WASHINGTON STATE UNIVERSITY

Nuclear Radiation Center

August 4, 2010

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U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

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

Subject: Supplemental information in Response to: WASHINGTON STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION REGARDING THE WASHINGTON STATE UNIVERSITY TRIGA REACTOR LICENSE RENEWAL (TAC NO. ME1589); Dated January 28, 2010.

Washington State University (WSU) has applied to renew operating License Number R-76 (Docket number 50-27). As part of the license renewal process, the U.S. Nuclear Regulatory Commission has submitted a Request for Additional Information (RAI) to Washington State University in a letter dated January 28, 2010. Washington State University responded to the RAI in a letter dated April 7, 2010. This letter is intended to provide supplemental information for the April 7, 2010 letter.

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

Date Executed 8/4/2010

Respectfully Submitted,

Donald Wall

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Director

Attachments

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The situation with respect to leaking pipes, fittings or pool wall penetrations for the water purification system is very similar to a leak in the cooling system primary loop. Leaking pipes, fittings or pool water penetrations for the water purification system would all drain into floor drains that route to a holding tank. A slow leak in one of these components could go unnoticed for several days, as the components are located in rooms that do not include checks on the reactor pre-startup checkout. Indications that such a leak might exist might first be made apparent by an unusually large consumption of makeup feedwater, or a direct observation of the leak.

A leaking beamport would likely be discovered in a 24 – 72 hour time period. For example, if a leak were to commence after hours on a Friday evening, the leak could go undetected until Monday. Reactor prestartup checkout requires the reactor operator to perform checks that are in the vicinity of the beamports. Thus a leaking beamport would be noticed by the reactor operator. The floor drains in the areas around the beamports all empty into the holding tank system that was previously described.

A leak through the pool wall, e.g. due to a crack in the concrete, could result in a route for passage of pool water that leads either to the beam room (Room 2) or into the soil, either directly beneath the pool, or in the below-grade, backfilled areas to the east, and a small section of the south pool wall. During the late 1990's a small leak allowed pool water to flow into the beam room. The water was allowed to evaporate or flow into the floor drain that leads to the holdup tank system. A leak of this type would likely be observed within 24 – 72 hours. A slow leak through the pool wall or floor into the ground could potentially go undetected for a very long time, in the case of a small leak rate, e.g. on the order of a gallon or a few gallons per day. This is because, in absence of a leak, pool water evaporation is the only mechanism for removal of water from the pool, and the evaporation rate changes according to pool water temperature, air temperature, relative humidity and air movement. The range of pool water temperatures throughout the year is generally about 25 – 40 °C, while air temperatures generally vary from about 16 to 29 °C. Relative humidity of the pool room air is not recorded. Thus, variations in pool water evaporation rate can easily mask an unobservable slow leak. However, it should be pointed out that pool water radionuclide content is monitored, and the radionuclide content of the pool is sufficiently low that the pool water remains below 10 CFR 20 limits for releases of effluent into the environment. Thus, even an undetected slow leak could not cause a violation of 10 CFR 20 release limits.

Estimate of the minimum detectable amount of leakage

The minimum detectable amount of leakage depends upon the leak pathway. A leak that occurs in observable areas (primary cooling loop, water purification system, beam ports, pool wall in laboratory areas) would be detected by observation, even for very low leak rates, certainly no more than ten gallons per day, and probably a leak rate of one gallon per day (or perhaps even less, depending upon location) would be noticed. The minimum detectable amount of leakage into an unobservable area, such as through the pool floor into the ground below, would depend upon detection of a statistically significant difference between normal loss by evaporation, and an abnormally large consumption of makeup pool water. Such an estimate depends partly upon the availability of a standard model for pool water evaporation, as influenced by pool water temperature, air temperature, relative humidity and air movement. WSU does not have a standard model to correlate pool water evaporation rates to these variables, as there has never been a reason to develop such a model. Thus, detection of an abnormally large consumption of makeup feed water depends upon reactor operator observation of unusual activity by the makeup feedwater system, or an unusually large number of gallons delivered, as indicated by the makeup feedwater meter, which indicates the number of gallons delivered. The makup feedwater meter is read, and recorded during the course of each reactor prestartup checkout. Fluctuations of a few gallons per day would normally be ascribed to variation in pool water evaporation rates. A larger, persistent increase, probably on the order of 40 – 80 gallons per day above normal consumption would likely be the minimum amount that would be noticed by a reactor operator.

Makeup feedwater volume records were reviewed and plotted for all readings taken between January 3, 2009 and August 3, 2010 in order to illustrate the nature of makeup feedwater addition, and the day to day variation in the quantities. The data are plotted in Figure 1.

