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April 6, 2010

Ms. Rachel S. Browder
U.S. NRC, Region IV
612 East Lamar Boulevard, Suite 400
Arlington, TX 76011-4125

SUBJECT: RESPONSE TO LETTER WRITTEN ON MARCH 9, 2010 - REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE RENEWAL APPLICATION DATE APRIL 14, 2009

Dear Ms. Rachel S. Browder:

This letter is written in response to the March 9, 2010 letter requesting additional information concerning the radioactive materials license renewal application date April 14, 2009.

Item 1: The renewal application included a change to the Radiation Safety Officer. Please clarify whether Dr. Sherry Farwell will continue to be the Authorized User for Ni-63 and/or do you want to be authorized for Ni-63 as well?

Response: Dr. Farwell is no longer with the School of Mines and I would like to take over as the authorized user. The equipment has been moved to the Chemistry Department where they reviewed the feasibility of putting the instrument back into service. After further review, we will be placing the instrument in storage until it can be properly dispositioned. The parts for the particular instrument are unavailable.

Item 2: Item 8 on Page 2 of the application describes the training program. Please describe how the licensee will assess individual's training qualifications. In addition, describe how the licensee will assess the overall training program. Confirm that the training will be given both initially, before beginning any duties in the vicinity of the radioactive materials, and at intervals not to exceed 12 months after the initial training. Please describe how lessons-learned, revisions to the radioactive materials program or other changes in the program will be communicated, incorporated into the training program, and assessed as part of the overall program.

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Response: The formal training provided by the RSO or qualified training organization will require individuals working under the authorized user to complete an examination and answer at least 80% of the questions correctly. The authorized user will be required to complete job specific training that will be documented. The authorized user will complete sign-offs on job specific functions after the RSO or authorized user have watched the individual successfully complete the tasks.

The licensee will assess the overall training program based on audit findings within the laboratory and feedback from individuals taking the training program.

The training will be given both initially, before beginning any duties in the vicinity of the radioactive materials, and at intervals not to exceed 12 months after the initial training. Environmental health and safety (EHS) audits are currently the responsibility of the RSO at the South Dakota School of Mines and Technology. As with the EHS audits, the radiation safety audits will be documented and any nonconformances will be communicated to the authorized user via formal audit report that also includes pictures, if appropriate. The RSO will follow-up on nonconformances to ensure compliance. The nonconformance will then be added to the annual refresher training as well as also being discussed with the responsible individuals at the time the nonconformance is found. As said earlier, the training program will be revised based on any audit findings. Incidents, accidents, and near misses are required to be reported. These will also be incorporated into the training.

The training described above is for work with unsealed sources. Individuals working with the equipment containing the Ni-63 source will be given training on the safe use of the equipment.

Item 3: The license renewal application requests unsealed radioactive materials that have a more significant health and safety impact then the radioactive material which has been licensed historically. Please describe the types and numbers of survey and monitoring instruments available to the radiation safety staff. The description should include the type of instrument and probe, the sensitivity range (e.g., mR/hr or counts per minute (cpm)), and the instrument's intended purpose (e.g., monitoring, surveying, assaying or measuring.) You must have at least one portable radiation monitoring instrument that is capable of making quantitative measurements required for such activities as: radiation level measurements of packages prior to transportation, package receipt surveys, incident and assuring that radiation levels in unrestricted areas are in compliance with NRC regulations.

Response: Equipment has not been purchased, yet. However, once the license has been granted and research funds are available we will plan to purchase a hand held Geiger counter as well as a liquid scintillation counter. Radiation monitoring instruments will comply with the required sensitivity range to ensure safety and effective monitoring.

Geiger Counter Description: General purpose rate meter with pancake probe with a detection range of 0-200 mR/hr and sensitivity (^{137}Cs gamma) of at least 3300 cpm/mR/hr will be purchased. It will be used for monitoring, surveying and measuring.

