Department of the Interior
US Geological Survey
PO Box 25046 MS 974
Denver, CO 80225-0046

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U.S. Nuclear Regulatory Commission
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Washington, DC 20555

Reference: U.S. Geological Survey TRIGA Reactor (GSTR), Docket 50-274, License R-113, Revision of Proposed Technical Specifications

Subject: Revision of Proposed Technical Specifications

Mr. Wertz:

As a result of our conversations on August 4 and 5, 2015, I am submitting proposed revisions to the Technical Specifications for our license renewal. The attached document was revised using the "track changes" feature of Microsoft Word.

Sincerely,

Tim DeBey

Tim DeBey

USGS Reactor Supervisor

I declare under penalty of perjury that the foregoing is true and correct. Executed on 9/8/15

Attachment

Copy to:
Vito Nuccio, Reactor Administrator, MS 911
USGS Reactor Operations Committee

A020
NRR

APPENDIX A

To

FACILITY LICENSE NO. R-113

DOCKET NO. 50-294

TECHNICAL SPECIFICATIONS AND BASES

FOR

THE UNITED STATES GEOLOGICAL SURVEY TRIGA RESEARCH REACTOR

SEPTEMBER 2015

TECHNICAL SPECIFICATIONS AND BASES FOR THE USGS TRIGA RESEARCH REACTOR

1. ~~1. INTRODUCTION~~Introduction

1.1 ~~SCOPE~~Scope

This document constitutes the Technical Specifications for the Facility License No. 113 as required by 10 CFR 50.36 and supersedes all prior Technical Specifications. This document includes the "Basis" to support the selection and significance of the specifications. Each basis ~~i~~is included for information purposes only. ~~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, except where they reference the USGS SAR or a specific Technical Specification. These specifications are formatted in a manner consistent with ANSI/ANS 15.1-2007.

~~14.1~~1.2 Definitions

Audit: A quantitative examination of records, procedures or other documents.

Channel: A channel is the combination of sensing, signal processing, and outputting devices which are connected for the purpose of measuring the value of a parameter.

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.

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.

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

Confinement: Confinement means an enclosure ~~on~~ of the reactor bay which ~~controls~~ is designed to limit the release of effluents from the enclosure to the external environment~~movement of air into and out of it~~ through ~~a~~ controlled or defined pathways.

Control Rod: A control rod is a device fabricated from neutron absorbing material and/or fuel which is used to establish neutron flux changes and to compensate for routine reactivity losses. 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:

1. 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.

2. Shim Rod: A shim rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section.

3. Transient Rod: The transient rod is a control rod having an electric motor and pneumatic cylinder drive with scram capabilities that can be rapidly ejected from the reactor core to produce a pulse. It may have an air-filled ~~a voided~~ follower.

~~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.~~

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.

Experiment: Any operation, hardware, or target (excluding devices such as detectors) 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:

1. Secured Experiment: A secured experiment is any experiment or component of an experiment that is held in a stationary position relative to the reactor core 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.

2. Movable Experiment: A movable experiment is one that is not secured and intended to be moved while near or inside the core during reactor operation.

~~Experiment Safety Systems: Experiment safety systems are those systems, including their associated input channel(s), which are designed to initiate a scram for the primary purpose of protecting experiments or personnel or to provide information which requires manual protective action to be initiated.~~

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

Instrumented Fuel Element: An instrumented fuel 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.

Irradiation Facilities: Irradiation facilities shall mean vertical tubes, rotating specimen rack, pneumatic transfer system irradiation tubes, sample-holding dummy fuel elements and any other in-tank device intended to hold an experiment.

Licensed Area: Rooms 149-152, 154, 157, 158, B10 and B11 of Building 15 and Room 2 of Building 10.

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

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

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

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

Reactivity Worth of an Experiment: The reactivity worth of an experiment is the value of the reactivity change that results from the experiment being inserted into or removed from its intended position.

~~Reactor Facility: The physical area defined by the area that contains Building 15, between North Center Street, 1st Street, 2nd Street, and South Center Street on the Denver Federal Center.~~

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

~~Performance of routine subcritical surveillance is not considered operating.~~

Reactor Operator: An individual who is licensed to manipulate the controls of a reactor.

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.

Reactor Secured: The reactor is secured when:

1. *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;

2. *Or* all the following conditions exist:

a. ~~The minimum number of~~All neutron-absorbing control devices are ~~is~~ fully inserted or other safety devices are in their shutdown position, as required by technical specifications;

b. The console key switch is in the off position, and the key is removed from the ~~lock~~key switch;

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

d. No experiments are being moved or serviced that have, on movement, a reactivity worth exceeding ~~the maximum value allowed for a single experiment, or~~ one dollar~~, whichever is smaller~~.

Reactor Shutdown: 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 included.

Reference core condition: The condition of the core when it is at ambient temperature (cold, 18-~~—~~25 °C) and the reactivity worth of xenon is negligible.

Review: A qualitative examination of records, procedures or other documents.

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

Scram time: Scram time is the elapsed time between the initiation of a scram and the instant that the control rod reaches its fully-inserted position.

Senior Reactor Operator: An individual who is licensed to direct the activities of reactor operators. Such an individual is also a reactor operator.

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" denotes permission, neither a requirement nor a recommendation.

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.

Shutdown Reactivity: Shutdown reactivity is the measured reactivity with all control rods inserted. The value of shutdown reactivity includes the reactivity value of all installed experiments and is determined with the reactor at ambient conditions.

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

Steady-State Mode (S.S. Mode): Steady-state mode shall mean operation of the reactor with the mode selector in the manual or auto position.

~~Substantive Changes: Substantive changes are changes that would provide a significant decrease in the safety of an action or event.~~

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

1. Quinquennial - interval not to exceed 70 months.
2. Biennial - interval not to exceed 30 months.
3. Annual - interval not to exceed 15 months.
4. Semi-annual - interval not to exceed 7.5 months.
5. Quarterly - interval not to exceed 4 months.
6. Monthly - interval not to exceed 6 weeks.
7. Weekly - interval not to exceed 10 days.

Unscheduled Shutdown: An unscheduled shutdown is defined as any unplanned shutdown of the reactor caused by actuation of the reactor safety system, operator error, equipment malfunction, or a manual shutdown in response to conditions that could adversely affect safe operation, not including shutdowns that occur during testing or checkout operations.

~~14.~~2 Safety Limits and Limiting Safety System Setting

~~0.~~2.

~~14.~~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.

1. The temperature in an aluminum-clad TRIGA fuel element shall not exceed 500 °C under any mode of operation.
2. The temperature in a stainless-steel clad TRIGA fuel element shall not exceed 1,150 °C.

~~(if cladding temperature is at or less than 500 °C) or 950 °C (if cladding temperature greater than 500 °C) under any mode of operation.~~

Basis. The important parameter for a TRIGA reactor is the fuel element temperature. This parameter is well suited as a single specification especially since it can be measured. 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 aluminum-clad TRIGA fuel element is based on data which indicate that the zirconium hydride will undergo a phase change at 535 °C. This phase change can cause severe distortion in the fuel element and possible cladding failure. Maintaining the fuel temperature below this level will prevent this potential mechanism for cladding failure~~.~~ (SAR 4.5~~.4~~).

The safety limit for the stainless-steel clad TRIGA fuel is based on data including the large mass of experimental evidence obtained during high performance reactor tests on this fuel. These data indicate that the stress in the cladding due to hydrogen pressure from the dissociation of zirconium hydride will remain below the ultimate stress provided that the temperature of the fuel does not exceed 1,150 °C~~. (if cladding temperature is at or less than 500 °C) or 950 °C (if cladding temperature greater than 500 °C)~~ (SAR 4.5.4.1).~~.~~

~~14.~~2.2 Limiting~~ed~~ Safety System Setting (LSSS)

Applicability. This specification applies to ~~the scram settings which prevent the safety limit from being reached.~~ thermal reactor power.

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

Specifications. The limiting safety system setting shall be a steady state thermal power of 1.1 MW~~, and there shall be at least 110 fuel elements in the core (not including fuel-followed control rods)~~.

