August 31, 2016

Dr. Sean McDeavitt, Director
Nuclear Science Center
Texas Engineering Experiment Station
1095 Nuclear Science Road, MS 3575
College Station, TX 77843

SUBJECT: TEXAS ENGINEERING EXPERIMENT STATION/TEXAS A&M UNIVERSITY SYSTEM – ISSUANCE OF AMENDMENT NO. 18 TO RENEWED FACILITY OPERATING LICENSE NO. R-83 FOR THE RECEIPT AND POSSESSION OF THE AGN-201M REACTOR FUEL

Dear Dr. McDeavitt:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 18 to Renewed Facility Operating License No. R-83 for the Texas A&M University System, Nuclear Science Center Reactor. This amendment consists of changes to the technical specifications (TSs) and license conditions in response to your application dated October 14, 2015, as supplemented by letters dated November 18, 2015, and March 3, March 15, March 18, May 11, August 2, and August 24, 2016.

The amendment revises the fuel storage requirements listed in TS 5.6 and the license conditions associated with the possession limits for byproduct and special nuclear materials.

A copy of our safety evaluation is also enclosed. If you have any questions, please contact me at (301) 415-3936 or by electronic mail at Patrick.Boyle@nrc.gov.

Sincerely,

/RA/

Patrick G. Boyle, Project Manager
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Amendment No. 18 to Renewed
   Facility Operating License No R-83
2. Safety Evaluation

cc: w/enclosures: See next page

cc:

Mayor, City of College Station
P.O. Box Drawer 9960
College Station, TX 77840-3575

Governor's Budget and
Policy Office
PO Box 12428
Austin, Texas 78711-2428

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Texas Commission on Environmental
Quality
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Austin, TX 78711-3087

Test, Research and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

Mr. Scott Miller, Manager
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College Station, TX 77843

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Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Amendment No. 18 to Renewed Facility Operating License No R-83
2. Safety Evaluation

cc: w/enclosures: See next page

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NAME	PBoyle	NParker	MYoung	AAdams	PBoyle
DATE	6/8/2016	6/7/2016	8/30/16	7/29/2016	8/31/2016

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TEXAS ENGINEERING EXPERIMENT STATION TEXAS A&M UNIVERSITY SYSTEM

DOCKET NO. 50-128

NUCLEAR SCIENCE CENTER

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 18
Renewed License No. R-83

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

   A. The application for amendment to the Texas Engineering Experiment Station/Texas A&M University System, Nuclear Science Center, (the facility), Renewed Facility Operating License No R-83 filed by the Texas Engineering Experiment Station/Texas A&M University System (the licensee), dated October 14, 2015, as supplemented on November 18, 2015, and March 3, March 15, March 18, May 11, August 2, and August 24, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 Commission's regulations 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.

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

Enclosure 1

2. Accordingly, the license is amended by adding license conditions 2.B.2.d, 2.B.2.e, and 2.B.3.d to read as follows:

   2. Pursuant to the Act and 10 CFR Part 70, the following activities are included:

      d. To receive, possess, but not use up to 0.7 kilograms of contained Uranium-235 as <20% enriched ^{235}U Fuel – AGN -201M, and any special nuclear materials produced by the operation of the AGN-201M reactor, for up to 5 years from the date of issuance of License Amendment No. 18.

      e. To receive, possess, but not use up to 0.020 kilograms of ^{239}Pu as a $^{239}PuBe$ AGN-201M Neutron Start Up Source in connection with storage of the AGN-201M reactor for up to 5 years from the date of issuance of License Amendment No. 18.

   3. Pursuant to the Act and 10 CFR Part 30, the following activities are included:

      d. to receive, possess, but not use, byproduct materials including contaminated or activated Fuel - AGN-201M and AGN-201M Neutron Start Up Source for up to 5 years from the date of issuance of License Amendment No. 18.

3. Accordingly, the license is amended by changes to the technical specifications as indicated in the attachment to this license amendment, and paragraph 2.C.2 of Renewed Facility Operating License No. R-83 is hereby amended to read as follows:

   Technical Specifications

   The Technical Specifications contained in Appendix A, as revised by Amendment 18, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

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

FOR THE NUCLEAR REGULATORY COMMISSION

/Mirela Gavrilas for RA/

Alexander Adams, Jr., Chief
Research and Test Reactors Licensing Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License
and Technical Specifications

Date of Issuance: August 31, 2016

ATTACHMENT TO LICENSE AMENDMENT NO. 18

RENEWED FACILITY OPERATING LICENSE NO. R-83

DOCKET NO. 50-128

Replace the following pages of the Renewed Facility Operating License with the revised pages. The revised pages are identified by amendment number and contains a vertical line indicating the area of change.

Renewed Facility Operating License No. R-83

REMOVE	INSERT
3	3
4	4

c. to receive, possess, and use, but not separate, in connection with the operation of the facility, such special nuclear material as may be produced by the operation of the facility.

d. To receive, possess, but not use up to 0.7 kilograms of contained Uranium-235 <20% enriched ^{235}U Fuel – AGN-201M, and any special nuclear materials produced by the operation of the AGN-201M reactor, for up to 5 years from the date of issuance of License Amendment No. 18.

e. To receive, possess, but not use up to 0.020 kilograms of ^{239}Pu as a ^{239}PuBe AGN-201M Neutron Start Up Source in connection with storage of the AGN-201M reactor for up to 5 years from the date of issuance of License Amendment No. 18.

3. Pursuant to the Act and 10 CFR Part 30, the following activities are included:

a. to receive, possess, and use, in connection with the operation of the facility, a sealed antimony-beryllium neutron startup source,

b. to receive, possess, and use, in connection with the operation of the facility, a sealed 2.5-curie americium-beryllium neutron source; and,

c. to receive, possess, and use, in connection with operation of the facility, such byproduct material as may be produced by operation of the reactor, which cannot be separated except for byproduct material produced in reactor experiments.

d. to receive, possess, but not use, byproduct materials including contaminated or activated Fuel - AGN-201M and AGN-201M Neutron Start Up Source for up to 5 years from the date of issuance of License Amendment No. 18.

4. Pursuant to the Act and 10 CFR Part 40, "Domestic Licensing of Source Material," to receive, possess, and use in connection with operation of the facility, not more than 6.8 kilograms of source material.

C. This license shall be deemed to contain, and is subject to the conditions specified 10 CFR Parts 20, 30, 40, 50, 51, 55, 70, and 73 of the Commission's regulations; is subject to all 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. <u>Maximum Power Level</u>

The licensee is authorized to operate the reactor at a steady-state power level up to a maximum of 1000 kilowatts (thermal) and to pulse the reactor in accordance with the limitations in the Technical Specifications.

2. <u>Technical Specifications</u>

   The Technical Specifications contained in Appendix A, as revised by license Amendment No. 18, are hereby incorporated in their entirety in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. <u>Physical Security Plan</u>

   The licensee shall maintain and fully implement all provisions of the Commission-approved physical security plan, including changes made pursuant to the authority of 10 CFR 50.54(p). The approved physical security plan, entitled "Texas A&M Engineering Experiment Station, Nuclear Science Center, Physical Security Plan for the Protection of Special Nuclear Material, Facility Operating License R-83, Docket Number 50-128, March 2015," consists of documents withheld from public disclosure pursuant to 10 CFR 73.21.

