The Connecticut Agricultural Experiment Station

123 HUNTINGTON STREET, P.O. BOX 1106, NEW HAVEN, CONNECTICUT 06504

Founded 1875 ***Putting science to work for society***

July 28, 2011

M516
Q-5

06-03754-01
03003787

RECEIVED
REGION 1
2011 AUG -1 PM 12:59

Betsy Ullrich
Nuclear Materials Branch 2
Division of Nuclear Materials Safety
U.S. Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, PA 19406-1415

SUBJECT: Response to request for additional information concerning application for renewal of license, Control no. 575193.

Dear Ms. Ullrich,

In reference to your letter of July 13, 2011 the following information is provided in support of renewal of License No. 06-03754-01. The Suggested Format for Providing Information Requested in Items 5 through 11 of NRC Form 313 of appendix C of NUREG-1556 "Consolidated Guidance About Materials Licenses. Program Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope" Vol. 7 has been employed.

This letter attempts to present an up-to-date application for renewal. All pertinent aspects of our current practices in relation to NRC guidelines have been consolidated into this document. Thus, the multiple attachments listed in the current license are no longer needed as details of our program are now covered by this letter and that of June 9, 2011.

Sincerely,

Richard B. Peterson

Dr. Richard B. Peterson
Radiation Safety Officer
The Connecticut Agricultural Experiment Station
Tel 203 974-8463
FAX 203 974-8502

575193

NMSS/RGN1 MATERIALS-002

5-6. RADIOACTIVE MATERIALS AND PURPOSES FOR USE.

Radioisotope	Form	Max. Poss. Limit	Proposed Use
Hydrogen-3	Any	1.3 Curies	Studies with plants and small lab animals. In vitro studies.
Carbon-14	Any	20 milliCurie	Studies with plants and small lab animals. In vitro studies.
Phosphorus-32	Bound/nonvolatile	5 milliCurie	In vitro studies, labeling of compounds.
Sulphur-35	Bound/nonvolatile	10 milliCurie	In vitro studies, studies with plants and small lab animals.

7. INDIVIDUALS RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

Radiation Safety Officer (RSO)- Dr. Richard B. Peterson

Dr. Peterson received his Ph. D. in Biochemistry from the University of Wisconsin in [redacted]. He completed a graduate level course there on Isotopic Techniques (including safety procedures). He has experience with radioisotopes (C-14, H-3, P-32, Fe-55, Mo-99, I-131) as a graduate student, postdoctoral research associate, and as a staff scientist in the Department of Biochemistry and Genetics of The Connecticut Agricultural Experiment Station (CAES). In most cases, these radioisotopes were applied to studies of photosynthesis and nitrogen fixation in higher plants and algae. He has a total of 40 years of experience in laboratory research. Dr. Peterson served as assistant RSO from 1984 to 1994 and as RSO from 1994 to present.

Authorized Users (Assistant RSOs)- Drs. Joseph J. Pignatello and Neil P. Schultes

Dr. Joseph Pignatello received his Ph.D. in organic chemistry from the University of California at Berkeley in [redacted]. He conducted postdoctoral studies at the Freshwater Biological Institute at the University of Minnesota from 1978 to 1983. While at the University of Minnesota he conducted research into the fate and transport of ^{14}C-pentachlorophenol in artificial outdoor streams. He also attended a 2-hour course on safe handling of radioisotopes sponsored by the U.S. Environmental Protection Agency. His current research in the Department of Environmental Sciences at CAES involves sorption and biodegradation of organic pollutants in soil systems. He has employed, and supervised use of, H-3 and C-14 in his research since 1985. Most of his work involves C-14 and a typical experiment involves use of one microcurie or less. Dr. Pignatello's research constitutes a substantial proportion of the radioisotope

use at this institution. His service as assistant RSO and Authorized User has enhanced personnel compliance and accountability with respect to the radiation safety program.

Dr. Neil Schultes received his Ph.D. from the Department of Genetics of Harvard Medical School in [redacted] He worked as a postdoctoral research associate in the Department of Biology at Yale University from 1990 to 1994. He has worked in the Department of Biochemistry and Genetics at CAES since 1994. Dr. Schultes has extensive experience in the use of P-32 and S-35 in laboratory research involving molecular biology techniques. He has completed three radiation safety courses over the course of his career and served as an assistant Radiation Safety Officer at Yale. The latter involved: radioisotope purchasing, record keeping, monitoring of exposures, waste disposal, and report writing. He has served as an assistant RSO and Authorized User at CAES since 1994 and specifically supervises use of P-32 in studies involving nucleic acids.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS (OCCUPATIONALLY EXPOSED INDIVIDUALS AND ANCILLARY PERSONNEL)

No confirmed occupational exposure even approaching 100 mrem has occurred at this institution since film badge monitoring began in 1984. Considering existing safeguards and the quantity of P-32 routinely used in labeling procedures, the prospect of an occupational exposure capable of delivering such a dose under current circumstances is unlikely.