Basis. The limiting safety system setting is a total core thermal power, which, if exceeded shall cause the reactor safety system to initiate a reactor scram. This setting applies to all modes of operation. In steady-state operation up to 1.1 MW, ample margins exist between this setting and the safety limits of peak fuel temperature as specified in SAR 14.2.1, as long as the aluminum-clad fuel is restricted to the F and G rings of the core assembly~~.~~ (SAR 4.5.4.1).~~.~~

Thermal and hydraulic calculations indicate that stainless-steel clad TRIGA fuel may be safely operated up to power levels of at least 1.9 MW with natural convection cooling~~.~~ (SAR 4.5.4.5).~~.~~

3. ~~14.3~~ Limiting Conditions of Operation

~~14.~~3.1 Reactor Core Parameters

~~14.~~3.1.1 Steady-state Operation

~~14.~~3.1.1.1 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~~the reactor at all times that it is in operation.

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 at least $0.30 with:

> ~~1~~a. Irradiation facilities and experiments in place and ~~the highest-worth~~all, non-secured experiment in ~~its~~ their most reactive state;
>
> ~~2~~b. The most reactive control rod fully-withdrawn; and
>
> ~~3~~c. The reactor in the reference core condition where there is no ^{135}Xe poison present and the core is at ambient temperature. Calculations may be performed to determine a "no ^{135}Xe poison" reactivity condition.

Basis. The value of the shutdown margin assures 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. Since the reactor is seldom in a "no ^{135}Xe poison" condition, it is acceptable to perform calculations to determine the "no ^{135}Xe poison" reactivity condition.

~~14.~~3.1.1.2 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 objectives that must be simultaneously met are to assure that the reactor has sufficient reactivity to meet its mission requirements, be able to be shut down at any time, and not exceed its fuel temperature safety limit.

Specifications. The maximum available excess reactivity shall not exceed $7.00 at reference core conditions.

Basis. This amount of excess reactivity will provide the capability to operate the reactor at full power with experiments in place and ^{135}Xe built up in the core. ~~Historical operation of the GSTR with an excess reactivity of greater than $6.90 has shown that sufficient shutdown margin exists to provide for safe operation and meet the requirements of the other technical specifications.~~

~~14.~~3.1.2 Pulse Mode Operation

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 ensure that the fuel temperature ~~safety limit~~ shall not be exceed~~ed~~ 830°C.

Specifications. The reactivity to be inserted for pulse operation shall be determined and limited by a mechanical stop on the transient rod, such that the reactivity insertion shall not exceed $3.00.

Basis. The fuel temperature rise during a pulse transient has been estimated conservatively to not exceed any fuel temperature limits with a $3.00 pulse insertion. ~~by adiabatic models. These models accurately predict pulse characteristics for operation of TRIGA cores and should be accepted with confidence, relying also on information concerning prompt neutron lifetime and prompt temperature coefficient of reactivity. These parameters have been established for TRIGA cores by calculations and have been confirmed in part by measurements at existing facilities. In addition, the calculations rely on flux profiles and corresponding power densities which have been calculated for a variety of TRIGA cores. A discussion of the temperature response to reactivity insertion can be found in SAR 4.2.1.10.~~

~~It is shown in the RELAP model for the limiting core configuration that reactivity insertions up to $3.00 in operational cores will produce pulse transients with maximum fuel temperatures no greater than 419 °C in the F and G rings (aluminum clad fuel is restricted to these positions) and no greater than 797 °C in the B ring (hottest point for stainless steel clad fuel). These peak temperatures last for less than two seconds. This maintains a safety margin for the temperature limits of the fuel set in SAR 13.1, allowing for uncertainties in measurements and/or calculations.~~

~~14.~~3.1.3 Core Configuration Limitations

Applicability. This specification applies to mixed cores of aluminum-clad and stainless-steel clad types of fuel.

Objective. The objective is to ensure that the fuel temperature safety limit shall not be exceeded due to power peaking effects in a mixed core.

Specifications. Aluminum-clad fuel shall only be loaded in the F and G rings of the core and there shall be at least 110 fuel elements in the core (not including fuel-followed control rods). ~~.~~ There shall not be a fuel element in the central thimble.

Basis. The limitation of power peaking effects ensures that the fuel temperature safety limit shall not be exceeded in an operational core. Keeping aluminum-clad fuel in the F and G rings limits those fuel temperatures to safe values for aluminum-clad fuel (SAR 4.5.1.2). Keeping at least 110 fuel elements in the core helps reduce the power peaking in the core.

~~14.~~3.1.4 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 must be removed from the core if:

~~1~~a. The transverse bend exceeds 0.0625 inches over the length of the cladding;

~~2~~b. Its length exceeds its original length by 0.10 inch for stainless-steel clad fuel or 0.50 inch for aluminum-clad fuel;

~~3~~c. A cladding defect exists as indicated by release of fission products;

~~4~~d. Visual inspection identifies significant bulges, pitting, or corrosion; ~~or~~ and

e. ^{235}U burnup is calculated to be greater than 50% of initial content.

Basis. Gross failure or obvious, significant 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).

~~14.~~3.2 Reactor Control a~~A~~nd Safety System

~~14.~~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~~ all control rods are operable.

Control rods shall not be considered operable if:

~~1~~a. Physical damage is apparent to the rod or rod drive assembly and it does not respond normally to control rod motion signals; or

~~2~~b. The scram time exceeds 1 second for the shim and regulating rods or 2 seconds for the transient rod.

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 (SAR 13.2.2.2.1).

~~14.~~3.2.2 Reactor Measuring Channels

Applicability. This specification applies to the information which shall be available to the Reactor Operator during reactor operation.

Objective. The objective is to specify the minimum number of power 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 power measuring channels listed in Table ~~14~~3.1 is operable.

Table 3.1 Minimum Measuring Channels			
Measuring Channel	Effective Mode		
	S.S.	Pulse	S.W.
Power level (NP1000 and NPP1000)	2	-	2
Pulse power level (NPP1000)	-	1	-
Power level (NM1000)	1	-	1
Water temperature	1	1	1

Basis. The power level monitors ensure that the reactor power level is adequately monitored for steady-state, square wave and pulse modes of operation (SAR 7.2.3.1). The specifications on reactor power level indication are included in this section since the power level is directly related to the fuel temperature. The water temperature monitor ensures that water temperature will be kept within the specified limit.

~~14.~~3.2.3 Reactor Safety System

Applicability. 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 ensure safe operation of the reactor.

Specifications. The reactor shall not be operated unless the minimum number of safety channels described in Table ~~14.~~3.2 and interlocks described in Table ~~14~~3.3 are operable.

Table 3.2 Minimum Reactor Safety Channels				
Safety Channel	Function	Effective Mode		
		S.S.	Pulse	S.W.
Power level	SCRAM @ 1.1. MW(t) or less	2	-	2
Preset timer	SCRAM (≤15 sec)	-	1	-
Console SCRAM button	SCRAM	1	1	1
High voltage	SCRAM on loss of nominal operating voltage to required power channels	2	1	2

Watchdog SCRAMs	Scram upon lack of response in DAC or CSC computer (one scram circuit per computer)	2	2	2

Table 3.3 Minimum Interlocks				
Interlock	Function	Effective Mode		
		S.S.	Pulse	S.W.
NM1000 Power level	Prevents control rod withdrawal at $<10^{-7}$% power	1	-	-
Transient Rod Cylinder	Prevents application of air unless fully inserted	1	-	-
1kW Pulse interlock	Prevents entering pulse mode above 1 kW	1	-	-
Shim and Regulating rod drive circuits	Prevents simultaneous manual withdrawal of two rods	1	-	1
Shim and Regulating rod drive circuits	Prevents withdrawal of any rod except Transient Rod	-	1	-

Basis. The power level scrams provide protection to ensure that the reactor can be shut down before the safety limit on the fuel element temperature will be exceeded. The manual scram allows the operator to shut down the system if an unsafe or abnormal condition occurs. The high voltage scram ensures that the required power measuring channels have sufficient high voltage as required for proper functioning of their power level scrams. The interlock to prevent startup of the reactor at count rates less than 10^{-7}% power ensures that the startup is not initiated unless a reliable indication of the neutron flux level in the reactor core is available. The interlock to prevent entering pulse mode above 1 kW is to ensure that the magnitude of the pulse will not cause the fuel element temperature safety limits to be exceeded. The interlock to prevent application of air to the transient rod unless the cylinder is fully inserted is to prevent pulsing the reactor in the steady-state mode. The interlock to prevent withdrawal of the shim, safety or regulating rod in the pulse mode is to prevent the reactor from being pulsed while on a positive period. The interlock to prevent simultaneous withdrawal of two control rods is to limit reactivity insertion rate from the standard control rods.