This license is effective as of the date of issuance and shall expire at midnight, 20 years from the date of issuance.

For the Nuclear Regulatory Commission

/RA/

William M. Dean, Director
Office of Nuclear Reactor Regulation

Attachment:
Appendix A, Technical Specifications

Date of Issuance: October 1, 2015

ATTACHMENT TO LICENSE AMENDMENT NO. 18

RENEWED FACILITY OPERATING LICENSE NO. R-83

DOCKET NO. 50-128

Replace the following pages of the Appendix A, “Technical Specifications” with the revised pages. The revised pages are identified by amendment number and contains a vertical line indicating the area of change.

Technical Specifications

REMOVE	INSERT
2 - 9	2 - 9
50	50

TECHNICAL SPECIFICATIONS

1 Introduction

1.1 Scope

This document constitutes the Technical Specifications for the Facility License No. R-83 as required by 10 CFR 50.36 and supersedes all prior Technical Specifications. This document includes the "bases" to support the selection and significance of the specifications. Each basis is included for information purposes only. They are not part of the Technical Specifications, and they do not constitute limitations or requirements to which the licensee must adhere.

1.2 Format

These specifications are formatted to NUREG-1537 and ANSI/ANS 15.1-2007.

1.3 Definitions

AGN-201M Neutron Start Up Source

A plutonium-beryllium (α,n) source used in the AGN-201M reactor to ensure the detectors are in their normal operating range and to verify operation of the low level interlock.

ALARA

The ALARA program (As Low as Reasonably Achievable) is a program for maintaining occupational exposures to radiation and release of radioactive effluents to the environs as low as reasonably achievable.

Audit

An audit is a quantitative examination of records, procedures, or other documents after implementation from which appropriate recommendations are made.

Channel

A channel is the combination of sensors, lines, amplifiers, and output devices that are connected for the purpose of measuring the value of a parameter.

Channel Test

A channel test is the introduction of a signal into the channel to verify that it is operable.

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.

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.

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.

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 losses. A control rod can be coupled to its drive unit allowing it to perform a safety function when the coupling is disengaged.

Regulating Control Rod

The regulating rod is a low-worth control rod used primarily to maintain an intended power level that need not have scram capability. Its axial position may be varied manually or by the servo controller.

Shim Safety Control Rod

A shim safety rod is a control rod having an electric motor drive and scram capabilities. It shall have a fueled follower section.

Transient Control Rod

The transient rod is a pneumatically driven control rod with scram capabilities that is capable of providing rapid reactivity insertion to produce a pulse.

Core Configuration

The core configuration includes the number, type, or arrangement of fuel elements, reflector elements, and regulating/shim-safety/transient rods occupying the core grid.

Core Lattice Position

The core lattice position is that region in the core (approximately 3” x 3”) over a grid-plug hole. A fuel bundle, an experiment, or a reflector element may occupy the position.

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

An operation, hardware, or target (excluding devices such as detectors, foils, etc.) that is designed to investigate non-routine reactor characteristics, or that is intended for irradiation within the pool, or in a beam port or irradiation facility. Hardware rigidly secured to a core or shield structure so as to be a part of its design to carry out experiments is not normally considered an experiment.

Secured Experiment

A secured experiment is any experiment, experiment facility, 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, other forces that are normal to the operating environment of the experiment, or by forces that can arise as a result of credible malfunctions.

Unsecured Experiment

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

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 reactor while the reactor is operating.

Experimental Facilities

Experimental facilities shall mean beam ports, including extension tubes with shields, thermal columns with shields, vertical tubes, through tubes, in-core irradiation baskets, irradiation cell, pneumatic transfer systems, and in-pool irradiation facilities.

Experiment Safety Systems

Experiment safety systems are those systems, including their associated input circuits, which are designed to initiate a scram for the primary purpose of protecting an experiment or to provide information for operator intervention.

Fuel Bundle

A fuel bundle is a cluster of two, three, or four fuel elements and/or non-fueled elements secured in a square array by a top handle and a bottom grid plate adapter. Non-fueled elements shall be fabricated from stainless steel, aluminum, boron, or graphite materials.

Fuel Element

A fuel element is a single TRIGA fuel rod of LEU 30/20 type.

Fuel – AGN-201M

UO_2 enriched to < 20% ^{235}U mixed with polyethylene and pressed into cylindrical discs and fueled control rod ends, and a core thermal fuse consisting of 0.4 grams of ^{235}U mixed with polystyrene.

Instrumented Fuel Element (IFE)

An instrumented fuel element is a special fuel element in which one or more thermocouples are embedded for the purpose of measuring the fuel temperatures during operation.

License

The written authorization, by the U.S. NRC, for an individual or organization to carry out the duties and responsibilities associated with a personnel position, material, or facility requiring licensing.

Licensee

A licensee is an individual or organization holding a license.

LEU Core

An LEU core is an arrangement of TRIGA-LEU fuel in a reactor grid plate.

Limiting Safety System Setting (LSSS)

The limiting safety system setting is the fuel element temperature, which if exceeded, shall cause a reactor scram to be initiated, preventing the safety limit from being exceeded.

Measured Value

A measured value is the value of a parameter as it appears on the output of a channel.

Operable

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

Operating

Operating means a component or system is performing its required function.

Operational Core – Steady State

A steady state operational core shall be an LEU core which meets the requirements of the Technical Specifications.

Operational Core – Pulse

A pulse operational core is a steady state operational core for which the maximum allowable pulse reactivity insertion has been determined.

Pool Water Reference Operating Level

The pool water reference operating level is 10 inches below the top of the pool wall. This level is designed to prevent pool water from rising above the top of the liner.

Protective Action

Protective action is the initiation of a signal or the operation of equipment within the reactor safety system in response to a parameter or condition of the reactor facility having reached a specified limit.

Pulse Mode

Pulse mode operation shall mean any operation of the reactor with the mode selector switch 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 Console Secured

The reactor console is secured whenever all control rods have been verified to be fully inserted and the console key has been removed from the console.

Reactor Operating

The reactor is operating whenever it is not secured or shutdown.

Reactor Operator

A Reactor Operator is 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 automatic reactor protection or to provide information for initiation of manual protective action.

Reactor Secured

The reactor is secured when:

Either

(1) 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

(2) All of the following conditions exist:

(a) All control rods are fully inserted;

(b) The console key switch is in the “off “ position and the key is removed from the console lock;

(c) The reactor is shutdown;

(d) No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless the control rod drives are physically decoupled from the control rods;

(e) No experiments are moved or serviced that have, on movement, a reactivity worth exceeding $1.00.

Reactor Shutdown

The reactor is shut down if it is subcritical by at least $1.00 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) and the reactivity worth of xenon is less than $0.01.

