

August 27, 2008

U.S. Nuclear Regulatory Commission
Region III
Materials Licensing Branch
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4352

Re: Amendment to Materials License No. 24-17210-01

To the Licensing Representative:

The following items (grouped below under 1-Radiation Safety Program, 2-Waste Management Program or 3-Training of Individuals) are submitted as proposed changes to our Materials License.

- 1. Radiation Safety Program. The RSO has determined that our program will be improved by modifying our policy on surveying shipments of radioactive materials. Also, review of past records of radiation badges or ring exposures has shown no justification for requiring all workers to wear radiation badges or rings. This is consistent with the kinds and low amounts of radioactive materials that most workers use at our institution. Finally, RSO contact information needed to be added to our Spill Report Form. For these reasons, the following changes (in italic or strikeout script) to our license are proposed.**

1a. SURVEYING SHIPMENTS OF RADIOACTIVE MATERIALS

Changes to page 6 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

Item 10b1: Maintaining the Inventory of Radioactive Material. The RSO audits usage and disposal of radioactive materials by AU or Investigators on a semiannual basis (May 1 and November 1 of each year) based on their submission of Form 1 (**Appendix G**), which summarizes use, disposal, decay, and transfer for each radionuclide. The RSO also reviews each order/delivery of radioactive material to KCOM to insure that AU or Investigator's do not exceed their possession limits, which are approved by the RSO. At the time of delivery of radioactive materials, Form 2 (**Appendix H**) is used by AU or Investigators to record relevant

information and survey results for the package. *Completed versions of Form 2 (the top half of the page down through "Wipes of Pkg. Surfaces") are submitted to the RSO within 3 business days of receipt of radioactive materials.* Completed versions of Form 2 detailing dates of use and disposal of each radioactive material are submitted to the RSO during the semiannual inventory audit.

Changes to page 19 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX H: Form (2) for Receipt, Use and Disposal of each Radioisotope

FORM 2 SEMI-ANNUAL RADIOISOTOPE REPORT

Within 3 business days of receiving this radioactive material, send a copy of this form (completed down through "Wipes of Pkg. Surfaces") to the RSO.

Name of User: _____ Date received: _____

Changes to page 22 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX J: Safely Opening Packages Containing Radioactive Material

All packages containing radioactive materials are opened using the following procedures.

- 9. Maintain records of receipt, package survey, and wipe test results on Form 2 (**Appendix H**). *Send a completed version of Form 2 (the top half of the page down through "Wipes of Pkg. Surfaces") to the RSO within 3 business days of receipt of radioactive materials.*

1b. WEARING RADIATION BADGES OR RINGS

Changes to page 6-7 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

Item 10c: Occupational Dose. We have done a prospective evaluation and determined that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits in 10 CFR Part 20. The RSO prepares an annual ALARA report, which summarizes KCOM occupational exposure data.

Upon request or if determined by the RSO, personnel working with radioactive materials will be provided wear a radiation monitoring badge and/or ring relying on Luxel OSL technology. These monitors will be exchanged on a quarterly schedule. Pregnant employees, who have declared their pregnancy, will be issued an additional fetal badge to be worn on the waist and exchanged monthly. Badges and rings are supplied by Landauer, Inc. (2 Science Road, Glenwood, Illinois)

Changes to page 24 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX K, continued:

- (2) *Upon request or determination by the RSO, staff and students working with radioactive materials are provided and should wear a radiation monitoring badge and/or ring. Pregnant individuals, who elect to work with radioisotopes, should wear a waist badge to monitor fetal exposure to radiation. These monitoring devices are provided by KCOM on a quarterly basis (or monthly for waist badges used to monitor fetal exposure).*

Changes to page 26 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX M: Procedures Involved with Research on Small Lab Animals

Instruction to Animal Caretakers Concerning Radioactivity in Animals

1. Personnel must wear lab coats and gloves whenever handling animals or carcasses.
2. Animal cages will be decontaminated by washing with detergent.
3. Rubber gloves will be worn by personnel.
4. The animal room will be surveyed for contamination by the RSO or delegate after each use of radioactive material.
5. All relevant animal caretakers must wear total body film badges, *upon request or if determined by the RSO.*

1c. RSO CONTACT INFORMATION ON SPILL REPORT FORM

Changes to page 29 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX P: Radioactive Spill Report Form

INCIDENT REPORT OF CHEMICAL OR RADIONUCLIDE SPILLS
Emergency personnel contacted [e.g., Radiation Safety Officer (RSO), Neil Sargentini;

Work: 660-626-2474 or 2559; Home: 660-627-5806; Police, Fireman]

2. Waste Management Program. The RSO has determined that our program will be improved by modifying our policy on incineration of radioactive materials, and by altering our calculation method for setting limits on radioactivity that may be disposed into the sewer. For these reasons, the following changes (in italic or strikeout script) to our license are proposed.