~~14.~~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 high quality 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 ion exchanger resin integrity.

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

~~1a. The tank water level shall be at least 16 feet above the top of the core;~~

~~2b~~a. The bulk tank water temperature shall not exceed 60 °C;

~~3c~~b. The conductivity of the tank water shall be less than 5 µmhos/cm when averaged over a one month period; and

~~4. The pH of the tank water shall be in the range of 4.5 to 7.5 if there is any aluminum-clad fuel in the core.~~

~~54d~~c. ~~When aluminum-clad fuel is in the core, t~~The reactor shall not be operated if the tank water level is more than 24 inches below the top lip of the reactor tank.

~~6.~~NOTE: These specifications are not required to be met if the reactor ~~core has been defueled or the tank water level is below the purification system suction.~~fuel has been removed from the tank.

Basis. ~~The minimum height of 16 feet of water above the top of the core guarantees that there is sufficient water to maintain suction on the primary pump for the primary cooling system. The intake for the primary cooling pump is located 5 feet below the top of the tank liner. This location is approximately 16 feet above the top of the reactor core.~~ The bulk water temperature limit is necessary to ensure that the ion exchange resin does not undergo severe thermal degradation. Experience at many research reactor facilities has shown that maintaining the conductivity within the specified limit provides acceptable control of corrosion (NUREG-1537). The minimum water level of no more than 24 inches below the top lip of the reactor tank ensures sufficient cooling water both for normal operation and during the design reactor tank leak of 350 gpm for ~~the~~ any aluminum clad fuel to cool to safe levels after a reactor shutdown. This water level (no more than 24 inches below the top lip of the tank) gives approximately 18 feet-4 inches of water above the top grid plate of the core.

~~14.~~3.4 This section intentionally left blank.

~~14.~~3.5 Ventilation and Confinement System

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

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

Specifications.

1. ~~1.~~ The reactor shall not be operated unless a facility ventilation system is operating and the reactor bay pressure is maintained negative with respect to surrounding areas by at least 0.1" water pressure except for ~~. This does not apply to~~ short periods of time (not to exceed 2 hours) for system troubleshooting, maintenance and movement of personnel or equipment through open doors, provided the CAM is operating. The normal mode ventilation system is considered operable if:

a. The normal exhaust fan is operating; and

b. The reactor bay is sufficiently confined to allow a minimum differential pressure of 0.1" water column to be maintained by the normal exhaust fan.

2. ~~2.~~ The reactor bay ventilation system shall operate in the emergency mode, with all exhaust air passing through a HEPA filter, whenever a high level continuous air monitor (CAM) alarm is present due to airborne particulate radionuclides emitted from the reactor or samples in the reactor bay. The emergency mode ventilation system is considered operable if:

a. The emergency exhaust fan is operating; and

b. The reactor bay is sufficiently confined to allow a minimum differential pressure of 0.1"water column to be maintained by the emergency exhaust fan

Basis. The worst-case maximum total effective dose equivalent is well below the 10 CFR 20 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 MHA and where the ventilation system does not operate during the MHA~~.~~ (SAR 13.2.1). Therefore, operation of the reactor for short periods while the reactor bay underpressure is not maintained because of testing or reactor bay open doors, 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.

~~14.~~3.6 This section intentionally left blank.

~~14.~~3.7 Radiation Monitoring Systems and Effluents

~~14.~~3.7.1 Radiation Monitoring Systems

Applicability. This specification applies to the radiation monitoring systems.

~~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 ~~ensure~~ assure safe operation of the reactor.

Specifications. The reactor shall not be operated unless the minimum number of radiation monitoring channels listed in Table ~~14~~3.4 are operating. Each channel shall have a readout in the control room and

be capable of sounding an audible alarm. ~~, except for time periods of up to 2 hours for repair and maintenance, provided:~~

~~1. The ventilation system is operating; and~~

~~2. No experiments or maintenance activities are being conducted which could directly result in alarm conditions.~~

~~Each channel shall have a readout in the control room and be capable of sounding an audible alarm.~~

Table 3.4: Minimum Radiation Monitoring Channels*	
Radiation Monitoring Channel	**Number**
Continuous Air Monitor	1
Radiation Area Monitor	1
Environmental Dosimeter	3

[a]~~Monitors~~ [*]Monitors may be out-of-service for up to 2 hours for calibration, maintenance, troubleshooting, or repair. During this out-of-service time, no experiments or maintenance activities shall be conducted which could directly result in alarm conditions (e.g., airborne releases or high radiation levels), and the ventilation system ~~is~~ shall be operating. A portable, gamma-sensitive ion chamber, visible from the control room, may be utilized as a temporary substitute for the required Area Radiation Monitor for a period up to 60 days.

Basis. The radiation monitors provide information to operating personnel regarding routine releases of radioactivity and any impending or existing danger from radiation. The alarm setpoints are chosen to be at levels higher than those normally encountered during routine reactor operations. Their operation will provide sufficient time to evacuate the facility or take the necessary steps to prevent the spread of radioactivity to the surroundings (SAR 11.1.6).

~~14.~~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 4.8×10^{-6} µCi/ml at the point of discharge.

Basis. If ^{41}Ar is continuously discharged at 4.8×10^{-6} µCi/ml, measurements and calculations show that ^{41}Ar released to the publicly accessible areas under the worst-case weather conditions would result in an annual TEDE of 0.5 mrem. This is only 5% of the applicable limit of 10 mrem. The calculation was performed with the Environmental Protection Agency's Comply code (SAR 11.1.1.1.4).

~~14.~~3.8 Limitations on Experiments

~~14.~~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 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:

> ~~1~~a. ~~Any~~ The absolute reactivity worth of any single movable experiment shall ~~have absolute reactivity worth~~be less than $1.00; and
>
> ~~2~~b. The absolute reactivity worth of any single secured experiment shall be less than $3.00.

Basis. The worst event which could possibly arise is the sudden removal of a movable experiment immediately prior to, or following, a pulse transient of the maximum licensed reactivity insertion. Limiting the worth of a movable experiment to less than $1.00 will ensure that the additional increase of transient power and temperature is slow enough for the high power scram to be effective and, since this transient is not a super-prompt pulse, we would not violate the 1 kW Pulse Interlock which prevents entering pulse mode above 1 kW (SAR 14.3.2.3).

The worst event that is considered in conjunction with a single secured experiment is the sudden removal of the experiment while the reactor is operating in a critical condition at a low power level. This is equivalent to pulse-mode operation of the reactor. Hence, the reactivity limitation for a single secured experiment at $3.00 is the same as that of a maximum allowed pulse, although a scram would be initiated much more quickly for the experiment removal accident~~.~~ (SAR 13.2.2.2.1 and 14.3.1.2).

~~14.~~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:

~~1~~a. Explosive materials, such as gunpowder, TNT, or nitroglycerin, in quantities greater than 25 milligrams TNT-equivalent shall not be irradiated in the reactor or irradiation facilities. Explosive materials in quantities less than or equal to 25 milligrams TNT-equivalent 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~~

~~2~~b. Each fueled experiment shall be controlled such that the total inventory of ^{131}I-^{135}I in the experiment is no greater than 1.5 curies and the total inventory of ^{90}Sr in the experiment is no greater than 5 millicuries; and~~.~~

~~3~~c. 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 materials (SAR 13.2.6.2). The 1.5-curie limitation on ^{131}I-~~—I-~~^{135}I, and the 5 millicurie limit on ^{90}Sr, ensure that in the event of a failure of a fueled-experiment involving total release of the iodine, the dose in the reactor bay and in the unrestricted area will be considerably less than that allowed by 10 CFR 20 (SAR 13.2.6).