Both ALARA (As Low As Reasonably Achievable) and Radiation Declared Pregnancy policies were formulated by the RSO in 2001 and signed by the CAES Director. These remain in effect and have been posted. Individuals desiring to employ radioisotopes in their research discuss their needs and plans with the RSO in advance and implement their procedures under the supervision of the RSO and/or an Authorized User. Guidelines for laboratory handling of radioisotopes are posted in appropriate areas.

A training session for radioisotope users is held annually and is conducted by the RSO. This has consisted of a video presentation, lecture, online tutorial, or roundtable discussion. Topics typically stress safety issues and compliance with provisions of the NRC license. Consideration has been given to including staff that are only peripherally exposed to radioisotopes. Maintenance personnel participate in the annual training session since these individuals perform their duties in laboratories where radioisotopes are used and transport packages from the mail room to end users. With regard to package transport, each new maintenance employee is asked to review and sign a form which briefly explains CAES policy on transport of potentially hazardous packages. The form lists several names and telephone numbers of individuals who are qualified to assist if extraordinary circumstances arise (i.e. damaged or leaking package). This contact list is posted in the mail room area. The CAES Chief of Maintenance has been made aware of this policy and contributes to its successful implementation with maintenance staff. CAES research staff has been urged to adopt procedures that avoid handling of packages containing radioactive materials by clerical employees.

9. FACILITIES AND EQUIPMENT

Sketches of laboratories at CAES in which radioisotopes are currently in use or could be anticipated as sites of future use were included in the prior letter dated June 9, 2011. Room 121 of the Johnson-Horsfall Laboratory is the site of current use of P-32 (and likely future use of S-35). Gas chromatographs possessing Ni-63 detectors (used under general license with Agilent) are located in Room 221 of Johnson-Horsfall. Studies employing H-3 and C-14 are underway in laboratories of the Slate Building (Rooms 302, 308, 310, 311). Warning labels are posted in the entryways of all areas in which radioisotopes are used or stored.

All laboratory benches are constructed with smooth, nonporous surfaces to facilitate cleanup of spills. It is noted that most laboratories in which radioisotopes are used possess fume hoods. All laboratories possess sinks that are in good working order and have free-flowing drains for efficient and safe disposal of liquid wastes. Plexiglass shielding is provided in the fume hood of Room 121 of the Johnson-Horsfall Laboratory for users of P-32 and S-35. All waste containers are labeled. Containers for storage for decay of P-32 and S-35 possess thick glass walls that provide adequate shielding. C-14 solid waste is stored in a steel drum in Room 120 which is normally kept locked. NRC documents and instructions for safe handling of radioisotopes are posted in these areas. The names and telephone numbers of the RSO and Assistant RSOs are posted in these areas for contact in case of emergency. All laboratories are properly ventilated. All refrigerators and freezers containing radioisotopes are labeled, equipped with locks, and storage of foodstuffs in these items is forbidden.

10. RADIATION SAFETY PROGRAM

Radiation Monitoring Instruments

Two Geiger counters (Eberline Model SK-1) are available for monitoring of bench tops and surfaces. A Cs-137 (5 microcuries) source is available to routinely verify operation of the hand-held counters. These units are calibrated annually by an outside contractor and certificates are filed with the RSO.

We will use instruments that meet the radiation monitoring instrument specifications published in Appendix M to NUREG-1556, Vol. 7, "Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope," dated December 1999. We reserve the right to upgrade our survey instruments as necessary.

Material Receipt and Accountability

The RSO or an Authorized User approves orders for radioactive materials. Quantities of radioisotopes purchased are appropriate to the projected needs. Records (including invoices) are maintained by the RSO of all receipts of radioisotopes from suppliers. During normal working hours maintenance personnel deliver packages containing radioactive materials (or other potentially hazardous materials). These employees have been instructed in safe handling of such packages and have been provided with a contact list of qualified personnel if a question arises (see above). Any obvious damage to a package should be reported to the RSO or other qualified individual. In any case, a damaged or leaking package should not be handled by the maintenance employee. Should a delivery occur outside of normal working hours a maintenance employee would receive the package and store it in the mail room until such time that it could be safely delivered to the end user.

Incoming packages from suppliers are first inspected by the end user for external damage or deformation. After donning latex gloves, the package is opened and the inner container inspected for any obvious damage or leakage. The container is scanned with a Geiger counter in the case of P-32. The presence of external contamination is tested by wipe test for H-3, C-14, and S-35.

Physical inventories will be conducted at intervals not to exceed 6 months.

Occupational Dose

All individuals using P-32 and/or S-35 are issued badges for monitoring whole body dose. The badge films are collected monthly for processing by a commercial monitoring company. Records of doses are maintained by the RSO. ALARA and Declared Pregnancy Policy documents are posted.

