WASHINGTON STATE UNIVERSITY

Nuclear Radiation Center

April 8, 2010

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Reference: Washington State University
Docket No. 50-27, License No. R-76

Subject: Start Up Report Close-out

Included with this cover letter is a description of the reactivity loss as a function of temperature measurements made at WSU, along with discussion of reactor physics measurements. The information that is included with this letter is intended to finalize any outstanding issues connected with the start up report of April 17, 2009.

I declare under penalty of perjury that the foregoing is true to the best of my knowledge.

Executed on : April 8, 2010

Respectfully Submitted,

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Start up Report Closeout

Washington State University converted its TRIGA research reactor from HEU to LEU fuel in 2008. The reactor returned to steady-state operation during October 2008. The reactor was operated on a regular basis between October 2008 and April 2009 to allow the buildup of ^{149}Sm in the new fuel to reach a steady-state concentration, which was deemed necessary to fully carry out pulse testing of the reactor. Pulsing limits were determined, and the reactor was returned to normal operation as of April 13, 2009. A Startup Report for the Washington State University Nuclear Radiation Center TRIGA Reactor was submitted to the U.S. NRC on April 17, 2009. The U.S. NRC provided an "OUTLINE OF REACTOR STARTUP REPORT' as Attachment 2 of the "ISSUANCE OF ORDER MODIFYING LICENSE NO. R-76 TO CONVERT FROM HIGH- TO LOW-ENRICHED URANIUM FUEL (AMENDMENT NO. 20) – WASHING TON STATE UNIVERSITY TRIGA REACTOR (TAC NO. MD6570) which was issued on September 4, 2008 (EA-08-250). The Outline of Reactor Startup Report contained requirements for contents of the startup report. The Startup Report that was submitted on April 17, 2009 followed the outline, as stipulated by the U.S. NRC, but also included the statement that further information regarding thermal neutron flux distributions and reactor physics measurements would be provided in the WSU annual report. The two pertinent items in the Outline of Reactor Startup Report are Items 6 and 7:

6. Thermal neutron flux distributions

   Measurements of the core and measured experimental facilities (to the extent available) with HEU and LEU and comparisons with calculations for LEU and if available, HEU.

7. Reactor physics measurements

   Results of determination of LEU effective delayed neutron fraction, temperature coefficient, and void coefficient to the extent that measurements are possible and comparison with calculations and available HEU core measurements.

Closeout of items 6 and 7 was not carried out in the annual report due to unexpected difficulties that were encountered during the course of attempting to gather the relevant data.

Thermal neutron flux distributions

There are no data available for experimental measurement of thermal neutron flux distributions for the HEU core. Thermal flux values for the irradiation position D8 for the LEU core were measured and provided in the startup report. The WSU reactor was originally an MTR fueled reactor, which was converted to TRIGA fuel by use of lower grid plate adapters to accommodate TRIGA fuel elements. Due to the geometry imposed by the arrangements of the fuel assemblies in the WSU reactor, WSU has attempted to, but not been able to develop or fabricate a means to measure in-core neutron fluxes.

Reactor physics measurements
WSU has attempted to measure the effective delayed neutron fraction within the LEU fueled reactor, but has been unable to generate data of sufficient quality. WSU does not have the means to measure the void coefficient within the reactor. WSU has measured the reactivity loss as a function of temperature to determine the magnitude of the negative temperature coefficient. Results are presented in Figure 1.

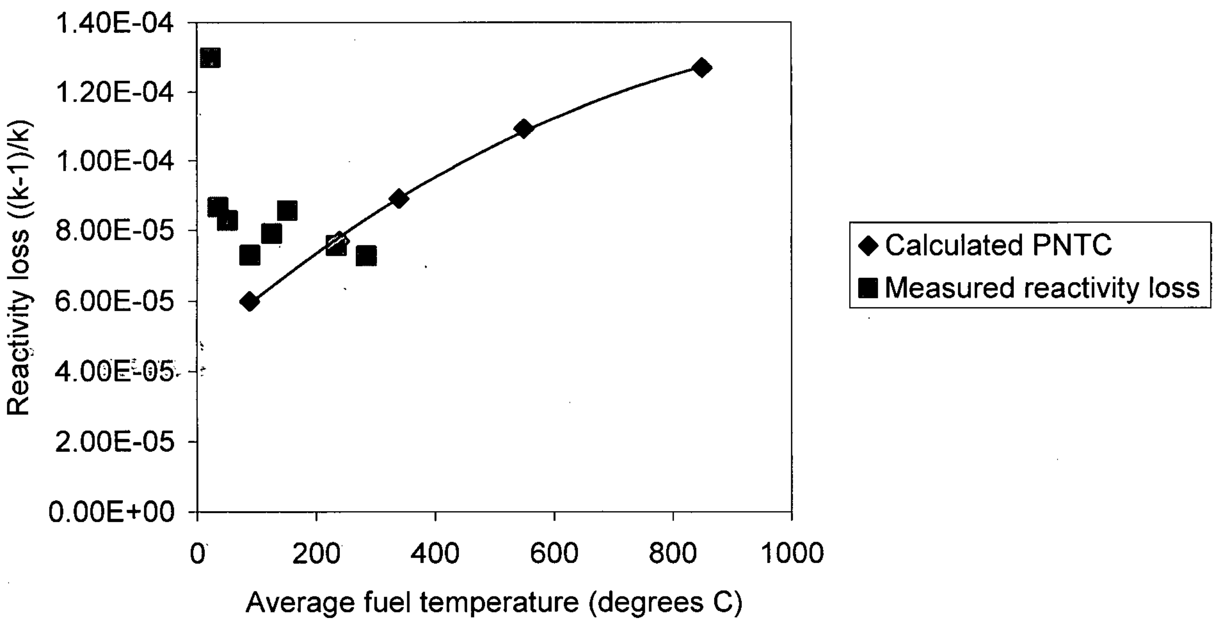

Figure 1. Reactivity loss as a function of core average fuel temperature.

The calculated values presented in Figure 1 are taken from the Conversion Safety Analysis report of August 2008. The values are for Core 35A at Beginning of Life. Since Figure 1 presents the data as Reactivity Loss, the y-axis values are positive. In other words, the y-axis values indicate a decrease in core reactivity as a function of temperature. The measured values were determined by operating the reactor at different power levels, corresponding to different fuel temperatures, and determining both average fuel temperatures and reactivity losses by consulting reactor control blade calibration data tables. The scatter in the data (particularly the data point at 30 °C) can be explained by uncertainty in correlation of measured fuel temperatures with core average temperatures. Nevertheless, it is clear that the WSU TRIGA Core 35A exhibits a pronounced reactivity loss as the fuel temperature rises. The experimentally measured data points terminate at core average temperature of 285 °C because the reactor had reached full power (1.0 megawatt), and so it is not possible to measure reactivity loss at higher core average temperatures.

Summary

Items 6 and 7 in Attachement 2 of ISSUANCE OF ORDER MODIFYING LICENSE NO. R-76 TO CONVERT FROM HIGH- TO LOW-ENRICHED URANIUM FUEL (AMENDMENT NO. 20) – WASHING TON STATE UNIVERSITY TRIGA REACTOR (TAC NO. MD6570) request data to the extent that either the data are available, or to the extent that measurements are possible. WSU has provided irradiation position thermal neutron flux measurements, and herein also provides temperature coefficient data. However, WSU has not been able to measure either the delayed neutron fraction or void coefficient. Accordingly, WSU submits this letter with the intent to finalize the issues from the start up report, and requests that the NRC consider the issues closed.