~~14.~~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 damage to the reactor or excessive release of radioactive materials in the event of an experiment failure.

Specifications. Where the possibility exists that the failure of an experiment (except fueled experiments) 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:

~~1~~a. 100% of the gases or aerosols escape from the experiment;

~~2~~b. 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;

~~3~~c. 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

4d. 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 GSTR will result in exceeding the total dose limits to an individual as specified in 10 CFR 20.

14.3.9 This section intentionally left blank.

1.4. 14.4 Surveillance Requirements

All bases for the following surveillance requirements can be found in the operating procedures within the Reactor Operations Manual or in the R-113 reactor license, Amendments 1 and 11Safety Analysis Report. The approved operating procedures are periodically reviewed and reapproved by the Reactor Operations Committee (ROC).

4.0 General

Applicability.

This specification applies to surveillance requirements of systems related to reactor safety.

Objective.

The objective is to verify the operability of systems related to reactor safety.

Specifications.

1. Surveillance requirements may be deferred during extended reactor shutdown (except TSsection 4.3,

itemsspecification 1 and 3, and TSsection 4.7 itemspecification 2); however, deferred requirements 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.

2. Any additions or modifications to the ventilation system, the core and its

associated support structure, the pool or its penetrations, the primary coolant system, the

rod drive mechanism or the reactor safety system shall be made and tested to assure that the systems will meet their functional requirements in accordance with manufacturer specifications or specifications reviewed by the ~~Reactor Operations Committee~~ROC. A system shall not be considered operable until after it is successfully tested.

3. The reactor control and safety systems, pool water level alarm, and radiation monitoring systems shall be tested to be operable after the completion of non-routine maintenance of the respective items.

Basis.

These specifications relate to changes in reactor systems which could affect the safety of the reactor. These changes will be formally addressed by following the requirements of 10 CFR 50.59. As long as changes or replacements to these systems meet -or exceed the original design specifications, then it can be assumed that they meet the presently accepted operating criteria. Additional requirements may be needed, based on the evaluation through the 10 CFR 50.59 process. This specification is not intended to circumvent or replace the regulations in 10 CFR 50.59.

~~14.~~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, core excess reactivity, specifications for fuel element condition and verification of the total reactivity worth of each control rod.

Specifications.

1. A channel calibration shall be made of the power level monitoring channels by the calorimetric method ~~semi-~~at least annually.

2. The total reactivity worth of each control rod shall be measured following any significant change in core or control rod configuration.

3. The core shutdown margin shall be determined at least annually and following any significant change in core or control rod configuration. Significance is determined to be any reactivity change expected to be greater than $0.30, not including reactivity changes from xenon fission product poisons or experiment movements.

~~3. The shutdown reactivity shall be determined prior to each day's operation, prior to each operation extending more than one day, or following any significant change in core or control rod configuration.~~

4. The core excess reactivity shall be determined ~~prior to each day's operation~~annually or following any significant change in core or control rod configuration. Significance is determined to be any reactivity change expected to be greater than ~~30 cents~~$0.30, not including reactivity changes from xenon fission product poisons or experiment movements.

5. The mechanical stop on the transient rod shall be checked ~~prior to~~ each day when ~~pulse~~pulsing is scheduled -unless the total rod worth of the transient rod is less than $3.00.

6. Verification of core configuration to include aluminum-clad fuel only in the F and G rings of the core and to have a minimum of 110 elements in the core shall be determined by visual means prior to each day of operation.

~~5~~7. All fuel elements shall be inspected for damage or deterioration and measured for length and transverse bend at least at quinquennial intervals or if 500 pulses have been performed since the last fuel inspection.

~~6. The core shutdown margin shall be determined at an annual frequency.annually and following any significant change in core or control rod configuration. Significance is determined to be any reactivity change expected to be greater than 30 cents, not including reactivity changes from xenon fission product poisons or experiment movements.~~

~~7.~~NOTE: These checks are not required if reactor fuel has been removed from the tank.~~the reactor core has been defueled.~~

Basis. Experience has shown that the identified frequencies will ensure performance and operability for each of these systems or components. Movement of the core components could change the reactivity of the core and thus affect both the core excess reactivity and the shutdown margin, as well as affecting the worth of the individual control rods. Evaluation of these parameters is therefore required after any such movement. Without any such movement, the changes of these parameters over an extended period of time and operation of the reactor have been shown to be small, so that an annual measurement is sufficient to ensure compliance with the specifications. Experience at TRIGA reactors indicates that examination of a five-year cycle is adequate to detect problems. A five-year cycle reduces the handling of the fuel elements and thus reduces the risk of accident or damage due to handling.

~~14.~~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 which are directly related to reactor safety.

Specifications.

1. The control rods shall be visually inspected for damage or deterioration at least biennially.

2. The scram time shall be measured ~~semi-~~at least annually or after any repair or non-routine maintenance is performed on a control rod drive.

~~3. The transient rod drive cylinder and associated air supply system shall be inspected and cleaned semi-annually and lubricated as necessary.~~

~~4~~3. A channel check of each of the reactor safety system channels in Table ~~14~~3.2 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. The same channel checks shall be performed after modifications or repairs to the scram channels to ensure operability of the respective channels.

~~5~~4. A channel test of items in Table 3.2 relating to pulsing shall be performed during each startup for pulse mode operation. A channel test of each other item in Table ~~14~~3.2 and ~~14~~3.3 in section ~~14.~~3.2.3, other than ~~power measuring channels~~the NM1000, shall be performed at least semi-annually.

~~6~~NOTE:~~.~~ These checks are not required if the reactor ~~core has been defueled.~~~~reactor~~ fuel has been removed from the tank.

Basis. Inspection of the control rods allows early detection of signs of deterioration indicated by signs of changes of corrosion patterns or of swelling, bending, or elongation. ~~Experience at TRIGA reactors indicates that examination of a five-year cycle is adequate to detect problems. A five-year cycle reduces the handling of the fuel elements and thus reduces the risk of accident or damage due to handling.~~ The channel checks performed daily before operation and after any modifications or repairs provide timely assurance that the systems will operate properly during operation of the reactor.
Experience has shown that the identified frequencies will ensure performance and operability for each of these systems or components.

~~14.~~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 the bulk water temperature monitoring systems are operating~~,~~ and to verify appropriate alarm settings.

Specifications.

1. A channel check of the reactor tank water level alarm setpoint shall be performed at least semi-annually.

2. A channel check of the reactor tank bulk water temperature alarm setpoint shall be performed quarterly. A channel calibration of the reactor tank bulk water temperature system shall be performed at least annually.

3. The reactor tank water conductivity shall be measured monthly. ~~unless the reactor tank is drained.~~

~~4. The reactor tank water pH shall be measured quarterly if aluminum-clad fuel is in the core.~~

~~5.~~NOTE: These checks are not required if the reactor ~~core is defueled and the water level is below the purification system suction.~~fuel has been removed from the tank.

Basis. Experience has shown that the frequencies of checks on systems which monitor reactor primary water can adequately keep the tank water at the proper level and maintain water quality at such a level to minimize corrosion and maintain safety. Experience at the GSTR shows that the surveillance specification on the conductivity is adequate to detect the onset of degradation of the quality of the pool water in a timely fashion. Experience also indicates that the surveillance specification on pool water level and pool water temperature are adequate to detect losses of pool water in a timely manner and to enable operators to take appropriate action when the coolant temperature approaches the specified limit. The quarterly and annual surveillances of the temperature monitor are also adequate to assure operability of the temperature channel. The pool water level alarm system is a reliable unit and therefore the specification of a~~n~~ semiannual test is sufficient to assure operability of the pool water level alarm.

~~14.~~4.4 This section intentionally left blank.