Liquid Scintillation Counter: A liquid scintillation counter will be purchased for the research project that will also be used for the tritium detection and measuring. Equipment has not been specified, yet.

Item 4: Please provide a copy of the written procedures that have been developed for safe use of radioactive materials, responding to spills, and general emergency response. The procedures should include radioisotope-specific safety guidelines. NUREG-1556, Volume 7, Appendix P may be used a reference.

Response: Copies of the General Laboratory Safety and Emergency Procedures taken from the radiation safety manual as well as Radioisototope-specific procedures are enclosed.

Item 5: The license renewal application requests radioactive materials in quantities greater than 1 millicurie and which have greater than 500 keV average energy (e.g., P-32, N-16) or positron annihilation (e.g ., N-13). Please commit to the following safety precautions when using such materials:

a) The use of low-density plastic shielding in order to keep bremsstahlung radiation to a minimum.
b) A mandatory radiation survey and wipe test for radioactive contamination after each use.
c) The use of extremity monitors for procedures that involve 1 millicuries or more.
d) A dry run prior to the performance of unfamiliar procedures in order to preclude unexpected complications. In addition, it is recommended that the RSO be present during new procedures.
e) The use of eye protection for procedures that involve 10 millicuries or more.

For example, for P-32 with average beta energy of 0.7 MeV, the dose rate from 1 IJCi/cm3 in water is 1.48 rads/hour.

For beta particle energies above 0.6 MeV, the dose rate through the nominal protective skin layer is 9 rads/hr from a uniformly thin deposit of 1 IJCi/cm2 of a beta emitting radionuclide.

The dose rate at 1 cm from 1 mCi of P-32 is approximately 200 rads/hr.

Response: We will commit to the safety precautions in the above statement, if we ever use the material amounts or materials with the energies specified in the above statement. We would like to reduce the quantities for Dr. Sundareshwar's work to 1 mCi per isotope. Also, we would like to remove N-13 and N-16 from the list. The quantities needed for use are much less, but we wanted to request a larger amount to ensure no issue with going over the amounts. For example, P-32 studies will be used to study soil biogeochemical processes in laboratory and the typical level of label used will be around 5.0 kBq g-1 of soil.

Response from Dr. Sundareshwar: Elaborate / complex experiments conducted in my lab are routinely preceded by a dry run. Appropriate safety gear is available in the laboratory and students are required to use these during laboratory work requiring their use.

Item 6: Please describe whether the newly requested material will be unsealed material or in liquid solution .

Response: The requested materials will be in liquid solution.

Item 7: Please describe the calibration of the monitoring dosimetry to the energies of the beta radionuclides requested, especially for N-16. Commercial vendors typically do not calibrate their dosimetry to the energy of N-16.

Response: Since N-13 and N-16 will not be used, this should not be an issue.

Item 8: The radionuclides for N-16 and N-13 are very short (seconds), what is the purpose of use for these radionuclides (e.g. , coincidence counting) and how will you receive them?

Response: N-13 and N-16 can be removed from the application.

Item 9: The application provided the training and experience for Dr. Sundareshwar, which indicated that "Several of his research investigation involved the use of H-3" (tritium). The use of tritium is not sufficient training and experience for authorized use of the other requested radionuclides with higher beta energies. Please provide a resume for Dr. Sundareshwar or specify another Authorized User, including resume. The resume should demonstrate training and experience in the biological hazards associated with the radionuclides requested, including specific isotopes handled, the maximum quantities of materials handled, where the experience was gained, the duration of experience and the type of use. If the training and experience is not available, then you may request a partial list of radionuclides to be authorized now and provide separate training and experience for the proposed authorized user at a later date.

Response: Dr. Sundareshwar will be working with his colleagues at University of South Carolina and Duke University on an on-going research project during which he will work with P-32 and C-14. We will provide the documentation concerning the experience gained to obtain approval for use of the isotopes at a later date.

