation of new equipment or significantly change the operation of the facility. In addition, there is no change to the licensed power level or fission product inventory. As a result, this amendment does not change potential release paths from, or any accident previously evaluated at, the facility. Therefore, the NRC staff finds that this amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

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

The proposed use of a power level and reactivity limit does not affect the margin of safety in any of the analyses used to establish the TSs. Therefore, the NRC staff finds that this amendment does not involve a significant reduction in a margin of safety.

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

The proposed changes do not affect the licensed power limit of 1.1 MW(t) as an LSSS and thus do not affect or significantly change the types or amounts of fission products generated by the OSTR. This amendment does not change the licensed power level of not in excess of 1.1 MW(t) or reactor design features. This amendment still requires that measuring channels, safety channels, and interlocks for transient mode operations be operable when such modes are resumed. For these reasons, the NRC staff finds that this amendment does not significantly change the types or increase the amounts of any effluents that may be released offsite.

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

The amendment does not affect any equipment that will affect the radiation dose rates to any occupational workers at the facility. There is no change in the steady-state power level limit 1 MW(t), nor any change to equipment used to protect the workers from radiation doses. TS 6.3, "Radiation Safety," which is not altered by this amendment, still requires the implementation of a radiation safety program as required in 10 CFR Part 20 to ensure that individual and cumulative occupational radiation exposure is as low as is reasonably achievable. Therefore, the NRC staff finds that there is no significant increase in individual or cumulative occupational radiation exposure.

4.2 Typographical Changes and Corrections

The NRC staff determined that certain changes to the TSs in this amendment, along with the associated pagination and reformatting changes, modify the format of the license or otherwise make editorial, corrective, or other minor revisions. Accordingly, these changes in the amendment meet the criteria for categorical exclusion set forth in 10 CFR 51.22(c)(10)(v).

4.3 Conclusion

Accordingly, the NRC staff has determined that issuance of this amendment changes a requirement with respect to the installation or use of a facility component located within the restricted area under 10 CFR Part 50 and makes formatting, editorial, corrective, or other minor revisions. The NRC staff has determined that amendment involves no significant hazards consideration as well as no significant increase in the amounts, and no significant increase in the types, of any effluents that may be released offsite, and there is no significant increase in individual or cumulative occupational radiation exposure. Therefore, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) and 10 CFR 51.22(c)(10)(v). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSION

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

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