~~14.~~4.5 Ventilation and Confinement System

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

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

Specifications.

1. A channel check of the reactor bay 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.

2. A channel ~~check~~ test of the reactor bay ventilation system's ability to automatically switch to the emergency mode upon actuation of the CAM high alarm shall be performed quarterly.

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

~~14.~~4.6 This section intentionally left blank.

~~14.~~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.

1. A channel check of the radiation ~~monitoring systems in section 14.3.7.1~~area monitor and continuous air monitor shall be performed ~~prior to each day's operation or prior to each operation extending more than one day.~~ monthly.

2. A channel test of the continuous air monitor shall be performed ~~monthly.~~quarterly.

3. A channel calibration of the radiation ~~monitoring systems in section 14.3.7.1~~area monitor and continuous air monitor and ^{41}Ar monitor shall be performed annually.

4. The environmental dosimeters shall be changed and evaluated at least 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. The frequency of changing and evaluating environmental dosimeters are also adequate to provide the required record based on past experience.

~~14.~~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 conduct of experiments which may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.

Specifications.

1. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before routine reactor operation with that experiment to ensure that the limits of ~~specification~~section 3.7.1 are not exceeded.

2. 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 s~~S~~ection ~~14.3.8~~ 3.8.2 and 3.8.3 by the Reactor Supervisor or ~~Reactor Operations Committee~~ROC in full accord with s~~S~~ection ~~14.~~6.2.3 ~~of these Technical Specifications~~, and the procedures which are established for this purpose.

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

~~14.~~4.9 This section intentionally left blank.

~~2.~~5. ~~14.5~~ Design Features

~~14.~~5.1 Site and Facility Description

Applicability. This specification applies to the U.S. Geological Survey TRIGA Reactor site location and specific facility design features.

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

Specifications.

1. ~~The restricted area is that area inside the fence surrounding the reactor portion of the building and the reactor operations area within the building itself. The unrestricted area is that area outside the reactor operations area and the fence surrounding the reactor portion of the building.~~The licensed area includes the following locations on the Denver Federal Center:

   a. Building 15: Rooms 149 through 152, Rooms 154, 157, 158, B10A and B11;

   b. Area inside the wrought iron fence and south cooling tower wall that is near the SW corner of Building 15;~~.~~

   c. Building 10: Room 2.

2. ~~Building 15 houses the TRIGA reactor and other research laboratories.~~The reactor bay volume is a 12000 cubic feet, and it is designed to restrict leakage.

3. The reactor facility shall be equipped with ventilation systems designed to exhaust air ~~or~~ and other gases from the reactor bay and release them from vertical level at least 21 feet above ground level.

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

Basis. The reactor building and site description are strictly defined (SAR Chapter 2). The facility is designed such that the ventilation system will normally maintain a negative pressure in the reactor bay with respect to the outside atmosphere so that there will be no uncontrolled leakage to the unrestricted

environment. Controls for normal and emergency 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 minimum exposure to operating personnel (SAR 9.1 and 13.2.1).

~~14.~~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.

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

2. The tank water inlet and outlet pipes to the heat exchanger and to the demineralizer shall be equipped with siphon breaks 14 feet above the top of the core or higher.

~~3. A tank water level alarm shall be provided to indicate loss of coolant prior to the tank level dropping more than 24 inches below the top lip of the tank.~~

~~4. A bulk tank water temperature alarm shall be provided to indicate high bulk water temperature prior to the temperature exceeding 60 °C.~~

~~5.~~NOTE: These specifications are not required to be met if the reactor core has been defueled.

Basis.

1. This specification is based on thermal and hydraulic calculations which 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 (SAR 4.5.4.5).

2. 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 (SAR 5.2).

~~3. Loss-of-coolant alarm caused by the water level dropping more than 24 inches below the top lip of the tank provides a timely warning so that corrective action can be initiated. This alarm is located in the control room (SAR 5.2).~~

~~4. The bulk water temperature alarm provides warning so that corrective action can be initiated in a timely manner to protect the quality of the ion exchange resin. The alarm is located in the control room (SAR 7.2.3.2).~~

~~14.~~5.3 Reactor Core and Fuel

~~14.~~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.

1. The core shall be an arrangement of TRIGA uranium-zirconium hydride fuel-moderator elements positioned in the reactor grid plate.

2. The TRIGA core assembly may consist of stainless-steel clad fuel elements (8.5 to 12.0 wt% uranium), aluminum-clad fuel elements (8.0 wt% uranium), or a combination thereof. ~~Aluminum-clad fuel elements are restricted to locations in the F or G rings.~~

3. 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 core may also contain two separated experiment positions in the D through E rings, each occupying a maximum of three fuel element positions.

4. ~~Core~~ G-ring grid positions may be empty (water filled).

5. The reflector, excluding experiments and irradiation facilities, shall be graphite, water, or a combination of graphite and water. A reflector is not required if the core has been defueled.

Basis.

1. Standard TRIGA cores have been in use for years and their characteristics are well documented. Analytic studies performed at GSTR for a variety of mixed fuel arrangements indicate that such cores with mixed loadings would safely satisfy all operational requirements (SAR 4.2).

2. 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 (SAR 4.2).

~~14.~~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.

1. The shim 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.

2. The transient control rod shall have scram capability and contain borated graphite, B_4C powder or boron, with its compounds in a solid form as a poison in an aluminum or stainless steel cladding. The transient rod drive mechanism 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 with its compounds in a solid form. These materials must 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 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 more detailed description of the control rods and their properties can be found in SAR 4.2.2.

~~14.~~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.

1. Aluminum-clad TRIGA fuel. The individual unirradiated aluminum-clad fuel elements shall have the following characteristics:

   a. Uranium content: nominally 8.0 wt% enriched to a nominal 20% ^{235}U;

   b. Hydrogen-to-zirconium atom ratio nominally 1 to 1; and

   c. Cladding is aluminum of a nominal 0.030 inch thickness.

2. Stainless-steel clad TRIGA fuel. The individual unirradiated standard TRIGA fuel elements shall have the following characteristics:

   a. Uranium content: nominal range of ~~of~~ 8.5 to 12.0 wt% enriched to a nominal 20% ^{235}U;

b. Hydrogen-to zirconium atom ratio nominally between 1.6 to 1 and 1.7 to 1; and

c. Cladding is 304 stainless steel of a nominal 0.020 inch thickness.

Basis.

1. A nominal uranium content of 8 wt% in an aluminum-clad TRIGA element is less than the traditional stainless-steel clad element design value of 8.5 wt%. Such a decrease gives a lower power density. The nominal hydrogen-to-zirconium ratio of 1 to 1 could result in a phase change of the ZrH if fuel temperature is allowed to exceed 535 °C. Although this would not necessarily cause a rupture of the fuel cladding, it would cause distortion and stressing of the cladding.

2. A maximum nominal uranium content of 12 wt% in a standard TRIGA element is about 50% greater than the lower-loaded nominal value of 8.5 wt%. Such an increase in loading would result in an increase in power density of less than 50%.

An increase in local power density of 50% reduces the safety margin by, at most, 10%. The maximum hydrogen-to-zirconium ratio of 1.7 to 1 could result in a maximum stress under accident conditions to the fuel element cladding of about a factor of 1.5 greater than the value resulting from a hydrogen-to-zirconium ratio of 1.6. However, this increase in the cladding stress during an accident would not exceed the rupture strength of the cladding.

~~14.~~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 which is being stored shall not become critical and shall not reach an unsafe temperature.

Specifications.

1. All fuel elements shall be stored in a geometrical array where the k-effective is less than 0.9 for all conditions of moderation.

2. 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 design values.

3. If stored in water, the water quality must be maintained according to ~~specification~~section 3.3.b.

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

~~3.~~6. ~~14.6~~ Administrative Controls

~~14.~~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. The minimum qualification for all members of the reactor operating staff shall be in accordance with ANSI/ANS 15.4, "Standard for the Selection and Training of Personnel for Research Reactors."

~~14.~~6.1.1 Structure

The reactor administration shall be related to the USGS and USNRC structure as shown in Figure ~~14.~~1.