Sincerely,

Jerilyn Roberts

Campus Environmental Health and Safety Director

Docket: 030-35198
License: 40-27640-01
Control: 472221

General Laboratory Safety Procedures

A. Policy and Purpose

This policy provides general guidelines for the safe handling of radioactive materials in the laboratory. The safety procedures contained in this policy apply to all laboratories and must be used in conjunction with other safety procedures that are pertinent to each specific laboratory.

B. Responsibilities

1. The principal investigator must ensure that the general safety procedures are observed by all individuals working in the laboratory and must establish additional safety practices, when applicable, to assure the safe utilization of radioactive materials.
2. The individual user must exercise extreme caution when working with radioactive materials and must observe all provisions of this procedure.
3. The radiation safety officer will assess the level of compliance of the general safety procedures contained in this procedure.

C. Procedures and Safety Practices

The following items are general radiation safety procedures that must be followed by each laboratory using radioactive materials.

1. Appropriate personal protective equipment or apparel must be utilized by persons working with radioactive materials, e.g., disposable gloves, lab coats, lab aprons, goggles, etc.

2. Radioactive materials must be stored under lock and key or the door to the laboratory must be locked when unattended, to prevent exposure to unauthorized persons and/or loss or theft of the materials. All radioactive materials will be stored such that the exposure rate at the surface of the storage area is less than 2.0 mR/hr.

3. Work with radioactive materials must be performed in ventilated fume hoods if the manipulation of such materials involves any possibility of airborne contamination. No fume hood is currently designated for radioactive work. Work must be completed with liquid solutions not requiring added ventilation.

4. Pipetting of radioactive solutions by mouth is strictly prohibited.

5. Smoking, drinking, eating, and applying of cosmetics is prohibited in areas where radioactive materials are used or stored.

6. Food and drink must not be kept in refrigerators used to store radioactive materials.

7. Contaminated glassware and other utensils must be kept separate from other laboratory glassware or utensils and must be labeled "radioactive".

8. Personnel monitoring badges, when required in a laboratory, must be kept in an area free of radioactivity when not in use. Do not take the badges home!

9. Remote handling equipment (long-handled tongs, remote pipettes, etc.) will be routinely used in handling high levels of radioactive materials.

10. If a personnel monitoring device has been assigned, it must be worn at all times while in areas where

radioactive materials are being used.

11. Lead and/or Plexiglas shields must be used for sources having high radiation intensity. Contact the RSO for information concerning the type and amount of shielding that would be required for your laboratory set-up.

12. Hands, shoes and clothing must be frequently monitored.

13. Liquid and solid radioactive waste must be placed in approved containers. Liquid waste containers are provided by the RSO.

14. When working with a new procedure in which radioactive materials are to be used, a dry run (without the isotope) should be considered to isolate any problem areas.

15. In the case of a spill or breakage, the area (table top, floor, etc.) must be decontaminated until all loose activity is removed. Fixed contamination must be reduced to the practical minimum. DECONTAMINATION IS TO BE PERFORMED BY LABORATORY PERSONNEL, NOT BY HOUSEKEEPING PERSONNEL. The spill should be reported to the RSO and an incident report completed.

16. All persons involved in a spill and decontamination activities must be checked immediately after the spill and after decontamination is finished. A Geiger-Mueller survey meter is to be used as required. After such an accident, the general area especially floors, doors, handles, stair railings, etc. must be surveyed.

17. Label all work areas where radioactive materials are used with "radioactive" tape.

18. All areas in which radioactive material is used or stored must be in compliance with Occupational Safety and Health Act, 1970 (OSHA) and United States Nuclear Regulatory Commission (NRC).

19. Entrance doors to rooms and laboratories in which radioactive materials are stored or used will be posted with a conventional sign bearing the words "CAUTION - RADIOACTIVE MATERIALS". In addition to the foregoing requirement, some areas may be required to post a sign bearing the words "CAUTION - HIGH RADIATION AREA" or "RADIATION AREA"; these areas will be designated by the RSO, in compliance with federal regulations.