2a. INCINERATION

Changes to page 10 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

3. Incineration. *Specified* radioactive materials may be disposed in the KCOM incinerator (in TBR) provided the gaseous effluent from incineration does not exceed the limits specified in **Appendix Q**. *All incinerations of radioactive material must each be approved, in advance, by the RSO.* Ash residues may be disposed of as ordinary waste provided appropriate surveys are made to determine that its radioactivity cannot be distinguished from background with typical low-level lab survey instruments. Ash residues with a half-life of 120 days or less may be held for decay-in-storage as described above. Ash residues with a half-life of greater than 120 days are stored for shipment to an authorized disposal site (see below). These residues are stored in marked barrels in the Radioactive Waste Storage Room (**Appendix F**).

Changes to page 30 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX Q: Allowed Incinerator Emissions of Radionuclides

Radionuclides may be released into the air from KCOM at no more than the values for Allowed Incineration of Radioactive Materials Per Day (shown below). Data are derived from the Code of Federal Regulations 10, Part 20, Appendix B, Table 2 (Effluent Concentrations, Air), p336-385. Note: total aggregate quantities of radionuclides released per day may be no more than one daily limit, e.g., 1/2 daily limit of Cr-51 + 1/4 daily limit of P-32 + 1/4 C-14 + 1/2 daily limit of H-3.

Nuclide	Allowed Effluent Concentrations in Air (μCi/ml)	Allowed Incineration of Radioactive Materials Per Day (μCi)*
Carbon-14	3.00E-09	104
Carbon-14 (CO ₂ upon incineration)	3.00E-07	3,900 10,398
Cerium-141	1.00E-09	35

Chromium-51	3.00E-08	1,040
Cobalt-57	4.00E-09	139
Gadolinium-153	3.00E-10	10
Hydrogen-3	1.00E-07	1,300 3,466
Indium-114 ^m	9.00E-11	3
Iodine-125	3.00E-10	10
Iodine-131	2.00E-10	7
Manganese-54	1.00E-09	35
Niobium-95	2.00E-09	69
Phosphorus-32	1.00E-09	35
Phosphorus-33	4.00E-09	139
Rubidium-86	1.00E-09	35
Ruthenium-103	9.00E-10	31
Scandium-46	3.00E-10	10
Strontium-85	2.00E-09	69
Sulfur-35	2.00E-08	693
Technicium-99 ^m	2.00E-07	6,932
Tin-113	2.00E-09	69

*Calculations: Allowed Incineration of Radioactive Materials per Day (μCi) = NRC Allowed Effluent Concentrations in Air ($\mu\text{Ci}/\text{ml}$) x Flow rate (2,550 ft^3/min) x Conversion Factor (28,317 ml/ft^3) x Incineration Time (180 480 min/day ; i.e., only one incineration is performed per day and it takes all day from fire up to cool-down)

Example for C-14:

$$(3.00\text{E-}09 \mu\text{Ci}/\text{ml}) \times (2,550 \text{ ft}^3/\text{min}) \times (28,317 \text{ ml}/\text{ft}^3) \times (180 \text{ 480 min}/\text{day}) = 3,900 \text{ 104 } \mu\text{Ci}/\text{day}$$

Values can be averaged over the number of days in a given week that incineration is performed at the effluent flow rate cited above. Thus, if two incinerations are performed in one week, the allowed values for incineration cited above may be doubled ~~1 week such that 520 μCi of C-14 (i.e., 5 x 104 μCi) may be incinerated in one day if no other radioactive materials are incinerated in the same week.~~

2b. DISPOSAL TO SANITARY SEWER

Changes to page 31-32 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX R: Allowed Release of Radionuclides to Sanitary Sewer – TBR Building

Radionuclides may be put into the sanitary sewer of the Timken-Burnett Research Building complex, in soluble form, at no more than the Allowed Activity per Day (shown below). Data are derived from allowed Monthly Average Concentrations from the Code of Federal Regulations 10, Part 20, Appendix B, Table 3 (Releases to Sewers), p336-385. Note: total

aggregate quantities of radionuclides released per day may be no more than one daily limit averaged over a month, e.g., 1/2 daily limit of Cr-51 + 1/4 daily limit of P-32 + 1/4 daily limit of H-3.