Reportable Occurrence

Any of the following events is a reportable occurrence:

(1) Operation with actual safety system settings for required systems less conservative than the LSSS specified in the Technical Specifications;

(2) Operation in violation of a Limiting Condition of Operation listed in Section 3 unless prompt remedial action is taken as permitted in Section 3;

(3) Operation with a required reactor or experiment safety system component in an inoperative or failed condition which renders or could render the system incapable of performing its intended safety function. If the malfunction or condition is caused during maintenance, then no report is required;

(4) An unanticipated or uncontrolled change in reactivity greater than $1.00. Reactor trips resulting from a known cause are excluded;

(5) Abnormal and significant degradation in reactor fuel or cladding, or both, coolant boundary, or confinement boundary; and

(6) An observed inadequacy in the implementation of either 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.

Review

A review is a qualitative examination of records, procedures, or other documents prior to implementation from which appropriate recommendations are made.

Safety Channel

A safety channel is a channel in the reactor safety system.

Safety Limit

Safety limits for nuclear reactors 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. For the Texas A&M NSC TRIGA reactor the safety limit is the maximum fuel element temperature that can be permitted with confidence that no damage to any fuel element cladding will result.

Scram Time

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

Senior Reactor Operator

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

Shall, Should and May

The word “shall” is used to denote a requirement; the word “should” to denote a recommendation; and the word “may” to denote permission, neither a requirement nor a recommendation.

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. This margin is determined assuming that the most reactive scrammable rod and any non-scrammable rods are fully withdrawn, and that the reactor will remain subcritical by this calculated margin without any further operator action.

Steady State Mode

Steady state mode of operation shall mean operation of the reactor with the mode selector switch in the steady state position.

Surveillance Intervals

The maximum surveillance intervals are provided for operational flexibility and the average surveillance intervals should be maintained over the long term.

Annually - an interval not to exceed 15 months.
Biennially - an interval not to exceed 30 months.
Monthly - an interval not to exceed 6 weeks.
Quarterly - an interval not to exceed 4 months.
Semiannually - an interval not to exceed 7.5 months.
Weekly - an interval not to exceed 10 days.

True Value

The true value is the actual value of a parameter.

Unscheduled Shutdown

An unscheduled shutdown is 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. It does not include shutdowns that occur during testing or check out operations.

5.6 Fuel Storage

Applicability

This specification applies to the following:

1. Storage of fuel element (TRIGA) and fueled devices at times when it is not in the reactor core.
2. Storage of Fuel-AGN-201M and AGN-201M Neutron Start Up Source.

Objective

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

Specifications

1. All fuel elements (TRIGA), fueled devices, and Fuel-AGN-201M shall be stored in a geometrical array for which the k-effective is less than 0.8 for all conditions of moderation and reflection.
2. Irradiated fuel elements (TRIGA) and fueled devices shall have sufficient natural convection cooling by water or air such that the fuel element or fueled device temperature will not exceed design values.
3. While the Fuel-AGN-201M and AGN-201M Neutron Start Up Source are being stored in the fuel storage room, additional special nuclear material shall not be allowed in the room.

Basis

The limits imposed by Specifications 5.6.1, 5.6.2, and 5.6.3 are conservative and ensure safe storage.

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 18 TO

RENEWED FACILITY OPERATING LICENSE NO. R-83

TEXAS ENGINEERING EXPERIMENT STATION/ TEXAS A&M UNIVERSITY SYSTEM

NUCLEAR SCIENCE CENTER REACTOR

DOCKET NO. 50-128

1.0 INTRODUCTION

By letter dated October 14, 2015 (Ref. 1), as supplemented on November 18, 2015 (Ref. 2), and March 3 (Ref. 3), March 15 (Ref. 4), March 18 (Ref. 5), May 11 (Ref. 6), August 2 (Ref. 7), and August 24 (Ref. 17), 2016, the Texas Engineering Experiment Station/Texas A&M University System (TEES/TAMUS), submitted a license amendment request (LAR) under the provisions of Section 50.90 of Title 10 of the *Code of Federal Regulations* (10 CFR) to the U.S. Nuclear Regulatory Commission (NRC or Commission) to amend the TEES Nuclear Science Center (NSC), Training, Research, and Isotope Production, General Atomics (TRIGA) Reactor (the facility) renewed Facility Operating License No. R-83 (Ref. 8), and technical specifications (TSs) (Ref. 9).

The proposed changes would revise the requirements in TS 1.3, “Definitions,” and TS 5.6, “Fuel Storage,” as well as revise possession limits in the license conditions to allow the receipt and temporary storage, but not use, of special nuclear material (SNM) from the Aerojet General Nucleonics-201 Modified (AGN-201M) reactor (NRC Facility Operating License No. R-23, Texas A&M University (TAMU), part of TAMUS) for a period not to exceed 5 years. The proposed changes would allow the fuel, core components, and Plutonium Beryllium (PuBe) neutron start up source from the AGN-201M, which all contain SNM, to be stored in the existing fuel storage room at the NSC.

The R-83 license is being amended to allow receipt of the SNM and byproduct material from the R-23 license. The ownership and responsibility of the R-23 license is not being changed, so the proposed action does not constitute a “transfer of license” pursuant to 10 CFR 50.80.

TEES/TAMUS made this license amendment request for license No. R-83 to support renovation plans for the Zachry Engineering Center building. These plans include reallocating the area in the Zachry Engineering Center building that is currently occupied by the AGN-201M reactor for other purposes. As a result, the AGN-201M reactor and its associated SNM need to be moved to another location. Custody of the SNM (fuel, fueled control rods, and the neutron startup source), from the AGN-201M reactor will be transferred to the TEES license allowing temporary storage of the SNM in the existing fuel storage room at the NSC. No additional licensing actions are anticipated for the R-83 license. A license amendment request (Ref. 10) has been submitted by TAMU for the AGN license R-23 to add the NSC as an area of storage for the AGN-201M reactor and support equipment.

Storage of the AGN-201M reactor components and SNM at the NSC will continue until a new facility, which is currently planned to be near the NSC, can be constructed to house the AGN-201M reactor. Consistent with the R-23 license, TAMU plans to reassemble the AGN-201M reactor in the new location, transfer the SNM (fuel, fueled control rods, and neutron startup source), and the byproduct material in the SNM, back on to the AGN-201M license, and resume normal operations (under the R-23 license). TAMU is developing additional license amendment requests, to seek permission to the move the AGN-201M reactor to its new operational location, once construction of the new building is completed, and to resume operations.

2.0 REGULATORY EVALUATION

The NRC staff reviewed the TEES/TAMUS's application to ensure 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) activities proposed 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. The NRC staff considered the following regulatory requirements, guidance, and licensing and design basis information during its review of the proposed changes.

The regulations in 10 CFR Part 20, "Standards for Protection Against Radiation," establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. Section 20.1801, "Security of stored material," states, "[t]he licensee shall secure from unauthorized removal or access license materials that are stored in controlled or unrestricted areas."

The regulations in 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," provide, in part, the regulatory requirements for transfer and storage of byproduct material.

The regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," provide the regulatory requirements for licensing of non-power reactors.

The regulations in 10 CFR 50.92, "Issuance of amendment," paragraph(a), state, in part, that "[i]n determining whether an amendment to a license […] will be issued to the applicant, the Commission will be guided by the considerations which govern the issuance of initial licenses […] to the extent applicable and appropriate."

The regulations in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," provide regulatory requirements for the protection of the environment.

The regulations in 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," provide regulatory requirements for the handling and security of SNM.