Emergency Procedures

A. Policy and Purpose

This policy provides general guidelines for handling emergency incidents involving radioactive materials in the laboratory. The safety procedures contained in this policy apply to all laboratories and must be used in conjunction with other safety procedures that are pertinent to each specific laboratory.

B. Responsibilities

1. The principal investigator must ensure that the emergency procedures are observed by all individuals working in the laboratory and must establish additional lab specific emergency procedures, when applicable, to assure the safe utilization of radioactive materials.
2. The individual user must exercise extreme caution when working with radioactive materials and must observe all provisions of this procedure.
3. The radiation safety officer will assess the level of compliance of the general safety procedures contained in this procedure.

C. Emergency Procedures (NUREG - 1556, Vol. 7 P-4 used as basis)

Copies of emergency procedures should be provided to all users. Post a current copy in each laboratory or other area where radioactive material is used.

General Safety Procedures to Handle Spills

Name and telephone number of RSO or an alternate person(s) should be posted conspicuously in areas of use, so that it is readily available to workers in case of emergencies. Licensee should have emergency equipment readily available for handling spills. Spill kits should include the following:

- Disposable gloves
- Disposable lab coats
- Disposable head coverings
- Disposable shoe covers
- Roll of absorbent paper with plastic backing
- Masking tape
- Plastic trash bags with twist ties
- "Radioactive Material" labeling tape
- Marking pen
- Pre-strung "Radioactive Material" labeling tags
- Box of Wipes
- Instructions for "Emergency Procedures"
- Pencil
- Appropriate survey instruments including batteries (for survey meters).

Minor Spills of Liquids and Solids

Instructions to Workers

1. Notify persons in the area that a spill has occurred.
2. Prevent the spread of contamination by covering the spill with absorbent paper. (Papershould be dampened if solids are spilled).
3. Clean up the spill, wearing disposable gloves and using absorbent paper.

4. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
5. Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination.
6. Report the incident to the Radiation Safety Officer (RSO) promptly.
7. Allow no one to return to work in the area unless approved by the RSO.
8. Cooperate with RSO/RSO staff (e.g., investigation of root cause, provision of requested bioassay samples).
9. Follow the instructions of the RSO/RSO staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).
10. RSO will complete incident report and will report to NRC, if appropriate.

Major Spills of Liquids and Solids

Instructions to Workers

1. Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.
2. Prevent the spread of contamination by covering the spill with absorbent paper (paper should be dampened if solids are spilled), but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
3. Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
4. Close the room and lock or otherwise secure the area to prevent entry. Post the room with a sign to warn anyone trying to enter that a spill of radioactive material has occurred.
5. Notify the RSO immediately.
6. Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap.
7. Allow no one to return to work in the area unless approved by the RSO.
8. Cooperate with RSO/RSO staff (e.g., investigation of root cause, provision of requested bioassay samples).
9. Follow the instructions of the RSO/RSO staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).
10. RSO will complete incident report and will report to NRC, if appropriate.

Incidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapors, and Gases

Instructions to Workers

1. Notify all personnel to vacate the room immediately.
2. Shut down ventilation system, if appropriate, to prevent the spread of contamination throughout system and other parts of facility.
3. Vacate the room. Seal the area, if possible.
4. Notify the RSO immediately.
5. Ensure that all access doors to the area are closed and posted with radiation warning signs, or post guards (trained) at all access doors to prevent accidental opening of the doors or entry to the area.
6. Survey all persons who could have possibly been contaminated. Decontaminate as directed by the RSO.
7. Promptly report suspected inhalations and ingestions of licensed material to the RSO.
8. Decontaminate the area only when advised and/or supervised by the RSO.
9. Allow no one to return to work in the area unless approved by the RSO.

10. Cooperate with RSO/RSO staff (e.g., investigation of root cause, provision of requested bioassay samples).
11. Follow the instructions of the RSO/RSO staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).
12. RSO will complete incident report and will report to NRC, if appropriate.