~~14.~~6.1.2 Responsibility

The following specific organizational levels~~,~~ and responsibilities shall exist:

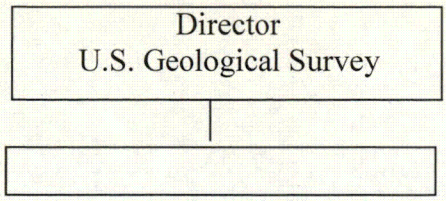
~~1. USGS Director (Level 1): The Director is accountable for ensuring that all regulatory requirements, including implementation and enforcement, are in accordance with all requirements of the USNRC and the Code of Federal Regulations.~~

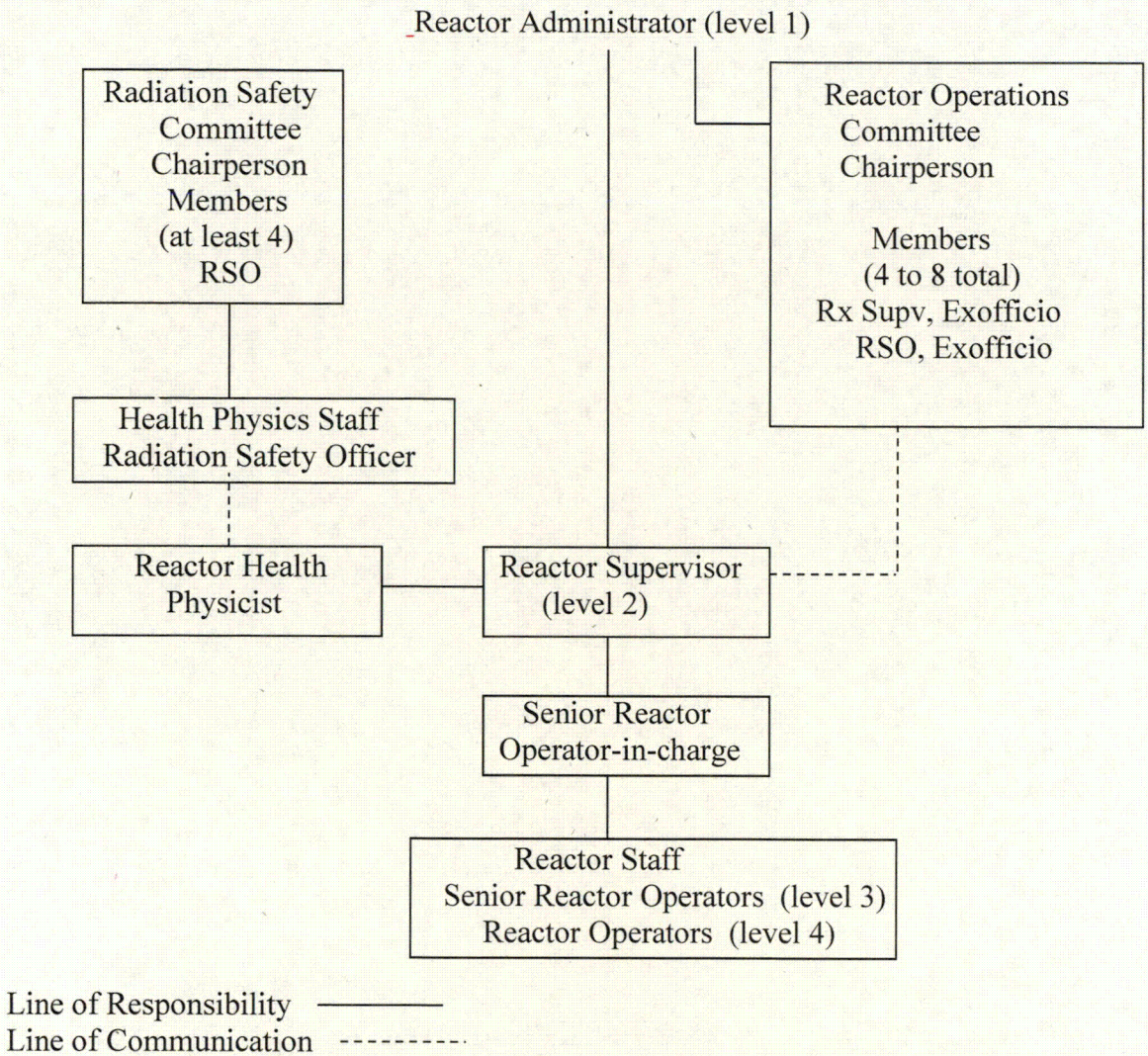
a~~1.~~~~2.~~ Reactor Administrator (Level ~~2~~1): The Reactor Administrator is responsible to the USGS Director and is responsible for guidance, oversight, and management support of reactor operations;~~,~~

~~3~~b~~2~~. Reactor Supervisor (Level ~~3~~2): 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;~~,~~

~~4~~c~~3~~. ~~Reactor Operator and~~ Senior Reactor Operator (Level ~~4~~3): The ~~Reactor Operator and~~ Senior Reactor Operators report to the Reactor Supervisor and are primarily involved in the oversight and direct manipulation of reactor controls, ~~monitoring of instrumentation, and~~oversight and direct operation and maintenance of reactor related equipment, and oversight of recovery from unplanned shutdowns;~~,~~ and

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





1: Administrative Structure

~~14.~~6.1.3 Staffing

1. The minimum staffing when the reactor is ~~operating~~ not secured shall be:

   a. A Licensed Operator in the control room;

   b. A second ~~facility staff~~ person present ~~or on call; and on call means an individual~~within the Denver Federal Center who~~:~~ is able to carry out prescribed instructions; ~~and~~

c. If neither of these two individuals is a Senior Reactor Operator, a Senior Reactor Operator 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~~ii. Can be contacted by phone, within 5 minutes, by the operator on duty~~,~~; and

iii~~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).

~~i. Can be reached by an available communication method within 5 minutes and~~

~~ii. Is capable of getting to the reactor facility within 30 minutes under normal conditions,~~

~~iii. Is within a 15 mile radius of the reactor facility.~~

~~c. A SRO shall be reachable by any communication method and capable of getting to the reactor facility within 30 minutes under normal conditions or is within a 15 mile radius of the reactor facility.~~

d. It is not necessary to have a SRO on call if the Reactor Operator in the control room is a SRO. If the Reactor Operator in the control room is a SRO, a second person shall be available at the facility or on call~~.~~; and

~~e~~e. A list of facility personnel and contact information shall be available to the operator on duty.

2. Events requiring the direction of a Senior Reactor Operator

a. Initial approach to critical ~~for each day's first critical operation;~~after each completed shutdown checklist;

b. ~~Reactor start-up and~~Initial approach to power after each completed shutdown checklist;

c. All fuel or control rod relocations within the reactor core region;

d. Relocation of any in-core components (other than normal control rod movements) or irradiation facility with a reactivity worth greater than one dollar; or

e. Recovery from an unscheduled shutdown or an unscheduled significant (>50%) power reduction.

~~14.~~6.1.4 Selection and Training of Personnel

The selection, training and requalification of operations personnel shall ~~be in accordance~~follow the guidance of ~~with~~ ANSI/ANS 15.4-2007, "Standard for the Selection and Training of Personnel for Research Reactors."

~~14.~~6.2 Review a~~A~~nd Audit

The ~~Reactor Operations Committee (~~ROC~~)~~ shall have primary responsibility for review and audit of the safety aspects of reactor facility operations.

~~14.~~6.2.1 Composition and Qualifications

The ~~Reactor Operations Committee~~ROC shall be composed of at least four voting members, including the Chairman. All members of the Committee shall be knowledgeable in subject matter related to reactor operations. To expedite Committee business, a Committee Chairman may be appointed. The Chairman of the ~~Reactor Operations Committee~~ROC is listed by name on the ~~Reactor Operations~~ Committee roster.