The regulations in 10 CFR 70.24, "Criticality accident requirements," paragraph (a), require, in part, for "[e]ach licensee authorized to possess special nuclear material in a quantity exceeding 700 grams of contained uranium-235 ... [to] maintain in each area in which such

SNM is handled, used, or stored, a monitoring system meeting the requirements of either paragraph (a)(1) or (a)(2) ... ." Section 70.24(a)(2) requires, a monitoring system capable of detecting a criticality with an alarm set at no more than 20 millirems per hour at no more than 120 feet from the material being stored.

The regulations in 10 CFR 73.40, "Physical protection: General requirements at fixed sites," provide regulatory requirements for physical protection of special nuclear material.

The regulations in 10 CFR 73.67, "Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance" provide regulatory requirements to minimize the possibility and detection of unauthorized removal of SNM.

The Atomic Energy Act of 1954, as amended, Section 182a, requires applicants for utilization facilities to include TSs as a part of the license. The regulatory requirements related to the content of the TSs are in 10 CFR 50.36, "Technical specifications." Section 50.36 requires that TSs include the following categories: (1) safety limits, limiting safety systems settings and limiting control settings, (2) limiting conditions for operation, (3) surveillance requirements, (4) design features, and (5) administrative controls.

NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content," (Ref. 11) provides guidance for development of TSs in Appendix 14.1, "Format and Content of Technical Specification for Non-Power Reactors." Appendix 14.1 states that the NRC accepts the guidance of the American Nuclear Standards Institute, Incorporated/American Nuclear Society (ANSI/ANS) Standard 15.1" 1990. The Development of Technical Specifications for Research Reactors," as modified by Appendix 14.1. NUREG-1537, Part 1, Chapter 14, Appendix 14.1, Section 5, "Design Features," states "The NRC accepts the guidance in this section of ANSI/ANS 15.1." ANSI/ANS 15.1-1990, Section 5.4, "Fissionable Material Storage," states that fuel shall be stored in a physical array where the maximum effective multiplication factor (k_{eff}) is no greater than 0.90 $\Delta k/k$ for all conditions of moderation and reflection.

NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria," (Ref. 12), provides guidance to NRC staff on the conduct reviews of non-power reactor license applications. Chapters referenced in the conduct of this review include: Auxiliary Systems (Chapter (Ch.) 9), specifically Section 9.2, "Handling and Storage of Reactor Fuel," and Ch. 14, "Technical Specifications."

3.0 TECHNICAL EVALUATION

The NRC staff reviewed the license amendment request, as well as the safety analysis report (SAR) (Ref. 13) submitted as part of the license renewal. The fuel storage location is described in Section 7, of the SAR. In response to an NRC staff request for additional information (RAI) (Ref. 14) additional details were provided by the TEES/TAMUS in multiple correspondence (Ref. 2, 3, 4, 5, and 6). The request was reviewed in accordance with the guidance of NUREG-1537, Part 2 (Ref. 12).

3.1 Facility Description

The NSC SAR, states that the NSC is located on the TAMUS campus in College Station, Texas. The NSC SAR section 1.1 “Introduction” states in part: “[t]he facility contains a university-operated research reactor designed to provide a center for the university's students from various disciplines, university, researchers, other academic and non-academic research, and commercial users.” The NSC SAR also states that the NSC houses the TRIGA reactor in a dedicated building apart from the main university campus and the TEES/TAMUS considers the NSC site boundary to also be the exclusion and restricted area boundaries (Ref. 13).

The NSC reactor building has an enclosed room intended for use as a fuel storage room.

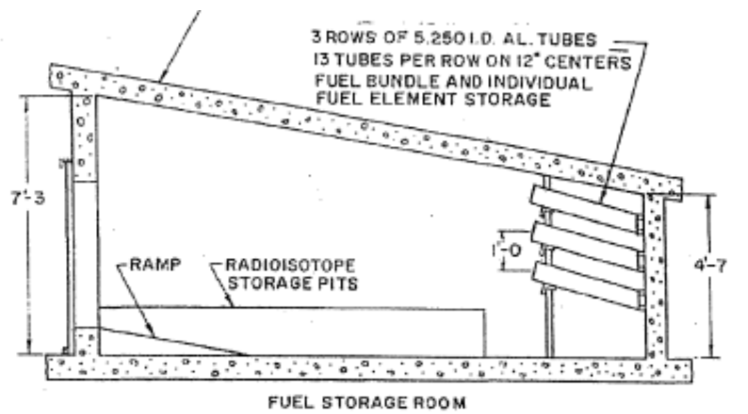

Figure 1 – Fuel Storage Room located in the NSC Reactor Building

3.2 Fuel Storage Location Details

The existing fuel storage room is designed to contain TRIGA fuel elements and maintain a maximum effective multiplication factor (k_{eff}) of 0.8 $\Delta k/k$. Four of these storage tubes were modeled as containing NSC TRIGA reactor fuel. In response to an NRC staff generated RAI (Ref. 13) TEES/TAMUS performed an analysis for storing the AGN-201M fuel in two separate five-gallon containers arranged at the opposite ends of the room (Ref. 2 and 3).

3.3 Description of AGN-201M Fuel, Fuse, and Control Rods

The AGN-201M SAR (Ref. 15), section 4.2 “Reactor Core” describes the AGN-201M fuel as consisting of fuel discs, a core thermal fuse, and safety and coarse control rods.

> The fuel itself is in a plate type configuration and is homogeneously mixed powder of polyethylene and UO_2 [...] in the form of 20 micron diameter particles. The core discs have been formed by pressing, under high pressure, the homogeneously mixed powder.

The safety analysis performed by TEES/TAMUS assumed that the fuel discs will be separated into two approximated equal amounts placed into each of the two five-gallon storage drums placed in the opposite ends of the room along the wall containing the fuel storage racks.

The analysis assumes that the storage drums will be separated by a minimum of 10 ft as stated by TEES/TAMUS in their RAI response (Ref. 3). The separation of the storage drums is one way to comply with the TS limit of $k_{eff} < 0.8$ for fuel in storage ensuring an inadvertent criticality is prevented. The AGN-201M reactor has a licensed power level of 5 watts. The reactor was not operated from 1997 to 2010 while the console was being modified and ceased operation in 2013 following the discovery of a single point of failure vulnerability in the new console (Ref. 18). As a result of this limited operating history, the AGN-201M fuel has extremely low levels of fission and activation products. External radiation dose rates from the AGN-201M fuel discs are sufficiently low to allow direct handling without special tools (i.e. they can be moved by hand if gloves are worn).

The core thermal fuse is described in the AGN-201M SAR (Ref. 15) as a small, right circular cylinder, fabricated from a mixture of fuel materials and polystyrene powder, which has double the normal loading of uranium than the normal reactor fuel discs. The fuse is intended to melt during an over power event and separate the core into two halves creating a subcritical condition. The analysis assumes that the fuse will be added to the five-gallon storage drum with the lesser amount of fuel. This arrangement is one method to help ensure that the total grams of uranium in the storage drum with the fuse is less than the amount analyzed for either five-gallon storage drums.