Minor Fires

Instructions to Workers

1. Immediately attempt to put out the fire by approved methods (i.e., fire extinguisher) if other fire hazards or radiation hazards are not present.
2. Notify all persons present to vacate the area and have one individual immediately call the RSO and fire department (as instructed by RSO).
3. Once the fire is out, isolate the area to prevent the spread of possible contamination.
4. Survey all persons involved in combating the fire for possible contamination.
5. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with a mild soap.
6. In consultation with the RSO, determine a plan of decontamination and the types of protective devices and survey equipment that will be necessary to decontaminate the area.
7. Allow no one to return to work in the area unless approved by the RSO.
8. Cooperate with RSO/RSO staff (e.g., investigation of root cause, provision of requested bioassay samples).
9. Follow the instructions of the RSO/RSO staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).
10. RSO will complete incident report and will report to NRC, if appropriate.

Fires, Explosions, or Major Emergencies

Instructions to Workers

1. Notify all persons in the area to leave immediately.
2. Call 911.
3. Notify the RSO and Campus Safety.
4. Upon arrival of Rapid City Fire Department (RCFD), inform them where radioactive materials are stored or where radioisotopes were being used; inform them of the present location of the licensed material and the best possible entrance route to the radiation area, as well as any precautions to avoid exposure or risk of creating radioactive contamination by use of high pressure water, etc.
5. Cooperate with RSO/RSO staff (e.g., investigation of root cause, provision of requested bioassay samples).
6. Allow no one to return to work in the area unless approved by the RSO.
7. Follow the instructions of the RSO/RSO staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).
8. RSO will complete incident report and will report to NRC, if appropriate.

H-3 Standard Operating Procedures

Introduction

Hydrogen-3 is a commonly used radionuclide with a half-life of 12.3 years, emitting only beta particles with a maximum energy of 0.019 MeV (Million Electron Volts) and an average energy of 0.0057 MeV. The beta particles from H-3 travel a maximum of 6 mm. in air.

Concerns

The major concern with using H-3 is that it cannot be easily monitored during it's use, therefore, special precautions are needed to keep the work environment clean. The regular use of wipe testing is the only way to insure that your work space is not contaminated. Contamination on the skin will not likely cause a significant dose to the dead layer of skin, however, it could lead to the internal absorption of H-3. The ingestion annual limit of intake (ALI) is 80 millicurie.

Shielding

Glass and plastic are the best shields for beta particles from H-3, normally no additional shielding is necessary.

Detection

A tiny drop of contamination containing H-3 can be easily detected with a wipe test from a liquid scintillation counter. A Geiger counter will not detect the presence of H-3.

Equipment / Supplies

The following equipment and supplies must be available:

- disposable latex or plastic gloves.
- full-length lab coat.
- containers for radioactive waste.
- pipettes dedicated to the use of H-3.
- commercial decontaminate, i.e. DuPont's "Count Off".
- absorbent bench covering or tray.

Safety Rules

If the following safety precautions are used, personnel radiation exposure will be as low as reasonably achievable.

1. Designate a specific area of the lab for H-3 handling.
2. Full-length lab coats must be worn by all persons who handle H-3.
3. Protect the skin of your hands from becoming contaminated from spills by wearing two pairs of disposable gloves.
4. Never pipette H-3 or any radionuclide by mouth.
5. Only use pipettes which have been dedicated to your specific use of H-3. Pipettes will easily become contaminated and therefore, should not be shared with others.
6. If you have reason to believe that your gloves are contaminated, immediately dispose of them in the radioactive waste container.

