United States Department of the Interior

U. S. GEOLOGICAL SURVEY
Interior Region 7 Upper Colorado Basin
Box 25046 M.S. 974
Denver Federal Center
Denver, Colorado 80225

Wednesday, May 13, 2020

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: U.S. Geological Survey TRIGA Reactor, Docket Number 50-274, License Number R-113, License Amendment Request 2020-01

Purpose

By way of this letter, the U.S. Geological Survey (USGS) is requesting approval for a license amendment to the GSTR reactor facility license R-113 by the U. S. Nuclear Regulatory Commission.

Background

In accordance with 10 CFR 50.90, whenever a licensee desires to make changes to the technical specifications and/or license, an application for amendment must be filed.

Discussion

The GSTR seeks to add a permanent exception to TS 3.1.3.2 which allows the reactor core to contain fewer than 110 fuel elements when either shutdown or operating at a power level not greater than 1 kW. This request for license amendment has been reviewed and approved by the GSTR Reactor Operations Committee.

Technical Specification (TS) 3.1.3 discusses core configuration limitations that are imposed upon the GSTR core. These limitations apply "…to mixed cores of aluminum-clad and stainless-steel clad types of fuel", with the objective "…to ensure that the fuel temperature safety limit shall not be exceeded due to power peaking effects in a mixed core".

TS 3.1.3.2 states "There shall be at least 110 fuel elements in the core (not including fuel-followed control rods)". The basis for this TS is that "keeping at least 110 fuel elements in the core helps reduce the power peaking in the core". This is to ensure that the peaking factor in any fuel element in the core is not too high to cause flow instabilities in the cooling channels. Clearly, this TS is intended to preserve safety margins when the steady-state reactor power level approaches 100%; however, when the reactor power is low, the power density in any given fuel rod is well below the accepted limitations in the Safety Analysis Report (SAR).

Effects of Proposed Technical Specification Change

TS 3.1.3.2 is stated in a way that makes it seem that there should always be at least 110 fuel

elements in the core, regardless of if the reactor is operating at all. This could be interpreted that the facility will violate this technical specification if we remove enough fuel elements such that there are fewer than 110 in the core. This could be implied that we would never be able to defuel the core if needed.

During control rod inspections, it is required for us to make sure the reactor is subcritical with all 4 control rods out in the out-position TS 3.1.1.2 number 5. If the excess is near the $7 limit in TS 3.1.1.2, we cannot achieve subcriticality with all 4 control rods out if we only remove 12 fuel elements from the core. Thus, we would not be able to perform surveillances on the control rods as stated in TS 4.2. With this change to the TS we would be able to perform control rod inspections in all circumstances.

Implementing the requested change to TS 3.1.3.2 would increase the experimental flexibility of the GSTR for low-power experiments while completely preserving the safety margins currently established by the current version of TS 3.1.3.2.

As part of a laboratory class taught at the GSTR in conjunction with the Colorado School of Mines (CSM) Nuclear Engineering program, the GSTR occasionally conducts approach-to-criticality experiments. This experiment involves first removing fuel from the core to ensure subcriticality even with all four control rods in their full-up position. Power measurements are taken, the control rods re-inserted and then a small amount of fuel is added back to the core. This process is then incremented to generate a 1/M plot, and the class will predict the minimum number of fuel elements needed to achieve criticality. Once the reactor reaches criticality, the reactor is shut down and the remaining fuel is added back into the core to return to normal operating core configuration. The maximum power level attained during this experiment is not greater than a few Watts; thus, the fuel in the core will not experience any increase in temperature and will not approach any safety limit.

There are situations where this experiment could require removing enough fuel to be below 110 elements in the core, which would result in noncompliance with TS 3.1.3.2 as-written. In such a case, the experiment would be modified by raising fewer than 4 control rods; however, this would reduce the quality of the experiment as it gives fewer data points for the 1/M plot.

Safety Analysis

The requested exception to operate with fewer than 110 fuel elements in the core at reactor power levels of 1 kW or below should be acceptable because such a configuration does not pose any unreviewed safety condition. The power peaking in the most extreme conjecturable situation would result in 1 kW concentrated in one element. The operating core configuration (OCC) utilized in the re-licensing of the GSTR shows that power peaking of less than 14 kW per element (ADAMS Accession Number ML13162A662) ensures sufficient cooling and that no flow instabilities occur. Thus, this requested license amendment does not approach any thermal-hydraulic limits established in either the Safety Analysis Report or the License. In any case where the reactor is operated at or below 1 kW with fewer than 110 elements in the core, fuel elements would be added before resuming any operations above 1 kW.

Additionally, this license amendment would not change or bypass any interlocks or SCRAM setpoints already present in the control system. All other technical specification limitations would still be in full effect.

This proposed change continues to meet all other requirements of the license, 10 CFR, and NUREG-1537 guidance.

Action
The USGS requests NRC review and approve the application for license amendment within 30 days.

Contact
If you have any questions regarding this matter, please contact me at (303) 236-4727.

Affirmation
I declare under penalty of perjury that the foregoing is true and correct.

5/13/2020

X Jonathan Wallick

Jonathan Wallick
Reactor Supervisor
Signed by: JONATHAN WALLICK

Copied to:
Dr. Robert Horton, Reactor Administrator, USGS
Geoffrey Wertz, Project Manager, US NRC
Craig Bassett, Inspector, US NRC

Attachments:
(1) Original, Markup, and Proposed Technical Specifications

Original

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 shall not exceed 830 °C.

Specifications.

1. 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.

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.

1. Aluminum-clad fuel shall only be loaded in the F and G rings of the core.

2. There shall be at least 110 fuel elements in the core (not including fuel-followed control rods).

3. There shall not be a fuel element in the central thimble.

4. Fuel shall not be inserted or removed from the core unless the reactor is subcritical by more than the calculated worth of the most reactive fuel assembly being moved.

5. Control rods shall not be manually removed from the core unless the core has been shown to be subcritical with all control rods in the full-out position.

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.

3.1.4 Fuel Parameters

Applicability. This specification applies to all fuel elements.

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Specifications.

Markup

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1. Aluminum-clad fuel shall only be loaded in the F and G rings of the core.

2. There shall be at least 110 fuel elements in the core (not including fuel-followed control rods), unless the reactor is either shutdown, or operating at a power level no greater than 1 kW.

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