We will monitor individuals in accordance with the criteria in the section entitled "Radiation Safety Program- Occupational Dose" in NUREG – 1556, Vol. 7, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Academic, Research and Development and Other Licenses of Limited Scope," dated December 1999.

Safe Use of Radionuclides and Emergency Procedures

All personnel who handle radioisotopes are instructed in essential aspects of their safe use. Gloves are worn during handling of radioactive materials. Adequate shielding is available for users of P-32. Typical radiotracer applications involve use of 50 microcuries of P-32. Absorbent material is kept nearby in case of a large scale spill. Foodstuffs and beverages are not allowed in areas where radioisotopes are used. Mouth-pipetting of radiolabeled reagents is forbidden. Refrigerators and freezers in which radioisotopes are stored are clearly labeled. Warning signs are posted at entryways and within areas where radioisotopes are used. The names and telephone numbers of the RSO and assistant RSOs are posted for contact in case of emergency. In the event of a spill the RSO will supervise cleanup and decontamination.

11. WASTE MANAGEMENT

All users are informed of procedures for safe disposal of radioactive wastes. Solid wastes containing H-3 and C-14 are stored in a labeled steel drum kept in locked Room 120 of the Johnson-Horsfall Laboratory pending disposal by a licensed disposal service. An annual inventory of C-14 and H-3 contaminated solid wastes is conducted. Solid waste containing P-32 and S-35 is allowed to decay in storage for at least 10 half-lives in shielded containers. The exteriors of packages containing these wastes are then scanned by Geiger counter and if found to be indistinguishable from background are disposed of in normal trash after removing any radioactive warning labels. Water-miscible waste containing P-32 and S-35 are stored for at least 10 half-lives then counted by scintillation spectrometry. When decayed to background levels these wastes are disposed into the sanitary sewer system. Disposal of water-miscible H-3 and C-14 waste into sanitary sewers is performed with ample flushing with tap water.

We will employ the Solubility Class Determination approach to determine solubility of compounds prior to introduction into sanitary sewers as described in NRC Information Notice 94-07. The *Handbook of Chemistry and Physics* by CRC Press will be used as the literature resource to assign solubility class. Only compounds classified as "very soluble" or "soluble" will be disposed of by this method [10 CFR 20.2003 (a) (1)]. Some aqueous wastes may contain labeled biological material. This material will contain proteins, carbohydrates, lipids, and finely dispersed solids. Since these substances quickly decompose to CO_2 and H_2O in sewage effluent they will be classed as "soluble".

After consideration of the quantities of C-14 and H-3 that we seek authorization to possess (see 5 above) and the average monthly aqueous discharge volume of effluent into the municipal sewer system by this institution (24734 liters), we have decided to employ a "hold and count" policy for water soluble wastes. Users will store aqueous wastes in non-breakable containers in fume hoods. Containers will be labeled appropriately (i.e., acids, bases) to prevent releases of material resulting from chemical reactions following additions. Prior to disposal a container will be gently agitated to thoroughly mix the contents and an aliquot will be withdrawn for counting by scintillation spectrometry. The total radiochemical content will be calculated using the measured volume of the waste. Maximum allowed concentrations of H-3 and C-14 in sewage effluent are 1×10^{-2} and 3×10^{-4} μCi/ml, respectively, as specified in 10 CFR Part 20 appendix B Table 3 (note μCi = microcurie). We will use a 10-fold safety factor so that any single disposal of either radioisotope will not exceed $0.1 \times (2.47 \times 10^{7}$ ml) × $(3 \times 10^{-4}$ μCi/ml) = 743 μCi for C-14 and $0.1 \times (2.47 \times 10^{7}$ ml) × $(1 \times 10^{-2}$ μCi/ml) = 24800 μCi for H-3. In other words, a single disposal during a one-month interval of either radioisotope at the limit specified will result in an average concentration in the sewage effluent for that month that is 10% of the limit allowed by the NRC [10 CFR 20.2003 (a) (2)]. Multiple releases in a single month are very unlikely but, if necessary, will be monitored to keep the total amounts below 7430 μCi for C-14 or 248000 μCi for H-3. Any planned releases of H-3 and C-14 during a one-month interval will first be assessed to determine that the sum of their fractional contributions, calculated according to 10 CFR 20.2003 (a) (3), is less than unity. Annual releases of H-3 and C-14 into the sewer system will not exceed 5 and 1 curies, respectively, as set forth in 10 CFR 20.2003 (a) (4). It should be noted that these annual release limits far exceed our requested limits for possession (see 5). The RSO will oversee the scheduling of releases of radioisotopes into the sewer system and maintain records of these discharges. We do not dispose of any wastes by incineration. Radioactive wastes that do not meet the solubility criteria discussed above or are contained in non-water miscible solvents will be stored pending disposal by a licensed contractor.

We will use the model waste procedures published in Appendix T to NUREG – 1556, Vol. 7, "Program-Specific Guidance About Academic, Research and Development, and Other Licenses of Limited Scope," dated December 1999.