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Post-Use Procedures

After handling H-3:

- Conduct monthly (weekly) wipe tests.
- Count weekly wipes in a Liquid Scintillation counter.
- Check all equipment, centrifuges, water baths for contamination.
- If any contamination is found, use a commercial radiation contamination remover (i.e. Count Off) with paper towels to clean up the equipment.
- Place the towels in the radioactive waste receptacle.
- If contamination cannot be removed, place a "radiation" label on the equipment indicating that it is H-3, maximum cpm found, and the date you measured the level.
- Check the work bench and floor.
- If contamination is found, it can usually be removed easily with "Count Off". If it cannot be removed, contact the RSO to obtain shielding materials.
- Inform your fellow lab workers if any unremovable contamination is found.
- Check the normal trash container to make sure no radioactive waste has been accidentally placed there.
- Store waste temporarily in specially marked containers.
- Call the RSO if you have any questions about where to survey or how to document.
- Wash your hands thoroughly.
- Bring the waste to the RSO frequently. Do not let it pile up.

C-14 Standard Operating Procedures

Introduction

Carbon-14 is a commonly used radionuclide with a half-life of 5,730 years, emitting only beta particles with a maximum energy of 0.156 MeV (Million Electron Volts) and an average energy of 0.049 MeV. The beta particles from C-14 travel a maximum of 22 cm.

Concerns

The major concern with using C-14 is that it cannot be easily monitored during it's use, therefore, special precautions are needed to keep the work environment clean. The regular use of wipe testing is the only way to insure that your work space is not contaminated. Contamination on the skin will not likely cause a significant dose to the dead layer of skin, however, it could lead to the internal absorption of C-14. The annual ALI is 2 millicurie.

Shielding

Glass and plastic are the best shields for beta particles from C-14. Normally no additional shielding is needed.

Detection

A tiny drop of contamination from C-14 can be easily detected with a wipe test from a Liquid Scintillation Counter. A Geiger-Muller pancake can be used to detect C-14, however the survey meter probe must be within a very close range (< 1 inch). Geiger-Muller detectors have a very low efficiency (~3%) for counting low energy C-14 beta particles.

Equipment / Supplies

The following equipment and supplies must be available:

- disposable latex or plastic gloves.
- a full-length lab coat.
- radioactive waste receptacle
- pipettes dedicated to the use of C-14.
- commercial decontaminate, i.e. Dupont's "Count Off".
- absorbent bench covering or tray.

Safety Rules

If the following safety precautions are used, personnel radiation exposure will be as low as reasonably achievable.

1. Designate a specific area of the lab for C-14 handling.
2. Full-length lab coats must be worn by all persons who handle C-14.
3. Protect your hands from becoming contaminated from spills by wearing two pairs of disposable gloves.
4. Never pipette C-14 or any radionuclide by mouth.
5. Only use pipettes which have been dedicated to your specific use of C-14.
6. Pipettes will easily become contaminated and therefore, should not be shared with others.
7. If you have reason to believe that your gloves are contaminated, immediately dispose of them in the radioactive waste container.

Post-Use Procedures

After handling C-14:

- Conduct a monthly(weekly) wipe test.
- Count the weekly wipes in a Liquid Scintillation counter.
- Check all equipment, centrifuges, water baths for contamination.
    - If any contamination is found, use a commercial radiation contamination remover (i.e. Count Off) with paper towels to clean up the equipment.
    - Place the towels in the radioactive waste receptacle.
- If contamination cannot be removed, place a "radiation" label on the equipment indicating that it is C-14, maximum cpm found, and the date you measured the level.
- Check the work bench and floor.
    - If contamination is found, it can usually be removed easily with "Count Off". If it cannot be removed, contact the RSO to obtain shielding materials.
    - Inform your fellow lab workers if any unremovable contamination is found.
- Check the normal trash container to make sure no radioactive waste has been accidentally placed there.
- Store the waste temporarily in containers marked with labels "Radioactive Waste-Do Not Empty". These labels are available in the RSO.
- Call the RSO if you have any questions about where to survey.
- Wash your hands thoroughly.
- Bring the waste frequently to the RSO.