Radionuclide	Monthly Average Concentration (μCi/ml)	Allowed Activity per Day (μCi)*	
Carbon-14	3.00E-04	395	301
Cerium-141	3.00E-04	395	301
Chromium-51	5.00E-03	6,585	5016
Cobalt-57	6.00E-04	790	602
Gadolinium-153	6.00E-04	790	602
Hydrogen-3	1.00E-02	13,170	10031
Indium-114 ^m	5.00E-05	66	50
Iodine-125	2.00E-05	26	20
Iodine-131	1.00E-05	13	10
Manganese-54	3.00E-04	395	301
Niobium-95	3.00E-04	395	301
Phosphorus-32	9.00E-05	119	90
Phosphorus-33	8.00E-04	1,054	802
Rubidium-86	7.00E-05	92	70
Ruthenium-103	3.00E-04	395	301
Scandium-46	1.00E-04	132	100
Strontium-85	4.00E-04	527	401
Sulfur-35	1.00E-03	1,317	1003
Technicium-99 ^m	1.00E-02	13,170	10031
Tin-113	3.00E-04	395	301

*Calculations: Allowed Activity Per Day (μCi) = NRC allowed Monthly Average Concentration of releases to sewers (μCi/ml) x Sewer Outflow (~~129,300 ft³/y~~ 2,830 ft³/month) x ~~Conversion Factors~~ (12 month/y) (28,317 ml/ft³) (1/365 y/day) x Flow Reduction Factor (~~0.1~~ 0.5). The one variable in these calculations is the Sewer Outflow. The value used here is the lowest monthly value over the last 42 months of data (Jan. 2005 thru May 2008), where values averaged 5,482 ft³/month and ranged from 2,830 to 9,620 ft³/month.

Example for C-14:

$$(3.00E-04 \text{ } \mu\text{Ci/ml}) (\del{129,300 \text{ ft}^3/\text{y}} 2,830 \text{ ft}^3/\text{mo}) (12 \text{ mo/y}) (28,317 \text{ ml/ft}^3) (1/365 \text{ y/day}) (\del{0.1} 0.5) = \del{301} \mu\text{Ci/day} \text{ } 395 \mu\text{Ci/day}$$

Values can be averaged over 1 month with prior permission of the RSO such that ~~9030~~ 11,850 μCi of C-14 (i.e., 30 x ~~301~~ 395 μCi) could be disposed in one day if no other radioactive materials were to be disposed over the 1-month period.

APPENDIX S: Allowed Release of Radionuclides to Sanitary Sewer – Admin. Building

Radionuclides may be put into the sanitary sewer of the old Administration Building, in soluble form, at no more than the Allowed Activity per Day (shown below). Data are derived from allowed Monthly Average Concentrations from the Code of Federal Regulations 10, Part 20, Appendix B, Table 3 (Releases to Sewers), p336-385. Note: total aggregate quantities of radionuclides released per day may be no more than one daily limit averaged over a month, e.g., 1/2 daily limit of Cr-51 + 1/4 daily limit of P-32 + 1/4 daily limit of H-3.