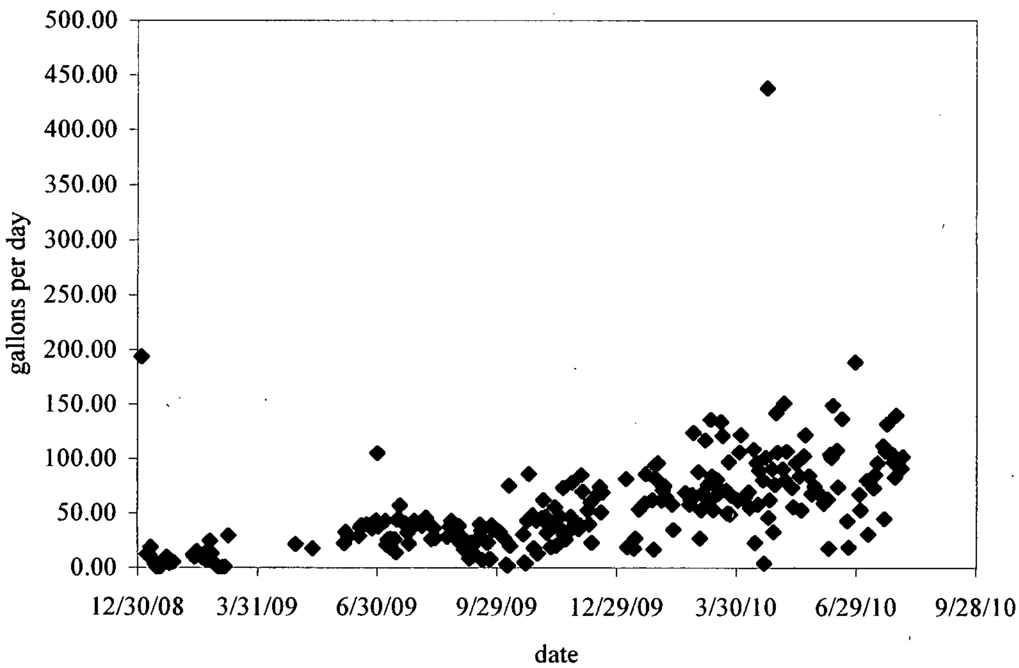

Figure 1. Daily makeup feedwater addition rate is plotted for the period of 1/3/2009 through 8/3/2010.

The average daily delivery rate of makeup feedwater is 82 ± 48 gallons per day, where the uncertainty is 1 standard deviation. The fairly large day to day fluctuations are probably due to the relatively coarse control of the makeup feedwater solenoid switching mechanism. The float switch that causes activation of the makeup feedwater system requires vertical movement of the switch. The large surface area of the pool would require a considerable volume of water to give rise to a sufficient amount of vertical movement to activate or deactivate the pool water makeup system.

Conclusions

If a pool leak developed in observable areas, in most cases it would likely be noticed within 24 – 72 hours. A small leak into unobservable areas could go unnoticed for an indeterminate period of time. The minimum detectable leak rate would depend upon the location of the leak, and the means by which the leak would be detected. The minimum detectable leak rate for an observable leak could be as low as one gallon per day. The minimum detectable leak rate for an unobservable leak may be in the range of 40 – 80 gallons per day.

The U.S. Nuclear Regulatory Commission transmitted to Washington State University a Request for Additional Information (RAI), dated January 28, 2010, with the subject line, "WASHINGTON STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION REGARDING THE WASHINGTON STATE UNIVERSITY TRIGA REACTOR LICENSE RENEWAL (TAC NO. ME1589)." Question number 4 in the RAI letter asks for information regarding pool integrity and uncontrolled leakage. Washington State University provided a response to the NRC in a letter dated April 7, 2010, with the subject, "Response to WASHINGTON STATE UNIVERSITY – REQUEST FOR ADDITIONAL INFORMATION REGARDING THE WASHINGTON STATE UNIVERSITY TRIGA REACTOR LICENSE RENEWAL (TAC NO. ME1589); Dated January 28, 2010." This letter is being submitted to provide supplemental information regarding pool leakage. The intent of this letter is to provide an estimate of the time period that a leak could exist before detection and an estimate of the minimum detectable amount of pool leakage.

Estimate of the time period that a leak could exist before detection

Pool water loss may be divided into two broad categories: rapid and slow. A rapid loss of pool water is a loss rate that exceeds the rate at which the pool water makeup system can supply additional water to the pool. A rapid pool water loss would trigger the low pool water level alarm, and thus be detected very quickly. The purpose of this letter is to discuss the least detectable amounts of pool leakage; therefore only the slow leak will be considered. A slow loss of pool water is defined as a loss rate that does not exceed the rate at which the pool water makeup system adds water to the pool.

Pool leakage, if it were to occur, must take place through one of the following potential pathways:

- Leaking pipes or fittings in the primary cooling circuit (including pool wall penetrations)
- Leaking pipes or fittings in the water purification system (including pool wall penetrations)
- Leaking beam port
- Leak through the pool floor or wall

Leaking pipes or fittings in the primary cooling circuit would likely be observed within 24 – 72 hours if the leak were to occur in the heat exchange and pump room (Room 201C). This is because there is an item on the reactor pre-startup checkout that requires the reactor operator to go into Room 201C. If the leak were to occur at the pool wall penetration the detection time could be somewhat longer, possibly one to three weeks. The pool wall penetration for the primary cooling system loop is in a small room where the pool water ion exchanger resides. In either case, i.e. in Room 201C or adjacent to the ion exchanger, effluent that flows through the floor drains is routed to a holding tank, where it is collected until it is analyzed for radionuclide content before release into the sewer system. Therefore, a slow leak via pipes, fittings, or pool wall penetration in the primary circuit does *not* give rise to unmonitored or uncontrolled releases to the environment.