The Committee is appointed by the USGS Director~~, U.S. Geological Survey~~. No definite term of service is specified; but should a vacancy occur in the Committee, the Director will appoint a replacement. The remaining members of the Committee will be available to assist the Director in the selection of new members. The Reactor Supervisor and the Radiation Safety Officer are ex-officio members of the Committee, and the Reactor Supervisor is the only non-voting member of the Committee. The ROC reports to the Reactor Administrator.

~~14.~~6.2.2 Charter and Rules

The ~~Reactor Operations Committee~~ROC consists of USGS members and non-USGS members, and the Committee must meet at least semi-annually.

Criteria have been established for the conduct of the meetings and a charter for the Committee is written in the USGS Survey Manual. Dissemination and review of Committee minutes shall be done within 60 days of each respective Committee meeting.

A quorum for review, audit, and approval purposes shall consist of not less than one-half of the committee membership, provided that the operating staff does not constitute a majority of the committee membership. The Chairperson or an alternate must be present at all meetings in which the official business of the committee is being conducted. Approvals~~‡~~ by the committee shall require an affirmative vote by a majority of the non-Survey members present and an affirmative vote by a majority of the Survey members present.

~~‡ ``Approval'' as used in this section shall mean approval for substantive issues, including Class II Experiments, 10 CFR 50.59 changes, license amendments or any other matters designated by the Reactor Administrator, the Reactor Supervisor, or the Reactor Operations Committee. Minor issues will continue to be handled by the reactor staff and the Reactor Supervisor as described elsewhere in the Reactor Operations Manual.~~

~~14.~~6.2.3 Review and Audit Function

Semi-annual meetings will be held to review and audit reactor operations.

The following items shall be reviewed:

~~1~~a. Determinations that proposed changes in the facility, procedures, tests, or experiments ~~equipment, systems, test, experiments, or procedures~~ are allowed without prior authorization by the responsible authority, ~~for example,~~as detailed in 10 CFR 50.59~~ or 10 CFR 830~~;

~~2~~b. All new procedures and major revisions thereto having safety significance, proposed changes in reactor facility equipment, or systems having safety significance;

~~3~~c. All new experiments or classes of experiments that could cause a reactivity change near a technical specification limit or result in the release of radioactivity;

~~4~~d. Proposed changes in technical specifications, license, or charter;

~~5~~e. Violations of technical specifications, license, or charter. Violations of internal procedures or instructions having safety significance;

~~6~~f. Operating abnormalities having safety significance;

~~7~~g. Reportable occurrences listed in section ~~14.~~6.7.2; and

~~8~~h. Audit reports.

A written report or minutes of the findings and recommendations of the review group shall be submitted to the Reactor Administrator and the review and audit group members ~~in a timely manner~~within 3 months after the review has been completed.

The audit function shall include selective (but comprehensive) examination of operating records, logs, and other documents. Discussions with cognizant personnel and observation of operations should be used also as appropriate. In no case shall the individual immediately responsible for the area perform an audit in that area. The following items shall be audited:

~~1~~a. Facility operations for conformance to the technical specifications and applicable license or charter conditions: at least once per calendar year (interval between audits not to exceed 15 months);

~~2~~b. The retraining and requalification program for the operating staff: at least once every other calendar year (interval between audits not to exceed 30 months);

~~3~~c. The results of action taken to correct those deficiencies that may occur in the reactor facility equipment, systems, structures, or methods of operations that affect reactor safety: at least once per calendar year (interval between audits not to exceed 15 months); and

4d. The reactor facility emergency plan and implementing procedures: at least once every other calendar year (interval between audits not to exceed 30 months).

Deficiencies uncovered that affect reactor safety shall immediately be reported to the Reactor Administrator. A written report of the findings of the audit shall be submitted to the Reactor Administrator and the review and audit group members within 3 months after the audit has been completed.

These meetings will also include annual audits of the reactor facility and reactor records by the Committee. ~~New Class I Experiments approved by the Reactor Supervisor will be discussed. Any new Class II Experiments pending or any business which requires Committee approval will be handled in the following manner.~~

~~1. The Reactor Supervisor will request a meeting of Survey members.~~

~~2. If the experiment is approved by them, the Reactor Supervisor will communicate the recommendations of the local group, along with the proposed experimental details to Non-Survey Members. The Reactor Supervisor shall provide adequate detail, either verbal, or in writing to the out-of-town members to allow an informed decision. The decisions, with comments and discussions, shall be documented for future review and audit purposes.~~

~~3. Approval to proceed will be given by the Reactor Operations Committee Chairman, who will sign the experiment application document to indicate Committee approval.~~

~~4. If the experiment cannot be approved in this manner, the experiment application document will be distributed to all Committee members for further discussion and will be placed on the agenda of the next full Committee meeting.~~
~~Normally the non-Survey members will attend only every other semi-annual meeting. These full Committee meetings are generally scheduled each spring. Special meetings for the review of specific problems or urgent Class II Experiments will be called whenever necessary.~~

~~A Quarterly Report will be prepared by the Reactor Supervisor for the members of the Committee. This report will be in sufficient detail to allow members of the Committee to review the safety standards associated with the operation and use of the reactor facility. Each Quarterly Report will include a synopsis of all experiments approved during the period to ensure that the intent and function of the Committee, as mentioned in the Technical Specifications is being maintained.~~

~~14.6.2.4 Inactive Member Status~~

~~Committee members will be considered on inactive status should prolonged absences from their normal business address not allow them to participate in routine Committee business. The Committee Chairperson is responsible to ensure the function of the Committee is not diluted so as to be ineffective by such actions and will recommend the appointments of alternates if the need arises.~~

~~The Reactor Supervisor will ensure that any members who are unable to attend a Reactor Operations Committee meeting, or are on inactive status due to other commitments, will be kept informed of all Committee business.~~

~~14.~~6.3 Radiation Safety

The Reactor Supervisor, in coordination with the Reactor 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 15.11-2009, ``Radiation Protection at Research Reactor Facilities.''

~~14.~~6.4 Procedures

Written operating procedures shall be ~~adequate~~ prepared, reviewed, and approved 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. Procedures shall be in effect and in use for the following items:

~~1~~a. ~~Performing reactor experiments;~~Surveillance checks, calibrations, and inspections that are required by Technical Specifications;

~~2~~b. Startup, operation and shutdown of the reactor;

~~3~~c. Implementation of e~~E~~mergency and security ~~situations;~~ plans;

~~4~~d. Core changes and fuel movement;

~~5. Control rod removal and replacement;~~

e~~6~~. Performing maintenance on major components that could ~~which may~~ affect reactor safety;

f~~7~~. Administrative controls for operations, maintenance, and experiments that could affect reactor safety;

~~8. Power calibration;~~

g~~9~~. Radiation protection, including ALARA requirements; and

h~~10~~. Use, receipt and transfer of licensed radioactive material, if appropriate.

~~Substantive changes to the above procedures shall be made only with the approval of the ROC. Except for radiation protection procedures, unsubstantive changes shall be approved prior to implementation by the Reactor Supervisor and documented by the Reactor Supervisor within 90 days of implementation. Unsubstantive changes to radiation protection procedures shall be approved and documented by the Reactor Health Physicist within 90 days of implementation.~~

~~14.~~6.5 Experiment Review and Approval

~~Administrative requirements are in place at the GSTR to ensure that all experiments are performed in a manner which will ensure the protection of the public. Experiment review meets the requirements of Regulatory Guide 2.2, and Standard ANSI N401-1974 (ANS-15.6) as modified by Regulatory Guide 2.4.~~

All experiments proposed for the reactor will be either Class I or Class II experiments. The classification of the proposed experiments will be the responsibility of the Reactor Supervisor.

Class I experiments include all experiments that have been run previously or that are minor modifications to a previous experiment. These are experiments which involve small changes in reactivity, no external shielding changes, and/or limited amounts of radioisotope production. The Reactor Supervisor has the authority to approve the following, as part of the 10 CFR 50.59 process:

~~1~~a. Experiments for which there exists adequate precedence for assurance of safety;~~.~~

~~2~~b. Experiments which represent less than that amount of reactivity worth necessary for prompt criticality;~~.~~ or

~~3~~c. Experiments in which any significant reactivity worth is stable and mechanically fixed, that is, securely fastened or bolted to the reactor structure.