The AGN-201M reactor control rods are made of the same fuel material as the normal fuel discs. The control rods are inserted into the reactor to start it up and control the power level. The analysis assumes that the control rods will be stored in the fuel racks designed for the TRIGA fuel. The total uranium content in the AGN-201M control rods is significantly lower than the total uranium content of the TRIGA fuel elements that have been previously analyzed for the fuel storage rack in the fuel storage room. If the control rods were placed in direct contact with each other, criticality is not possible based on the uranium content in the control rods.

Operation of the AGN-201M reactor resulted in very small quantities of byproduct material being produced in the fuel discs and fueled control rods. The dose consequence from this material is negligible, based on surveys conducted by TEES/TAMUS (Ref. 1).

3.3.1 Criticality Analysis

The NRC staff requested (Ref. 14) a neutronic analysis of the AGN-201M fuel in the proposed storage location that considered the geometry and properties of the AGN-201M fuel. TEES/TAMUS stated (Ref. 2 and 3) that they had performed a criticality analysis for the proposed storage location using an advanced computer code. Specifically, TEES/TAMUS performed its analysis using the Monte Carlo N-Particle code, version 5, which is an appropriate tool for determining the k_{eff} of material in a specific geometry. Based on the calculations performed, the maximum k_{eff} is expected to remain below the TS limit of $0.8\Delta k/k$ for all conditions of moderation or reflection in the proposed storage location, provided the 10 ft of separation is maintained.

TEES/TAMUS utilized the method presented in NUREG/CR-0095, "Nuclear Safety Guide TID- 7016, Revision 2," (Ref. 16) for a solid angle assessment. The NRC staff reviewed the geometries involved and confirmed that the minimum angle would be met for the proposed analytical method. The most conservative value of k_{eff} determined was 0.6665Δk/k for the condition where the fuel is in the five-gallon storage drum with no absorber and a water reflector. Modeling with water as a reflector demonstrates the conditions in the room if flooding were to occur. Modeling with a water reflector reduces the leakage term and increases the multiplication factor in comparison to a bare core in air, so is considered to be more conservative than modeling in air.

TEES/TAMUS performed an analysis (Ref. 3) for the accident condition if the two five-gallon storage drums were inappropriately stacked on top of each other and the resulting k_{eff} was determined to be 0.8945Δk/k. While this value would exceed the TS limit for fuel storage, the fuel would remain in a safe subcritical condition for the bounding analysis. It is also below the guidance in NUREG-1537, Part 2, Section 9.2 "Handling and Storage of Reactor Fuel," k_{eff} value of 0.9.

In an effort to validate the modelling of the AGN-201M fuel in the five-gallon storage drums, TEES/TAMUS performed an analysis predicting the excess reactivity of the bare AGN-201M core (single stack of all of the fuel plates, similar to the operating core configuration) for comparison to measured values. The resulting calculation showed an excess reactivity of 0.0760 Δk/k. According to the 2010 SAR submitted to the NRC as part of the license renewal for the AGN-201M R-23 license (Ref. 15), the excess reactivity in the core is 0.00427 Δk/k when the additional reactivity of the polymer rod in the glory hole (center hole in the core for inserting samples or the cadmium shutdown rod) is added to the total excess. The predicted value is higher than the measured value, and is considered to be conservative. This conservativism results from the assumptions used in modelling the core, including: 1) homogenous modelling of the core of fuel with no air gaps that would be present even with the control rods (fully inserted) and 2) modelling of the glory hole (hole in the center of the core for experiment placement) with fuel material instead of the polymer rod normally placed in the location for reactor operations. These combined assumptions produce a bounding analysis, but caused the excess reactivity to be significantly over predicted.

The TEES/TAMUS stated (Ref. 1, 2, and 3) that the administrative controls allow the PuBe neutron source to be stored in the radioisotope storage pits in the TRIGA fuel storage room (see Figure 1) or in its own storage container that provides neutron and gamma shielding for the source. The quantity of plutonium present in the neutron source will not contribute to the total k_{eff} in the room because the total quantity of Pu is very small. Therefore the exact location of the PuBe source in the room does not impact the criticality analysis for the other material stored in the room and the use of administrative controls is acceptable. Placing the PuBe source in the administratively controlled location provides additional isolation from the other SNM in the room, but is not required to ensure compliance with the k_{eff} fuel storage TS.

The NRC staff reviewed criticality analysis and the methodology chosen to perform the analysis and determined that TEES/TAMUS appropriately calculated that the k_{eff} would be less than the TS limit of 0.8Δk/k for the SNM while stored in the fuel storage room.

3.3.2 Radiological Analysis

The NSC facility has procedures and policies in place to ensure compliance with the 10 CFR Part 20 requirements. The SNM and byproduct material in the AGN-201M reactor fuel and control rods poses a minimal radiation hazard based on surveys conducted to date and the very limited operating history of the core. The proposed storage location is separated from the surrounding area by a locked door and adequate radiological posting to ensure personnel are aware of the associated radiological hazards.

The radiological procedures and policies will ensure the PuBe source is stored in a manner that is in compliance with the 10 CFR Part 20 requirements. The planned storage of the PuBe source in its own shielded container or the radioisotope storage pits in the NSC fuel storage room (see Fig. 1) are locations that meet the requirements in 10 CFR Part 20.

A radiation monitor is present in the NSC fuel storage room and is capable of detecting an inadvertent criticality consistent with the requirements of 10 CFR 70.24(a)(2). The TRIGA SAR (Ref. 13) states that the monitor provides an alarm in the control room alerting staff to off normal conditions. According to 10 CFR 70.24(a)(2), a radiation monitor is required if a licensee is authorized to possess greater than 700 grams of contained uranium-235. Because the total of the possession limits for TEES/TAMUS exceeds the 700 gram threshold, this monitor is required to be present.

The NRC staff has observed the proposed storage location and finds that the radiological controls present continue to meet 10 CFR 20.1101, “Radiation protection programs,” and 10 CFR 20.1801, “Security of stored material,” requirements.

3.3.3 Security Considerations

The storage location must be able to provide a secure location for the SNM relative to the quantity being stored in the location consistent with 10 CFR 73.67. Because the quantity of the material being stored in the room is less than the amount of special nuclear material of moderate or low strategic significance, the requirements in 10 CFR 73.67 are used for review of the storage location. The proposed storage location for the AGN-201M fuel is in a room that is secured with a lock and key and has an intrusion detection system. These measures meet the requirements in 10 CFR 73.67.

The room therefore provides adequate security for storage of the proposed quantity of low strategic significance SNM in accordance with 10 CFR 73.40, “Physical protection: General requirements at fixed sites.”

3.3.4 Conclusions

The proposed license amendment allows receipt and storage at the NSC, but not use of the AGN-201M reactor fuel and PuBe neutron start up source. The fuel will be removed from the AGN-201M reactor assembly and stored in a suitable location. Based on the analysis performed by TEES/TAMUS for the fuel storage location, the margin to criticality is expected to be within the TS limit of a k_{eff} <0.8. The NRC staff concludes that storage of the AGN-201M fuel and PuBe start up source in the NSC fuel storage room is acceptable, provided the conditions in the analyses are maintained through administrative controls consistent with the TS for fuel storage limits.