P-32 Standard Operating Procedures

Introduction

Phosphorus-32 is a commonly used radionuclide with a half-life of 14.3 days, emitting beta particles with a maximum energy of 1.71 MeV (Million Electron Volts). The beta particles travel a maximum of 20 feet in air at maximum energy. See Appendix A for information on the rate at which P-32 decays.

Concerns

The major concerns with using P-32 are:

- **Surface radiation exposure to the skin of the hands.** A drop of contamination containing 1 microcurie of P-32 on 1 cm^2 area of the skin produces an exposure of 2,000 millirems / hour. One microcurie = 2.22 x 10^6 dpm (disintegrations per minute).
- **Radiation exposure in air over an open vial.** The dose rate at the opening of a vial containing 1 millicurie of P-32 can be as high as 26,000 millirems per hour.

This means that the quarterly As Low As Reasonably Achievable (ALARA) limit of 1,875 millirems for the hands would be reached in a little over 4 minutes.

Using lower concentrations is very desirable. Most companies will provide lower concentrations if requested. The cost of using pre-labeled materials or lower concentrations is higher but the return in safety more than offsets the additional cost.

Shielding

Plexiglas (lucite) is the best shield for beta particles from P-32. When more than 1 millicurie of P-32 is handled, a sufficient number of x-rays (bremmstrahlung) may be formed to require Lead foil to be added to the exterior of the shield. The beta particles travel a maximum of 3.1 mm. in glass, 6.7 mm. in lucite, and 8 mm. in tissue.

Detection

A tiny drop of contamination of P-32 can be easily detected with an pancake-style Geiger Counter.

Equipment / Supplies

The following equipment and supplies must be available:

- A Geiger Counter sensitive to beta particles. This device will allow the detection not only of P-32 beta particles but also the secondary x-rays.
- 3/8" or 1/2" Plexiglas benchtop shield. If you are going to handle more than 1 millicurie, we recommend the 1/2" thickness.
- Disposable latex or plastic gloves.
- Ring badge (need to be determined by the RSO).
- Full-length lab coat.
- Plexiglas containers for radioactive waste. These are available from many lab equipment vendors such as VWR, Fisher, etc.
- Pipettes dedicated to the use of P-32.
- Plastic safety glasses.
- Commercial decontaminate, i.e. DuPont's "Count Off".
- Absorbent bench covering or tray.

Safety Rules

If the following safety rules are followed, personnel radiation exposure will be as low as reasonably achievable.

1. Designate a specific area of the lab for P-32 handling.

    - Place the Plexiglas shield near a wall on top of absorbent bench paper or pads (not toward another work area on the other side of the bench) away from the main flow of traffic in the lab.
2. All persons handling P-32 and issued a ring badge must wear the ring badge inside the disposable glove on the hand which is most frequently used to handle vials, samples, pipettes, etc. containing P-32. The sensitive portion of the ring badge must face the radioactive material.
3. Full-length lab coats must be worn by all persons who handle P-32.
4. Protect the skin of your hands from becoming contaminated by wearing two pairs of disposable gloves.
5. A Geiger counter must be in operation during the experiment, and preferably at all other times.
    - To avoid contaminating the detector, a thin sheet of plastic (i.e., Saran Wrap) may be placed around the detector
6. Place all vials and test tubes containing P-32 behind a 3/8" or 1/2" thick Plexiglas shield.
    - Check the radiation level in front of the shield to determine if Lead foil should be added to block out the x-rays (called bremmstrahlung) formed by the beta particles interacting with the Plexiglas.
7. Do not work directly over an open container of P-32.
8. Never pipette P-32 or "any radionuclide" by mouth.
9. Only use pipettes which have been dedicated to your specific use of P-32.
    - Pipettes will easily become contaminated and therefore, should not be shared with others.
10. Use the Geiger Counter to check your gloves frequently for contamination.
    - If contamination is found, immediately dispose of the gloves in the radioactive waste container

Post-Use Procedures

After handling P-32:

