UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 E. LAMAR BLVD
ARLINGTON TX 76011-4511

June 7, 2021

Suzanne Arnette, Ph.D.
Radiation Safety Officer
Boise State University
1910 University Drive, MS-1826
Boise, ID 83725-1826

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION

Dear Dr. Arnette:

We have reviewed your letter dated May 3, 2021 requesting to amend NRC license number 11-27388-01. Before we can take further action, we will need the following additional information. Provide the information in a signed and dated letter by reply email within 30 days.

1. The NRC does not regulate deuterium (D) so deuterium will not be listed in the NRC license. The NRC regulates tritium (T) so tritium will be listed in the license. You requested authorization for two neutron generators containing both D-D and D-T heads. For the D-T neutron generators, provide the maximum activity of tritium per source (per generator) and the total amount of tritium (for all generators).

2. As mentioned in item 1, the NRC does not regulate deuterium since deuterium is not byproduct material. However, the NRC regulates the radiation emitted by deuterium. 10 CFR 20.1502(a), "Conditions requiring individual monitoring of external and internal occupational dose," state that each licensee shall monitor occupational exposure to radiation from licensed (tritium) and unlicensed (deuterium) radiation sources under the control of the licensee and shall supply and require the use of individual monitoring devices. Commit to update your radiation safety manual and procedures, as needed, to reflect that the licensee will monitor occupational exposures to radiation from licensed and unlicensed radiation sources under the control of the licensee.

3. Task 1: Training - Demonstrate that the radiation safety training covers these topics.

   A. Fundamentals of radiation safety, characteristics of radiation, units of radiation dose and quantity of radiation, hazards of exposure, levels of radiation for licensed material, and methods for controlling radiation dose (time, distance and shielding)

   B. Radiation detection instruments (use, operation, calibration, instrument limitations, survey techniques and use of personnel monitoring)

   C. Equipment to be used (operation of equipment, storage, control and disposal of licensed material), and maintenance of equipment

   D. Hazards of radiation exposure (gamma and neutrons) and radiation protection methods

4. Task 1: Training - Provide documentation demonstrating completion of training in radiation safety associated with the new type of activity for the principal investigator, authorized users and radiation safety officer.

5. Task 1: Training - Provide description of a quantifiable hands-on-training (other than the trainer feels that the trainee is ready) by establishing minimum hours of hands-on-training that are needed by the trainee.

6. Task 2: Facility Diagram - Confirm that there is no floor above the experimental area. Describe the administrative and/or engineering methods used to control access to the roof when a neutron generator is used in the experimental area.

7. Task 3: Operating Procedures - The following deficiencies were identified in the proposed Standard Operating Procedure. Correct and re-submit operating procedure.

   A. Sealed source and device (SSD) registration certificate CO-1012-D-101-S has the following description: “Following tube operation, neutron activation of tube components and the housing assembly will produce external gamma radiation. Care should be taken because of induced radiation in the generator or in samples, structures or equipment in the vicinity of the generator. It will be necessary to monitor the generator and test samples before personnel are allowed to approach or work with this equipment.” The operating procedure does not mention the monitoring and safety precautions that will be taken regarding external gamma radiation due to neutron activation.

   B. Engineering controls – Describe the administrative and/or engineering controls (example: audio/visual alarms, other) used to alert users that radiation is being emitted when the neutron generator is in use and not to enter the experimental area until short activation products have decayed away.

   C. Engineering controls – Describe the administrative and/or engineering controls (example: maze door interlock, other) used to disengage the system in the event that the maze door is opened when the neutron generator is in use.

   D. Equipment: There is no mention of radiation survey meters and type of meters that will be used by staff when entering the maze area after the neutron generator is used and for conducting ambient radiation surveys.

   E. Additional Safety Information – the section “Limiting Conditions That Void the Radiological Control Area (RCA)” states that one of the limiting condition requiring to stop work, cease use of the RCA, and notify the radiation safety officer is when “Radiation levels exceed 70 millirem/hour at 30 centimeters away from a radiation source.” Please note that the SSD certificate CO-1012-D-101-S states that radiation levels at 30 centimeters from the source are 4.65 Rem/hour, 36.8 Rem/hour, 9.25 Rem/hour and 1,162 Rem/hour depending on different neutron generator tube models, thus triggering an immediate stop work every time a generator is in use. Correct the statement to reflect the limiting condition (expected radiation levels) outside the shielded walls at 30 centimeters in restricted and unrestricted areas in accordance with 10 CFR Part 20 limits (see items 8 and 9 below).

8. Task 4: Dose Assessment, Table 1 - The predicted dose rate for all of the unrestricted areas (locations 2, 3 and 4) exceed the regulatory limit of 2 millirem in any one hour for individual members of the public established in 10 CFR 20.1301(a)(2). The results listed in Table 1 are 3.1 millirem per hour for location 2, 3.7 millirem per hour for location 3, and 4.8 millirem per hour for location 4. Please note that the SSD certificate CO-1012-D-101-S states that for laboratory or above ground use of neutron generators, two basic types of shielding are described in Technical Bulletin No. 104 provided by Thermo MF Physics. These are shielded room/labyrinth shielding with approximately 5 feet of concrete shielding, and pit or well installations in which the earth provides shielding. Describe corrective actions, update Table 1 and re-submit.