Class II experiments include all new experiments and major modifications of previous experiments. These experiments must be reviewed and approved, as part of the 10 CFR 50.59 process, by ~~the Reactor Operations Committee~~ROC before being run. The Radiation Safety Committee may also be consulted. These experiments may involve larger changes in reactivity, external shielding changes, and/or larger amounts of radioisotope production. These include:

~~1~~a. In-core experiments which involve, in an unstable form, reactivity worth greater than that necessary to produce a prompt critical condition in the reactor core;~~.~~

~~2~~b. Experiments involving corrosive chemicals, pressures or temperatures which, if failure should occur, could endanger the safety of the reactor core;~~.~~

~~3~~c. Dynamic experiments which could introduce appreciable reactivity worth into the reactor by failure or malfunction. Included in this group are circulation systems which operate in or at the core and by which if a failure occurred, the core could be damaged;~~.~~

~~4~~d. Experiments which are dynamically coupled to the reactor core and together function as a system, i.e. to measure nuclear absorption cross sections, or study transient responses;~~.~~

~~5~~e. Experiments which interfere in any way with the normal function of any of the reactor safety circuits;~~.~~

~~6~~f. Experiments which could produce radiation levels sufficient to cause serious personnel radiation injury;~~.~~ or

~~7~~g. Experiments which by their unusual hazard could produce injury or death.

~~The radioisotopes produced at the GSTR may only be transferred to licensed users. Individuals associated with the U.S. Geological Survey may be approved to receive radioactive material under the authority of the USGS license by the USGS Radiation Safety Committee. Other users must have a current Radioactive Material License. This information is verified during the approval of the experiment, prior to performance of the experiment.~~

~~14.~~6.6 Required Actions

~~14.~~6.6.1 Actions to Be Taken in Case of Safety ~~System Setting~~Limit Violation

In the event a safety ~~system setting~~ limit ~~(steady state power level of 1.1 MW)~~ is exceeded:

a. The reactor shall be shutdown and reactor operation shall not be resumed until authorized by the NRC;

b. An immediate notification of the occurrence shall be made to the Reactor Supervisor, Reactor Administrator, ROC; and

c. A report, and any applicable follow-up report, shall be prepared and submitted to the NRC. The report shall describe the following:

i. Applicable circumstances leading to the violation including, when known, the cause and contributing factors;

ii. Effects of the violation upon reactor facility components, systems, or structures and on the health and safety of personnel and the public; and

iii. Corrective action to be taken to prevent recurrence.

~~1. The reactor shall be shut down and reactor operation shall not be resumed until authorized by the Reactor Operations Committee;~~

~~2. An immediate notification of the occurrence shall be made to the Reactor Administrator, ROC Chairperson; and~~

~~3. Reports shall be made to the USNRC in accordance with Section 14.6.7.2 of these Technical Specifications. The written report (required within 14 days) shall include an analysis of the causes and extent of possible resultant damage, efficacy of corrective action, and recommendations for measures to prevent or reduce the probability of recurrence. This report shall be submitted to the ROC for review and submitted to the NRC when authorization is sought to resume operation of the reactor.~~

~~14.~~6.6.2 Actions to Be Taken in the Event of an Occurrence of the Type Identified in Section ~~14.~~6.7.2 Other than a Safety ~~System Setting~~Limit Violation

For all events which are required by ~~regulations or~~ Technical Specifications to be reported to the NRC within 24 hours under s~~S~~ection ~~14.~~6.7.2, except a safety ~~system setting~~limit violation, the following actions shall be taken:

~~1~~a. The reactor shall be secured and the Reactor Supervisor notified;

~~2~~b. Operations shall not resume unless authorized by the Reactor Supervisor;

~~3~~c. The ~~Reactor Operations Committee~~ROC shall review the occurrence at their next scheduled meeting; and

~~4~~d. Where appropriate, a report shall be submitted to the NRC in accordance with s~~S~~ection ~~14.~~6.7.2 ~~of these Technical Specifications~~.

~~14.~~6.7 Reports

~~14.~~6.7.1 Annual Operating Report

An annual report covering the previous calendar year shall be created and submitted, no later than March 31 of the year following the report period, by the Reactor Supervisor to the ~~US~~NRC consisting of:

~~1~~a. A brief summary of operating experience including the energy produced by the reactor and the hours the reactor was critical;

~~2~~b. The number of unplanned shutdowns, including ~~reasons therefore~~corrective actions taken (when applicable);

~~3~~c. A tabulation of major preventative and corrective maintenance operations having safety significance;

~~4~~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;

~~5~~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;

~~6~~f. ~~-~~A summarized result of environmental surveys performed outside the facility; ~~and~~

~~7~~g. A summary of exposures received by facility personnel and visitors where such exposures are greater than 25% ~~percent~~ of that allowed;~~.~~ and

h. Results of fuel inspections (when performed).

~~14.~~6.7.2 Special Reports

In addition to the requirements of applicable regulations, and in no way substituting therefore, reports shall be made by the Reactor Supervisor to the NRC as follows:

a~~1~~. A report within 24 hours by telephone, digital submission, or fax to the NRC Operations Center followed by a written report within 14 days that describes the circumstances associated with any of the following:

~~a~~i. Any ~~accidental~~ release of radioactivity above applicable limits into unrestricted areas, whether or not the release resulted in property damage, personal injury, or exposure;

ii~~b~~. Any violation of a safety limit;

iii~~c~~. Operation with a ~~safety system setting~~LSSS less conservative than specified in the Technical Specifications;

iv~~d~~. Operation in violation of a Limiting Condition for Operation;

v~~e~~. Failure of a required reactor safety system component which could render the system incapable of performing its intended safety function unless the failure is discovered during maintenance tests or periods of reactor shutdown;

vi~~f~~. Any unanticipated or uncontrolled change in reactivity greater than $1.00;

vii~~g~~. An observed inadequacy in the implementation of either administrative or procedural controls, such that the inadequacy could have caused the existence or development of a condition which could result in operation of the reactor outside the specified safety limits; or

viii~~h~~. Abnormal and significant degradation in reactor fuel, cladding, or coolant boundary

~~A release confirmed to be fission products greater than 10 CFR 20 values from a fuel element;~~

b~~2~~. A report within 30 days in writing to the NRC, Document Control Desk, Washington, D.C. of:

i~~a~~. Permanent changes in the facility organization involving Level 1-2 personnel; or

ii~~b~~. Significant changes in the transient or accident analyses as described in the Safety Analysis Report.~~;~~

~~14.~~6.8 Records

~~14.~~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

1. Normal reactor operation (but not including supporting documents such as checklists, data sheets, etc., which shall be maintained for a period of at least two years);

2. Principal maintenance activities;

3. Reportable occurrences;

4. Surveillance activities required by the Technical Specifications;

5. Reactor facility radiation and contamination surveys;

6. Experiments performed with the reactor;

7. Fuel inventories, receipts, and shipments;

8. Approved changes to the operating procedures; and

9. ~~Reactor Operations Committee~~ ROC meetings and audit reports.

~~14.~~6.8.2 Records to be Retained for at least One ~~Certification Cycle~~Operator License Term

1. Records of retraining and requalification of Reactor Operators and Senior Reactor Operators shall be retained for at least one ~~certification cycle.~~license term;~~.~~ and

2. Records of ~~the most recently completed certification cycle for an individual shall be maintained at least as long as that individual is employed at the facility.~~retraining and requalification of licensed operators shall be maintained while the individual is employed by the ~~the~~ licensee, or until that operator's license is renewed, whichever is shorter.

~~14.~~6.8.3 Records to be Retained for the Lifetime of the Reactor Facility

1. Gaseous and liquid radioactive effluents released to the environs;

2. Offsite environmental monitoring surveys;

3. Reviews and reports pertaining to a violation of the safety limit, the limiting safety system setting, or a limiting condition of operation;

~~3~~4. Radiation exposures for all personnel monitored; and

~~4~~5. Drawings of the reactor facility.