WASHINGTON STATE UNIVERSITY

Nuclear Radiation Center

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U.S. Nuclear Regulatory Commission
Washington DC, 20555

Re: Reportable Occurrence

Section 1 (Definitions) of the Technical Specifications for License R-76 (Washington State University) states in subsection (2) under Reportable Occurrence that "release of fission products into the environment" is a Reportable Occurrence.

A 34.3 mg sample of highly enriched uranium was being irradiated as an experiment on July 20, 2015. The Continuous Air Monitor (CAM) generated a warning signal at 8:55 a.m. on July 20. The reactor was shut down to investigate the cause of the warning signal. The CAM filter was removed for analysis, and a pool water sample taken. The CAM filter showed the presence of ^{88}Rb and ^{138}Cs which are decay products of the fission products ^{88}Kr and ^{139}Xe.

The following calculations are based on the following conservative assumptions:

- all of the ^{88}Kr and ^{138}Xe is released from the uranium sample into the pool water
- all of the ^{88}Kr and ^{138}Xe leave the pool water and enter the pool room air
- all of the ^{88}Kr, ^{88}Rb, ^{138}Xe and ^{138}Cs remain airborne
- all of the ^{88}Kr, ^{88}Rb, ^{138}Xe and ^{138}Cs are released as effluent.

No credit is taken for the solubility of the radionuclides in the pool water and radioactive decay during the course of the release.

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The sample was irradiated such that it produced approximately 10^{15} fissions. The mass 88 isobaric yield is 3.58%; the number of ^{88}Kr atoms that were released was 3.58×10^{13}. The mass 138 isobaric yield is 6.77% which gives a release of 6.77×10^{13} atoms of ^{138}Xe.

Table 1 of 10 CFR 20 provides occupational limits, with Column 3 presenting the derived air concentration (DAC) values. Table 2, column 1 of 10 CFR 20 provides air effluent release limits. The release of fission products that is described in this report is calculated in terms of the relationship to the values of 10 CFR 20.

The pool room ventilation system was operated in the dilute mode for approximately 48 hours after the sample breach. The ventilation system normally operates in "Auto" mode, which has an exhaust flow rate in excess of 4500 cfm. Calculating the annual release equivalent with the ventilation system flow rate in "Auto" mode is more conservative than using the "Dilute" mode flow rate. Consequently, the release of the fission product gasses in the present case assumes that the ventilation system is in "Auto" mode for the entire year. The total volume of air exhausted by the ventilation system over the course of one year (at 4500 cfm) is 6.70×10^{13} mL. The air effluent release limit, the airborne radionuclide release (averaged over one year) and the ratio of the fission product release to the release limits are presented in Table I.

Table I. Radionuclide Release vs. Air Effluent Release Limits

Isotope (a)	Effluent release limit (uCi/mL)	Number fission product atoms released	Activity averaged over 1 year (uCi/mL)	Ratio of the release to the release limit
^{88}Kr	9×10^{-9}	3.58×10^{13}	4.58×10^{-13}	5.09×10^{-5}
^{88}Rb	9×10^{-8}	3.58×10^{13}	4.58×10^{-13}	5.09×10^{-6}
^{138}Xe	2×10^{-8}	6.77×10^{3}	8.66×10^{-13}	4.33×10^{-5}
^{138}Cs	8×10^{-8}	6.77×10^{13}	8.66×10^{-13}	1 08 $\times 10^{-5}$

(a) Values are calculated only for those isotopes that are released in the greatest quantity.

The DAC value limits, airborne radionuclide release averaged over one year and the ratio of the radionuclide release to the DAC values are presented in Table II. The activity averaged over one year is the same in Table II vs. Table I because the volume of air circulated through the pool room over the course of one year far exceeds the volume of the pool room air. The volume of air used for the calculations of Table II is based on a pool room exhaust flow rate of 4500 cfm.

Table II. Radionuclide Release vs. DAC Values

Isotope (a)	DAC limit (uCi/mL)	Number of atoms released	Activity averaged over 1 year (uCi/mL)	Ratio of the release to the DAC limit
^{88}Kr	2×10^{-6}	3.58×10^{13}	4.58×10^{-13}	2.29×10^{-7}
^{88}Rb	3×10^{-5}	3.58×10^{13}	4.58×10^{-13}	1.53×10^{-8}
^{138}Xe	4×10^{-6}	6.77×10^{3}	8.66×10^{-13}	2.17×10^{-7}
^{138}Cs	2×10^{-5}	6.77×10^{13}	8.66×10^{-13}	4.33×10^{-8}

(a) Values are calculated only for those isotopes that are released in the greatest quantity.

The data in Tables I and II illustrate that the amount of activity in the fission product release is less than both the effluent release limits and the relevant DAC values. There is no lower limit for release (of fission products) specified in the WSU Technical Specifications. Accordingly the release, although minor, constitutes a Reportable Occurrence.

Respectfully Submitted,

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Director