3.4 Proposed Changes to License Conditions and Technical Specifications

TEES/TAMUS has proposed changes to the license conditions for SNM and byproduct material possession limits. TEES/TAMUS has also proposed changes to the TSs.

3.4.1 Proposed Changes to License Conditions

TEES/TAMUS has proposed (Ref. 6) adding paragraphs d. and e. to License Condition 2.B.2 of the TRIGA License No. R-83. These license conditions would permit the temporary possession of the 10 CFR Part 70 materials (SNM) contained in the AGN-201M reactor fuel and PuBe neutron start up source under the TEES/TAMUS TRIGA Facility Operating License No. R-83. The quantity of SNM and form of the material is consistent with the AGN-201M core and neutron start-up source. Proposed License Conditions 2.B.2.d and 2.B.2.e would authorize possession up to five years after the issuance of the requested license amendment (Amendment No. 18). The requested five-year period in the License Condition is consistent with TAMU's construction plans for the new facility to house and operate the AGN-201M reactor at the new location. A significant delay in the construction schedule could result in the need for TEES/TAMUS to submit a license amendment application requesting that the five-year period in the License Condition be extended.

TEES/TAMUS's proposed that paragraph d and e of License Condition 2.B.2 be added as follows:

d. to receive and possess, but not use up to 0.7 Kilograms of contained Uranium-235 as AGN-201M < 20% enriched ^{235}U reactor fuel, and any special nuclear materials produced by the operation of the AGN-201M reactor, for up to five years following issuance of license amendment xx dated May xx, 2016.

e. to receive and possess, but not use up to 0.020 kilograms of ^{239}Pu as a ^{239}PuBe sealed neutron start-up source in connection with storage of the AGN-201M reactor, for up to five years following issuance of license amendment xx dated May xx, 2016.

The NRC staff eliminated the reference to a specific date in the proposed License Conditions 2.B.2.d and 2.B.2.e to ensure that the five-year period that begins based upon the date of issuance of the amendment (Amendment No. 18). The NRC staff modified the proposed License Condition 2.B.2.d by moving the AGN-201M description next to the fuel term consistent with the proposed TS definitions, discussed below The NRC staff also modified proposed License Condition 2.B.2.e by using the term for the PuBe neutron start up source consistent with the proposed TS definitions, discussed below. The NRC staff's revised wording, for proposed license conditions d. and e., as agreed upon by TAMUS/TEES (Ref. 17), reads as follows:

d. To receive, possess, but not use up to 0.7 kilograms of contained Uranium-235 as <20% enriched ^{235}U Fuel - AGN-201M, and any special nuclear materials produced by the operation of the AGN-201M reactor, for up to 5 years from the date of issuance of License Amendment No. 18.

e. To receive, possess, but not use up to 0.020 kilograms of ^{239}Pu as a ^{239}PuBe AGN-201M Neutron Start Up Source in connection with storage of the AGN-201M reactor for up to 5 years from the date of issuance of License Amendment No. 18.

TEES/TAMUS has also proposed (Ref. 6) adding paragraph d. to License Condition 2.B.3 of the TRIGA operating license R-83. This license condition would permit the temporary possession of the 10 CFR Part 30 materials (byproduct material consisting of fission products and activation products) contained in the AGN-201M reactor fuel (including fueled control rod ends, and core thermal fuse) and PuBe neutron start up source under the TAMU TRIGA Facility Operating License No. R-83. Proposed License Condition 2.B.3.d would allow possession for up to five years after issuance of the requested license amendment (Amendment No. 18). The requested five-year period in the license condition is consistent with TAMU's construction plans for the new facility to house the AGN-201M reactor and operate the AGN-201M reactor at the new location. A significant delay in the construction schedule could result in the need for TEES/TAMUS to submit a license amendment application requesting that the five-year period in the license condition be extended.

TEES/TAMUS's proposed that paragraph d of License Condition 2.B.3 be added as follows:

d. to receive and possess, but not use or separate, byproduct materials produced by operation of the AGN-201M reactor, including contaminated and activated AGN-201M reactor components for up to five years following issuance of license amendment xx dated May xx, 2016.

The NRC staff eliminated the reference to a specific date in the proposed License Condition 2.B.3.d to assure that a five-year period begins based upon the date of issuance of the amendment (Amendment No. 18). The NRC staff also modified the proposed license conditions by moving the AGN-201M description next to the fuel term consistent with the proposed TS definitions, discussed below. The NRC staff's revised wording for proposed License Conditions d. as agreed upon by TAMUS/TEES (Ref. 17) reads as follows:

d. To receive, possess, but not use, byproduct materials including contaminated or activated Fuel - AGN-201M and AGN-201M Neutron Start Up Source for up to 5 years from the date of issuance of License Amendment No. 18.

The NRC staff reviewed the proposed license changes associated with the amendment. The NRC staff finds that TEES/TAMUS has identified storage locations for this material consistent with the requirements in the regulations. The proposed license conditions clearly identify the type and quantity of material being added to the license. The proposed conditions state that the material, in the reactor components, will be received and possessed, but not used, and include a reasonable period for the temporary storage, consistent with plans for construction and operation at a new location. The NRC staff finds the proposed possession limits in License Conditions 2.B.2 and 2.B.3 allow for receipt of the AGN-201M fuel, control rods, thermal fuse, and PuBe startup source for storage at the NSC and prohibits use of the material while in storage. Therefore, the proposed license conditions are acceptable.

3.4.2 Proposed Changes to Technical Specifications

In its supplemental response (Ref. 2), TEES/TAMUS proposed changes to TS 1.3, "Definitions," by adding the following definitions:

AGN-201M Neutron Start Up Source

A plutonium-beryllium (α,n) source used in the AGN-201M reactor to ensure the detectors are in their normal operating range and to verify operation of the low level interlock.

Fuel – AGN-201M

UO_2 enriched to < 20% ^{235}U mixed with polyethylene and pressed into cylindrical discs and fueled control rod ends, and 0.4 grams of ^{235}U mixed with polystyrene.

The NRC staff modified the definition for Fuel-AGN-201M to clarify that the 0.4 grams of ^{235}U mixed with polystyrene is the core thermal fuse as described in the AGN-201M SAR. The revised TS definition for Fuel-AGN-201M, as agreed upon by TAMUS/TEES (Ref. 17) is as follows:

Fuel – AGN-201M

UO_2 enriched to < 20% ^{235}U mixed with polyethylene and pressed into cylindrical discs and fueled control rod ends, and a core thermal fuse consisting of 0.4 grams of ^{235}U mixed with polystyrene.

The NRC staff reviewed the proposed definitions and finds them acceptable. The definitions, as modified, clarify TS 5.6 "Fuel Storage," by identifying the physical and chemical form of the material being added to Facility Operating License No. R-83 during the storage period. The AGN-201M fuel discs are described as the polyethylene pressed into cylindrical discs. The control rod ends are composed of the same material. A special AGN-201M fuel component, referred to as the "fuse", is described as the ^{235}U mixed with polystyrene. As a result, the definition of "Fuel AGN-201M" describes all of the components in the AGN-201M reactor that contain ^{235}U and will be stored at the NSC.