9. Task 4: Dose Assessment, Table 1 - The allowable annual time at dose (hours) for all of the unrestricted areas (locations 2, 3 and 4) exceed the regulatory limit of 100 millirem in a year established in 10 CFR 20.1301(a)(1) for members of the public. The results after multiplying the dose rate values by the allowable annual time at dose values are 502.2 millirem in a year for location 2, 492.1 millirem in a year for location 3, and 504 millirem in a year for location 4. Task 4 incorrectly states that 500 millirem in a year is the NRC limit for the general public. Please correct Table 1 and re-submit.

10. Task 4: Dose Assessment - This section describes the radiation detection instrument that will be used to detect neutron radiation.

    A. Indicate what type of equipment will be used to detect gamma radiation from activation products. Provide manufacturer name, model number, type of instrument, instrument range, type of radiation detected, instrument probe model number, and number of equipment.

    B. The Standard Operating Procedure in Appendix A (Limiting Conditions) states that removable contamination > 70 dpm/100 cm^2 beta/gamma or 10 dpm/100 cm^2 alpha will be measured after initial attempts to remove contamination from area or equipment. Indicate what type of equipment will be used to perform contamination surveys. Provide manufacturer name, model number, type of instrument, instrument range, type of radiation detected, type of detector, and number of equipment.

    C. For the instruments described in 10.A. and 10.B. provide calibration frequency (NUREG-1556, Volume 14, revision 1 state 6-months) and confirm that a licensed vendor (not the licensee) will provide the calibration services.

11. Task 5: Emergency Procedures - Provide copy of emergency procedures for the use of neutron generators referenced in the amendment request. Include a most credible scenario such as when a neutron generator is in use and the electricity goes out, radiation monitors become non-functional, and staff needs to wait until neutron activation products decay away, and use of survey meter to access the maze.

12. Task 6: Use Agreement - The use agreement state that the neutron generator will be used for materials exploration and classroom instruction. Provide radiation safety instructions and training, and method for monitoring doses of the students receiving classroom instruction that will have access to the A) experimental area, B) utility/storage area, and C) operator desk/control area.

13. Section 2, Sample Loading, of the Standard Operating Procedure has Item 2.1 in red boldface. Explain the meaning of the second sentence.

14. The Standard Operating Procedure in Appendix A ends in Step 3 and appears to be incomplete. There is no description of Step 4 – Neutron Generator Operation, and subsequent steps. Provide complete Standard Operating Procedure including description of the following elements.

    A. Limitations on irradiation of types and amounts of radioactive material, irradiation of explosives, irradiation of flammable material, irradiation of animals, etc.

    B. Console key control

    C. Stay time after use of the neutron generator

    D. Use of survey meter when accessing the experimental area after the use of the neutron generator

    E. Description of any other radiation protection measures users need to follow

15. Material Receipt and Accountability/Physical Inventory - Describe how licensed material will be received, accounted, and inventoried. Include the following elements in the inventory report.

    A. Semiannual frequency
    B. Quantity and kind of licensed material
    C. Location of licensed material
    D. Date of Inventory
    E. Name of individual conducting inventory
    F. Record retention of 3 years

16. Operating and Emergency Procedures - Include the following items in the Operating and Emergency Procedures and re-submit.

    A. Instructions for maintaining security of licensed material during storage and use. Confirm that the licensee will not transport neutron generators for use at other licensee's authorized locations, field stations and temporary job sites.

    B. Instructions to keep licensed material under control and immediate surveillance during use. Steps to maintain accountability during use.

    C. Steps to take to keep radiation exposures ALARA

    D. Steps to control access to the area of use

    E. Steps to take and whom to contact when an emergency occurs

    F. Methods and occasions for conducting radiation surveys, including surveys for detecting contamination

G. Procedures to minimize personnel exposure during routine use and in the event of an incident

H. Methods and occasions for locking and securing stored licensed materials

I. Procedures for picking up, receiving, and opening packages containing licensed material

J. Instructions for maintaining records in accordance with regulations and license conditions

K. Steps for the use, inspection and maintenance of neutron generators

L. Procedures for identifying and reporting to the NRC defects and noncompliance, as required by 10 CFR 21.21(a)

M. Procedures and actions to be taken if the licensed material inside the neutron generator is ruptured, including actions to prevent the spread of contamination

N. Instructions for proper storage and disposal of radioactive waste

O. Maintenance of neutron generators – Description of daily visual inspection (or other frequency) and 6-month routine maintenance

P. Neutron generators will be taken out of service when defects are identified, and repairs will only be made by the manufacturer

Q. The opening, repair, and modification of neutron generators will be performed only by the manufacturer

R. Operating and Emergency procedures address handling of contamination resulting from the routine use, initial installation, replacement, or accidental damage of the targets or glass tubes

17. Provide waste management procedures for the use of licensed material and/or licensed material generated from the use of neutron generators.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.390 of the NRC's "Rules of Practice," a copy of this letter will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at https://www.nrc.gov/reading-rm/adams.html.

To continue review of your application, we request that you submit your response to this letter within 30 calendar days from the date of this letter. In your response, please refer to the license, docket, and control number specified below. We will assume that you do not wish to further pursue this licensing action if we do not receive a reply within the specified timeframe noted above.

If you have questions, require additional time to respond, or require clarification on any of the information stated above, you can contact me at 817-200-1189.

Thank you for your cooperation.

Sincerely,

Roberto J. Torres

Digitally signed by Roberto J. Torres
Date: 2021.06.07 13:54:52 -05'00'

Roberto J. Torres, M.S., Senior Health Physicist
Materials Licensing and Decommissioning Branch

Docket: 030-32218
License: 11-27388-01
Control: 625764