Radionuclide	Monthly Average Concentration (μCi/ml)	Allowed Activity per Day (μCi)*	
Carbon-14	3.00E-04	545	219
Cerium-141	3.00E-04	545	219
Chromium-51	5.00E-03	9,077	3650
Cobalt-57	6.00E-04	1,089	438
Gadolinium-153	6.00E-04	1,089	438
Hydrogen-3	1.00E-02	18,154	7306
Indium-114 ^m	5.00E-05	91	36
Iodine-125	2.00E-05	36	15
Iodine-131	1.00E-05	18	7
Manganese-54	3.00E-04	545	219
Niobium-95	3.00E-04	545	219
Phosphorus-32	9.00E-05	163	66
Phosphorus-33	8.00E-04	1,452	584
Rubidium-86	7.00E-05	127	51
Ruthenium-103	3.00E-04	545	219
Scandium-46	1.00E-04	182	73
Strontium-85	4.00E-04	726	292
Sulfur-35	1.00E-03	1,815	730
Technicium-99 ^m	1.00E-02	18,154	7300
Tin-113	3.00E-04	545	219

*Calculations: Allowed Activity Per Day (μCi) = NRC allowed Monthly Average Concentration of releases to sewers (μCi/ml) x Sewer Outflow (~~129,300 ft³/y~~ 3,900 ft³/month) x Conversion Factors (12 month/y) (28,317 ml/ft³) (1/365 y/day) x Flow Reduction Factor (~~0.1~~ 0.5). The one variable in these calculations is the Sewer Outflow. The value used here is the lowest monthly value over the last 42 months of data (Jan. 2005 thru May 2008), where values averaged 4,822 ft³/month and ranged from 3,900 to 5,750 ft³/month.

Example for C-14:

(3.00E-04 μCi/ml) (~~129,300 ft³/y~~ 3,900 ft³/mo) (12 mo/y) (28,317 ml/ft³) (1/365 y/day) (~~0.1~~ 0.5) = ~~301~~ 545 μCi/day

Values can be averaged over 1 month with prior permission of the RSO such that ~~9030~~ 16,350 μCi of C-14 (i.e., 30 x ~~301~~ 545 μCi) could be disposed in one day if no other radioactive materials were to be disposed over the 1-month period.

3. Training of Individuals. I have had a request to become a new Authorized User. Also, we have some investigators retire or change their employment. For these reasons, the following changes (in italic or strikeout script) to our license are proposed.

3a. NEW AUTHORIZED USER

John R. Martin, Ph.D. Dr. Martin is a professor in our department of Pharmacology and has been using H-3 since 2006 as an Investigator under my supervision as RSO. He presented to me a certificate verifying his completion of a 4-hour course in radiation safety at St. Louis University in 1985. Since 2006, he has attended annual in-service training seminars on radiation safety presented by a consulting health physicist at KCOM. His work at KCOM has relied on the use of H-3. The Biohazards Committee, chaired by the RSO, reviewed and approved Dr. Martin's request to become an authorized user. His name has been added to the list below.

3b. CHANGES IN AUTHORIZED USERS

Changes to page 14 of Information Supplementary To NRC Form 313 For Renewal Of NRC Material License No. 24-17210-01, January 7, 2005:

APPENDIX C: Authorized Users

Authorized Users of Radioactive Materials at KCOM (All individuals below are listed in our current NRC license)	
Authorized User	Material and Use
Robert W. Baer, Ph.D.	All
Richard J. Cenedella, Ph.D.	All
Neal R. Chamberlain, Ph.D.	All
James L. Cox, Ph.D.	All (excluding iodine-125 and iodine 131)
Charles R. Fleschner, Ph.D.	All
<i>John R. Martin, Ph.D.</i>	<i>All</i>
Orin B. Mock, Ph.D.	All
Krishnakant H. Pandya, Ph.D.	All
George W. Patrick, Ph.D.	All
James A. Rhodes, Ph.D.	All
Neil J. Sargentini, Ph.D.	All
William L. Sexton, Ph.D.	All
Melissa K. Stuart, Ph.D.	All
Lex C. Towns, Ph.D.	All
Nandor J. Uray, Ph.D.	All
Allan K. Willingham, Ph.D.	All

Additional Information:

Current Investigators at KCOM (Not to be listed on license)

Abbas Samadi, Ph.D. Supervised by Neil J. Sargentini, Ph.D. (RSO)
Vineet Singh, Ph.D. Supervised by Neil J. Sargentini, Ph.D. (RSO)

Please let me know if you have any questions. Clean copies of the affected pages are attached.