Since the added definitions changed the pagination of existing definitions, TEES/TAMUS provided replacement pages 2 through 9 for its TSs. The NRC staff confirmed that new definitions as revised, were reflected and that other portions of TS 1.3 "Definitions," remain unchanged.

In its supplemental response (Ref. 7), TEES/TAMUS proposed changes to TS 5.6, "Fuel Storage." TS 5.6 currently reads:

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 will not become critical and will not reach an unsafe temperature.

Specifications

1. All fuel elements and fueled devices shall be stored in a geometrical array for which the k-effective is less than 0.8 for all conditions of moderation and reflection.

2. Irradiated fuel elements and fueled devices shall be stored in an array, which will permit sufficient natural convection cooling by water or air such that the fuel element or fueled device temperature will not exceed design values.

TEES/TAMUS proposed changing TS 5.6, "Fuel Storage," to read as follows:

Applicability

This specification applies to the following:

1. Storage of TRIGA reactor fuel at times when it is not in the reactor core.

2. Storage of AGN-201M reactor fuel and start up source in the NSC fuel storage vault.

Objective

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

Specifications

1. All fuel elements and fueled devices shall be stored in a geometrical array for which the k-effective is less than 0.8 for all conditions of moderation and reflection.

2. Irradiated fuel elements and fueled devices shall be stored in an array, which will permit sufficient natural convection cooling by water or air such that the

fuel element or fueled device temperature will not exceed design values.

3. Possession of the AGN-201M fuel, byproduct material, and neutron start-up source is restricted to receipt, possession, but not use in the operation of the NSC reactor. Specification 2, above, is not applicable to these materials.

4. There shall be no introduction of any additional SNM while the AGN-201 SNM are stored in the fuel storage vault.

The NRC staff modified the Applicability statements 1 and 2 and Specification 1 to reflect the definitions from TS 1.3. The NRC staff modified Specification 2 to identify which fuel requires cooling while in storage. The NRC staff eliminated Specification 3, which was intended to negate the cooling requirements in Specification 2 that are applicable to the irradiated TRIGA fuel and fueled devices only, but created confusion with the Applicability statement. The NRC staff limited Specification 2 to irradiated TRIGA fuel and fueled devices. The NRC staff modified Specification 4 (renumbered as 3) by deleting the phrase “There shall be no introduction” and rewording the Specification to state that “additional special nuclear material shall not be allowed in the room” since the term “introduction” was not defined. The revised TS 5.6 for “Fuel Storage”, as agreed upon by TAMUS/TEES (Ref. 17) is as follows:

Applicability

This specification applies to the following:

1. Storage of fuel element (TRIGA) and fueled devices at times when it is not in the reactor core.

2. Storage of Fuel-AGN-201M and AGN-201M Neutron Start Up Source.

Objective

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

Specifications

1. All fuel elements (TRIGA), fueled devices, and Fuel-AGN-201M shall be stored in a geometrical array for which the k-effective is less than 0.8 for all conditions of moderation and reflection.

2. Irradiated fuel elements (TRIGA) and fueled devices shall have sufficient natural convection cooling by water or air such that the fuel element or fueled device temperature will not exceed design values.

3. While the Fuel-AGN-201M and AGN-201M Neutron Start Up Source are being stored in the fuel storage room, additional special nuclear material shall not be allowed in the room.

The NRC staff reviewed the proposed changes to TS 5.6 and concluded the following. The proposed applicability statements, as modified, for TS 5.6 identifies the TRIGA fuel as well as the SNM associated with the AGN-201M reactor as defined in section 1.3 of the TSs. The applicability statement addresses both of the fuel types that will be possessed at the NSC and is therefore acceptable.

The NRC staff also finds that proposed specification TS 5.6.1 maintains the 0.8 $\Delta k/k$ maximum value for the storage of fissile material, which is more conservative (lower maximum) than the recommendation in ANSI/ANS 15.1-1990. The proposed TS 5.6.2 does not require the Fuel-AGN-201M to be cooled by natural convection, because of the low residual activity (zero decay heat) associated with the AGN-201M fuel relative to the melting point of the fuel, air or water cooling while in storage, is not required. The prohibition on adding SNM to the fuel storage room in proposed TS 5.6.3 is consistent with the analysis performed by TEES/TAMUS that did not account for any other SNM in the room. If TEES/TAMUS wants to store additional SNM in the fuel storage room, a new analysis would need to be performed and a license amendment application submitted to the NRC.

The proposed revisions to TS 5.6 is consistent with the guidance in ANSI/ANS 15.1-1990, which has been accepted by the NRC staff as stated in NUREG-1537, Part 1. Based on its review stated above, the NRC staff concludes that the proposed revisions to the TS 5.6 are acceptable.

4.0 ENVIRONMENTAL CONSIDERATION

The regulations in 10 CFR Part 51.22, “Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review,” paragraph (a) state that licensing actions may be found eligible for a categorical exclusion if the action does not individually or cumulatively have a significant effect on the human environment. The proposed license amendment involves the following components from the AGN-201M reactor: 1) AGN-201M reactor fuel, 2) AGN-201M control rods, and 3) ANG-201M neutron startup source. The NSC SAR (Ref. 13) defines the NSC site boundary as the restricted area boundary. TEES/TAMUS indicated (Ref. 1) that the AGN-201M fuel, control rods and startup source will be stored in the fuel storage room which is within the restricted area consistent with the requirements of 10 CFR Part 20. The NRC staff has confirmed that the proposed storage location of the AGN-201M fuel is completely within the site boundary. The NRC staff has determined that the amendment involves changes in the use of a facility component in that it allows storage of components within the restricted area, as defined in 10 CFR Part 20. In addition, as required by 10 CFR 51.22(c)(9), an evaluation of the effect on the other criteria for categorical exclusion is presented below:

(i) *The amendment or exemption involves no significant hazards consideration;* [10 CFR 51.22(c)(9)(i)]

The regulations in 10 CFR 50.92, “Issuance of amendment,” state that the NRC 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; or* [10 CFR 50.92(c)(1)]

The proposed license amendment allows the AGN-201M fuel, thermal fuse, control rods, and neutron startup source to be stored, but not used, at the TRIGA/NSC facility. The amendment does not affect reactor operating procedures or administrative controls that have the function of preventing or mitigating accidents. Because the material is not being used in or near the TRIGA core, it is does not impact the probability or consequence any previously analyzed accident with respect reactor operation.

The amendment does not change storage accidents postulated at the facility. ANSI/ANS-15.1-1990, contains TS limits on fissionable material storage limiting fuel, including fueled experiments and fuel devices not in the reactor. It requires that the material and devices be stored in a geometric array where k_{eff} is not greater than 0.90 for all conditions of moderation and reflection using light water. The purpose of this limit is to prevent criticality accidents and their consequences concerning special nuclear material in storage in the most limiting conditions. TS 5.6, Specification 1, limits the k_{eff} value to 0.8, which is less than the k_{eff} value of 0.9 that is provided as guidance in NUREG 1537 and ANSI/ANS 15.1 1990.