- Use the Geiger Counter to check your hands, shoes, clothing, work bench, floor, centrifuges, and water baths for contamination.
- If any contamination is found on your shoes and/or clothing, contact the RSO. You will likely have to remove it temporarily until the radiation decays to background. The RSO has some disposable clothing that you can wear home, but we do not have any shoes.
- If any contamination is found on your hands, wash thoroughly with soap and water. This will usually be sufficient to remove the surface contamination. If it does not, contact the RSO for assistance.
- If any contamination is found on the work bench, floor, or lab equipment, use a commercial radiation contamination remover (i.e. Count Off) with paper towels to clean up the equipment. Place the towels in the radioactive waste receptacle.
- If contamination cannot be removed, place a "radiation" label on the equipment indicating that it is P-32, maximum cpm found, and the date you measured the level.
- If contamination cannot be removed from the floor, contact the RSO to obtain shielding materials.
- Inform your fellow lab workers if any unremovable contamination is found.
- Check the normal trash container to make sure no radioactive waste has been accidentally placed there.
- Store the waste temporarily in Plexiglas containers or other containers which are sufficient to absorb P-32's beta particles.
- Complete the Survey log.
- Call the RSO if you have any questions about where to survey or how to document.
- Wash your hands thoroughly after using P-32.
- Bring the waste to the RSO frequently. Do not let it pile up.

DECAY RATE OF P-32

Days Elapsed	% of Activity Remaining	Decay Factor
0	100.0	1.00
1	95.3	0.953
2	90.8	0.908
3	86.5	0.865
4	82.4	0.824
5	78.5	0.785
6	74.8	0.748
7	71.2	0.712
8	67.8	0.678
9	64.6	0.646
10	61.6	0.616
11	58.7	0.587
12	55.9	0.559
13	53.2	0.532
14	50.7	0.507
15	48.3	0.483
16	46.0	0.460
17	43.8	0.438
18	41.8	0.418
19	39.8	0.398
20	37.9	0.379
21	36.1	0.361
22	34.4	0.344
23	32.2	0.328
24	31.2	0.312
25	29.7	0.297
26	28.3	0.283
27	27.0	0.270
28	25.7	0.257
29	24.5	0.245
30	23.3	0.233
...	...	...
143 (10 half-lives)	0.1	0.001

For example, if your vial contained 500 microcuries of P-32 on 7/1/10, the amount of activity remaining on 7/8/10 (7 elapsed days) would be:

Activity x Decay Factor = 500 microcuries x 0.712 = 356 microcuries

Procedure source: SUNY Upstate Medical University

Browder, Rachel

From: Roberts, Jerilyn C. [Jerilyn.Roberts@sdsmt.edu]
Sent: Tuesday, April 06, 2010 5:22 PM
To: Browder, Rachel
Subject: SDSM&T Reply
Attachments: License Application Reply to 030910 Letter.pdf; Radiation Safety - General Laboratory Safety Procedures and Emergency Procedures.pdf; Isotope specific procedures.pdf

South Dakota School of Mines and Technology
Docket: 030-35198
License: 40-27640-01
Control: 472221

Ms. Browder,

This e-mail is in response to the additional information request letter dated 03/09/2010. I have attached a letter answering the questions posed in the March 9th letter. In addition, I have also attached lab safety, emergency, and isotope specific procedures as requested. I will send original copies via mail tomorrow.

If there is a need to add Sulfur-35 to the list of isotopes, will that be a problem as long as there is sufficient training documentation provided for the authorized user? Is it possible to use a consultant to the School of Mines as an authorized user until sufficient training has been completed?

I also wanted to ensure the authorized user's name is spelled correctly. I had an error on the application. It should be Dr. Pallaoor Sundareshwar.

Thanks.

Jerilyn Roberts
Environmental Health and Safety Director
South Dakota School of Mines and Technology
501 East St. Joseph Street
Rapid City, SD 57701-3995
605 394-6729
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Jerilyn.Roberts@sdsmt.edu

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