Neil Sargentini, Ph.D.
Associate Professor
RSO and Chair, Biohazards Committee (includes the Radiation Safety Subcommittee)
A. T. Still University of Health Sciences
Kirksville College of Osteopathic Medicine
Department of Microbiology and Immunology
800 W. Jefferson Street
Kirksville, MO 63501

Email: nsargentini@atsu.edu
Tel: 660-626-2474 or 2559
Fax: 660-626-2523

PERTINENT INFORMATION:

Applicant:

Kirksville College of Osteopathic Medicine, A.T. Still University of Health Sciences
800 West Jefferson
Kirksville, MO 63501

Radiation Safety Officer and Chair of Biohazards Committee:

Neil J. Sargentini, Ph.D.
Tel.: 660-626-2474 or 2559; FAX: 660-626-2523

Certifying Officer:

Philip C. Slocum, D.O., FCCP, FACOI, FCCM
Dean, Kirksville College of Osteopathic Medicine
Tel.: 660-626-2354; FAX: 660-626-2080

Cc. Philip C. Slocum, D.O., FCCM, FACOI, FCCP
Dean, Kirksville College of Osteopathic Medicine

CLEAN PAGES WITH CHANGES

The page numbers (but not the total page numbers) on these pages correspond to the page numbers in the current (January 7, 2005) version of Materials License No. 24-17210-01, and the page numbers indicated in the accompanying letter detailing changes in this addendum proposal.

- 1 - Beckman LS3801 Liquid Scintillation Counter (TBR)
- 1 - Beckman LS7000 Liquid Scintillation Counter (TBR)
- 1 - Packard Cobra Model 5002 Gamma Counter (TBR)

The Geiger counters are calibrated annually by Mid-America Calibrations, Inc, 808 SW Nautica Ct., Lee's Summit, MO 64082, or any other firm licensed to perform survey meter calibrations by the NRC or an agreement state. Liquid scintillation counters are maintained by KCOM under a service agreement with Beckman Coulter Inc.

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.

Item 10b: Material Receipt and Accountability. Physical inventories will be conducted at intervals not to exceed 6 months, to account for all sealed sources and devices received and possessed under the license. Procedures for ensuring accountability of radioactive materials are described below.

Item 10b1: Maintaining the Inventory of Radioactive Material. The RSO audits usage and disposal of radioactive materials by AU or Investigators on a semiannual basis (May 1 and November 1 of each year) based on their submission of Form 1 (**Appendix G**), which summarizes use, disposal, decay, and transfer for each radionuclide. The RSO also reviews each order/delivery of radioactive material to KCOM to insure that AU or Investigator's do not exceed their possession limits, which are approved by the RSO. At the time of delivery of radioactive materials, Form 2 (**Appendix H**) is used by AU or Investigators to record relevant information and survey results for the package. Completed versions of Form 2 (the top half of the page down through "Wipes of Pkg. Surfaces") are submitted to the RSO within 3 business days of receipt of radioactive materials. Completed versions of Form 2 detailing dates of use and disposal of each radioactive material are submitted to the RSO during the semiannual inventory audit.

Item 10b2: Ordering and Receiving Radioactive Material. The procedure for ordering and receiving radioactive material is designed to insure that the RSO has up-to-date knowledge of all additions of radioactive materials to the campus inventory, and that received materials will either be under lock and key in the North Wing Storeroom (for up to 3 hours) or under the control of an approved AU or Investigator. These procedures as well as those for internal or external transfer are outlined in **Appendix I**.

Item 10c: Occupational Dose. We have done a prospective evaluation and determined that unmonitored individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits in 10 CFR Part 20. The RSO prepares an annual ALARA report, which summarizes KCOM occupational exposure data.

Upon request or if determined by the RSO, personnel working with radioactive materials will be provided a radiation monitoring badge and/or ring. These monitors will be

exchanged on a quarterly schedule. Pregnant employees, who have declared their pregnancy, will be issued an additional fetal badge to be worn on the waist and exchanged monthly.

Form 2 (**Appendix H**), which is collected semiannually during the inventory audit, also updates the status of previously trained and new lab personnel, and it updates their need for radiation badges. All personnel with potential exposure to radiation are required to attend an Annual In-Service Update on Radiation Safety (Item 8c).

Item 10c1: Investigational Levels: This institution hereby establishes investigational levels for occupational radiation doses which, when exceeded, will initiate review or investigation by the RSO. These levels are listed below and apply to the exposure of individual workers.