The licensee provided k_{eff} values for fuel elements in storage in Section 9.2.2 of the license renewal SAR. The k_{eff} values for fuel elements stored in the vault, in the most reactive condition (fully submerged in water), was 0.45. Because this value is within the TS limit, criticality accidents and their consequences are prevented. The maximum analyzed k_{eff} the AGN-201M SNM in its proposed storage geometry is 0.6665. Because this value is within the TS limit, criticality accidents and their consequences are also prevented. The requested license amendment is within the acceptable k_{eff} limits, therefore it does not involve a significant increase in the probability or consequences of an accident previously evaluated

Therefore, the NRC staff finds this change does not significantly increase 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; or* [10 CFR 50.92(c)(2)]

The proposed changes allow storage of AGN-201M SNM and components (fuel, thermal fuse, control rods, and neutron startup source) and byproduct material contained therein. The amendment does not allow their use in the TRIGA reactor.

Therefore, the facility conditions for which the postulated accident has been evaluated are still valid and no new accident scenarios, failure mechanisms, or single failures are introduced by storage of this material at the facility.

For these reasons, the presence of AGN-201M fuel, control rods, and PuBe neutron startup source in the fuel storage location 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 margin of safety related to operation of the TRIGA reactor is based on fuel temperatures while the reactor is operating and maintaining sufficient cooling. Since the AGN-201M SNM and byproduct material is not used for the operation TRIGA reactor or related equipment the margin of safety for the TRIGA reactor is unaffected. Because the proposed changes do not alter the k_{eff} limit currently applicable to storage and this limit is below 0.9, the proposed changes to do not involve a reduction in a margin of safety.

Therefore, the NRC staff concludes that this amendment involves no significant hazards.

(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 AGN-201M fuel, control rods, and startup source, will be stored, but not used at the NSC facility. The AGN-201M fuel matrix is designed to retain fission products produced during operation of the reactor. The existing fission product inventory (source term) in the fuel is extremely low since the reactor has not operated for several years. The startup source is a sealed source designed for minimal leakage. Because no additional radioactive materials will be produced, the potential for release is very small and the quantities available for release are very limited. In addition, the amendment does not alter any equipment associated with operation of the TRIGA reactor. For these reasons, the NRC staff finds that there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite due to storage of the AGN-201M fuel and PuBe neutron start up source at the NSC facility.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure. [10 CFR 51.22(c)(9)(iii)]

The amendment permits storage of the AGN-201M fuel, control rods, and a PuBe neutron start up source in a room with radiological control features and that is separate from the normal building access areas. No additional shielding is needed to mitigate the radiation levels of the fuel, control rods, or the PuBe neutron start up source as the existing radiation levels are extremely low. Furthermore, the amendment will not change the radiation protection program at the NSC for limiting individual or cumulative occupational radiation doses. Therefore, the NRC staff finds that there is no significant increase in individual or cumulative occupational radiation exposure.

In the LAR Section 9 (Ref. 1), TEES/TAMUS performed a significant hazards evaluation consistent with the requirements in 10 CFR 50.92, “Issuance of amendment,” and determined that the activity does not present a significant hazard. The NRC staff reviewed TEES/TAMUS’s evaluation and concludes, as stated above, that the proposed amendment involves no significant hazard consideration.

The NRC staff also determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). In accordance with the regulations in 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

5.0 CONCLUSION

The NRC staff has concluded, based on the considerations above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

6.0 REFERENCES

1. Texas A&M University System, "Texas A&M University - Request for Amendment to License No. R-83 and Technical Specification Associated With Receiving and Storing Special Nuclear Material Currently Located in the TAMU AGN-201M Reactor," October 14, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15287A148).

2. Texas A&M University System, "Texas A&M University - Response to Request for Additional Information From NRC, Dated November 9, 2015, Regarding Receipt of Special Nuclear Material at the Nuclear Science Center From the AGN-201M Reactor," November 18, 2015 (ADAMS Accession No. ML15322A354)

3. Texas A&M University System, "Texas A&M Univ. - Supplement to License Amendment Request Dated October 14, 2015," March 3, 2016 (ADAMS Accession No. ML16063A264)

4. Texas A&M University System, "Texas A&M Univ. - Supplement to License Amendment Request Dated October 14, 2015," March 15, 2016 (ADAMS Accession No. ML16075A409)

5. Texas A&M University System, "Texas A&M Univ. – Supplement 3 to License Amendment Request Dated October 14, 2015," March 18, 2016 (ADAMS Accession No. ML16078A392)

6. Texas A&M University System, "Texas A&M Univ. – Supplement 4 to License Amendment Request Dated October 14, 2015," May 11, 2016 (ADAMS Accession No. ML16132A516)

7. Texas A&M University System, "Texas A&M Univ. – Supplement 5 to License Amendment Request Dated October 14, 2015," August 2, 2016 (ADAMS Accession No. ML16215A512)

8. U.S. Nuclear Regulatory Commission, "Texas Engineering Experiment Station/Texas A&M University System - Issuance of Renewed Facility Operating License No. R-83 (TAC No. ME1584)," October 1, 2015 (ADAMS Accession No. ML13030A410)

9. U.S. Nuclear Regulatory Commission, "Texas Engineering Experiment Station/Texas A&M University System - Technical Specifications "Appendix A" Renewed Facility Operating License R-83 Dated October 1, 2015 (TAC No. ME1584)," October 1, 2015 (ADAMS Accession No. ML13030A426)

10. Texas A&M University, "Texas A&M Univ. - License Amendment Request for AGN-201M Reactor to approve changes to Technical Specification 5.2 and 5.3 Authorizing Interim Storage of the Special Nuclear Material and the Disassembled AGN-201M Reactor on the TX A&M Engineering Site." November 11, 2015 (ADAMS Accession No. ML15315A027)

11. U.S. Nuclear Regulatory Commission, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,” NUREG-1537, Part 1, February 1996 (ADAMS Accession No. ML042430055)

12. U.S. Nuclear Regulatory Commission, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria,” NUREG-1537, Part 2, February 1996 (ADAMS Accession No. ML042430048).

13. Texas A&M University System, Texas Engineering Experiment Station, Nuclear Science Center Reactor, “REDACTED - Application for License Renewal Including the Safety Analysis Report,” February 27, 2003, (ADAMS Accession No. ML102920025)

14. U.S. Nuclear Regulatory Commission, “Request for Additional Information for TAMUS NSC TRIGA Reactor,” November 2, 2015 (ADAMS Accession No. ML15302A018)

15. Texas A&M University, “Texas A&M Univ. AGN 201M- Safety Analysis Report dated June 30, 2011 Redacted for Public Release,” May 4, 2016 (ADAMS Accession No. ML16125A275)

16. U.S. Nuclear Regulatory Commission, “NUREG/CR-0095, "Nuclear Safety Guide TID-7016, Revision 2," June 30, 1978

17. Texas A&M University System, Texas Engineering Experiment Station, Nuclear Science Center Reactor, “Email from Dr. S. McDeavitt to P. G. Boyle Regarding Proposed License Conditions and TS Revised Wording,” August 24, 2016 (ADAMS Accession No. ML16238A253)

18. U.S. Nuclear Regulatory Commission, “Texas A&M University Aerojet General Nucleonics Model 201-Modified Reactor, Confirmatory Action Letter Regarding Shutdown Related to Reactor Safety System (TAC No. ME1588),” July 30, 2013 (ADAMS Accession No. ML13189A058)

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