NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

November 17, 2022

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Docket Number 50-184 license amendment request

Dear Sirs/Madams:

On October 19, 2021, we requested a license amendment for operation of the NBSR with debris remaining in the primary system. Attached are answers to NRC questions regarding the primary and effluent monitoring systems.

Sincerely,

Thomas Newton
Deputy Director
NIST Center for Neutron Research

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

Executed on November 17, 2022

By: ______________________

Questions for NIST:

1. For effluent monitoring on the stack, the original equipment vendor normally provides a primary calibration and efficiency factor (cpm/uCi/cc) based on a standard gas (typically Xe-133 or Ar-41). That efficiency factor is suitable for converting instrument response from cpm to uCi/cc for that calibration gas. Which primary calibration gas was used by the equipment vendor for the NIST stack monitor?

   Subsequently, a periodic calibration "check" is performed using a solid source such as Cs-137 to verify the monitor is working correctly.

   Given that NIST assumes there will be a potential release of fission products during startup operations (vs the standard calibration gas), how will this stack monitor's output (in unit of cpm) be converted to uCi/cc (or uCi/sec) of a fission product mix of noble gases (vs. the calibration gas)?

   The stack monitors are calibrated annually using a Cs-137 source in a fixed geometry. During every operating cycle, typically shortly after startup, NCNR Health Physics performs a calibration verification of the system. Two samples are collected. One uses a "Cary Chamber" ion chamber. The charge in the chamber is measured over time. This allows for any contribution from tritium to be subtracted and the concentration of Ar-41 in the stack to be determined. Secondly, a 1 L Marinelli air sample is collected and counted on an HPGe system. These two samples are used to establish a count rate to Ar-41 concentration calibration for the stack monitor. The calibration factor is also compared to previous calibration to ensure that there has been no shift that cannot be explained by counting statistics or measurement variability.
   Any significant rise in the stack count rate will result in a stack sample being immediately collected. The sample will be counted using a high purity germanium detector. This will allow for an accurate measure of the µCi/cc in the stack and an accurate assessment of the potential offsite dose consequences. In addition, there will be a real-time HPGe gamma spectroscopy system continuously monitoring the stack during start up to assess any potential fission product releases.

2. Does the helium sweep system have the likelihood/potential to leak fission product gases into the plant's work environment (i.e., confinement building)? If the helium sweep is expected to entrain the noble gas releases, iodines, and particulates which would be subsequently released through valve leakage into the confinement building and reactor process area, how is NIST expecting radiological conditions to change (airborne and surface contamination)?

   The helium sweep system is a closed, but not leak tight system. Any fission product generation due to loose fuel particles in the primary system would be a tiny fraction of that generated during the event of February 3, 2021, and would be readily detected by the fission product monitor. In the event of fission product generation, there could be *some minor airborne and surface contamination from system leakage but would be easily dealt with (see below).*

How does NIST plan to address radiological concerns associated with the operation of the helium sweep system leaking into the plant work environment? Does NIST have sufficient radiation protection personnel and equipment to perform radiological control functions involving failed fuel presuming increased contamination levels, increased survey frequencies, airborne radioactivity, bioassay, etc.?

As part of our startup protocol, all health physics (10) and operations (30) personnel will be paying close attention to the possibility of fission product generation and leakage into confinement. This will include increased contamination and area survey frequency, as well as air sampling if fission product and effluent monitors indicate the possibility of increased fission product levels. In addition, there are real-time air samples located at strategic locations through the confinement building. These real-time monitors will be closely watched during startup.

Will NIST provide radiological surveys sufficient to characterize these radiological conditions? Does NIST have the capability to provide radiological controls such as airborne controls such as air samplers, HEPA units, respiratory equipment, personnel decontamination facilities, etc.?

As always, NIST will provide the results of radiological surveys which will be of sufficient depth to characterize whatever radiological conditions exist. We have the capability to provide adequate controls for airborne radioactivity as well as personnel decontamination. It should be noted that there is no credible scenario by which airborne concentrations would be of a level to require personnel respiratory protective equipment (as was also the case during the February 3, 2021 event).

3. Please provide information on the recent use (since shutdown) and the effectiveness of the D_2O auxiliary cleanup system (demineralizers, RCS filtration) in removing unclad fuel and fission products from the storage tank system prior to restart. Has the D_2O auxiliary cleanup system been sufficiently used to the point whereby the removal of unclad fuel and fission products from the storage tank system have been maximized? Has the demineralizer resin been refreshed/replaced and filter pore size reduced to the maximum (typically from 20 micron pore size to 0.2 micron)?

   The primary purification system has been operating regularly for well over a year and has been effective in removal of dissolved fission products in the primary coolant. It should be noted that this purification system is supplied by an overflow at the top of the reactor vessel and top of the emergency tank and most fuel debris is too heavy to rise to this level, even with main primary pumps running (see primary debris supplement). Thus, we believe that all fission products that can be removed via the purification system have been. We replace our primary resin when primary conductivity measurements *indicate that it is no longer an effective means of ion exchange. The last time a new ion exchange column was placed on line was August 2022. The filter pore size is 5 micron and has not changed. Note: U_3O_8 fuel particles are larger than 44 microns.*

Does NIST have the facilities to handle and store of high activity waste once reactor operations have restarted and additional fission products are generated?

Based on initial analysis, NIST does not believe that there will be any significant release of fission products. If fission products are released it will not result any significant quantity of additional radioactive waste. We routinely handle high activity items, including all items that were used in cleanup from the February 3 event. In addition, NIST routinely handles high activity waste items as part of its normal operating routine. Examples include old shim arms, upgraded reactor components, fuel element components, etc. Thus, NIST has the training, procedures and facilities to handle such items.

4. Given that reactor restart is likely to impact plant radiation levels and therefore worker dose, are there opportunities prior to restart to reduce general area dose rates by providing increased shielding on valves, crud traps, heat exchangers, etc.?

   Reactor restart is not likely to significantly impact existing dose rates in plant areas. Analysis has shown any remaining material in the plant is not likely to be exposed to any significant neutron flux. The material in the plant is unlikely to move as numerous efforts have been made to move the remaining hotspots. Thus, it is unlikely that dose rates in the worker occupied areas will significantly increase after startup. Detailed surveys of work areas have shown that although doses are higher than before the incident, the fields present will not present any hindrance to maintenance operations. The HP team will continue to monitor doses and will ensure any work performed continues to be ALARA. One of the items in our cleanup contract with Framatome is to build two easily flushable crud traps in low flow areas of the primary system.

5. For long term reactor operation, given the anticipated increase in air emissions, what length of time can NIST operate and still be able to meet the ALARA dose constraint on air emissions described in 10 CFR 20.1101(d)?

   We will not know the level of increase in stack emissions (if any) until the reactor is restarted. At that time, a detailed evaluation will be made and will include establishment of any limits on operations to meet the 10 mrem/year ALARA limit in 20.1101 (d).