Investigational Levels to Monitor Individual Occupational Radiation Doses

Dose Equivalence	Investigational Levels (mrem per calendar quarter)	
	Level I	Level II
Total effective dose equivalent (sum of deep dose equivalent and committed effective dose equivalent)	125	375
Lens of the eye (eye dose equivalent)	375	1125
Skin or any extremity (shallow dose equivalent)	1250	3750
Individual organ or tissue (sum of deep dose equivalent and committed dose equivalent)	1250	3750

The RSO will review and initial the results of personnel monitoring at least every 3 months. The following actions will be taken at the Investigational Levels stated above (Table).

- A. Personnel dose less than Investigational Level I. Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's dose is less than values for Investigational Level I.
- B. Personnel dose equal to or greater than Investigational Level I, but less than Investigation Level II. The RSO will review each such dose in comparison with those of others performing similar tasks as an index of ALARA program quality. If the dose does not equal or exceed Investigational Level II, no action related specifically to the exposure is required unless deemed appropriate by the RSO.
- C. Personnel dose equal to or greater than Investigational Level II. The RSO will investigate the causes of all personnel doses equaling or exceeding Investigational Level II and, if warranted, will take action. The RSO will meet with the employee and relevant supervisors to investigate how exposure can be reduced and will record a report of the discussion and any solutions for the file.
- D. Establishment of new Investigational Levels above those listed above in the table. In cases where a worker's or a group of worker's doses need to exceed an

longest-lived radioisotope will have transpired, and the initials of the individual who sealed the container. The container may be transferred to a DIS area.

- The contents of the container should be allowed to decay for at least 10 half-lives of the longest-lived radioisotope in the container.
- Prior to disposal as ordinary trash, each container should be monitored as follows:
 - Check the radiation detection survey meter for proper operation.
 - Survey the contents of each container in a low background area.
 - Remove any shielding from around the container.
 - Monitor all surfaces of the container.
 - Discard the contents as ordinary trash only if the surveys of the contents indicate no residual radioactivity, i.e., surface readings are indistinguishable from background.
 - If the surveys indicate residual radioactivity, return the container to DIS area and contact the RSO for further instructions.
- If the surveys indicate no residual radioactivity, record the date when the container was sealed, the disposal date, type of waste (used or unused material, gloves, etc.), survey instrument used, and the initials of the individual performing surveys and disposing of the waste.

2. Procedure for Disposal of Liquids into the Sanitary Sewer. Radioactive materials may be disposed of in the sanitary sewer of the TBR complex (**Appendix R**) or Admin. Building (**Appendix S**) according to limits derived from information in 10 CFR 20, Appendix B. Make sure that the amount of each radioisotope does not exceed the monthly and annual discharge limits specified in 10 CFR 20.2003(a)(4) and 10 CFR 20, Appendix B.

- Confirm that the liquid waste being discharged is soluble or biological material that is readily dispersible in water.
- Record the date, radioisotope(s), estimated activity of each radioisotope, location where the material is discharged, and the initials of the individual discharging the waste.
- Liquid waste should be discharged only via designated sinks, toilets or release points.
- Discharge liquid waste slowly with water running from the faucet to dilute it.
- Survey the sink and surrounding work surfaces to confirm that no residual material or contamination remained in the sink or on work surfaces.
- Prior to leaving the area, decontaminate all areas or surfaces, if found to be contaminated.
- Maintain records of each radioisotope and its quantity and concentration that is released into the sanitary sewer system.

3. Incineration. Specified radioactive materials may be disposed in the KCOM incinerator (in TBR) provided the gaseous effluent from incineration does not exceed the limits specified in **Appendix Q**. All incinerations of radioactive material must each be approved, in advance, by the RSO. Ash residues may be disposed of as ordinary waste provided appropriate surveys are made to determine that its radioactivity cannot be distinguished from background with typical low-level lab

APPENDIX C: Authorized Users

Authorized Users of Radioactive Materials at KCOM (All individuals below are listed in our current NRC license)

Authorized User	Material and Use
Robert W. Baer, Ph.D.	All
Richard J. Cenedella, Ph.D.	All
Neal R. Chamberlain, Ph.D.	All
James L. Cox, Ph.D.	All (excluding iodine-125 and iodine 131)
Charles R. Fleschner, Ph.D.	All
Timothy P. Geisbuhler, Ph.D.	All
John R. Martin, Ph.D.	All
Orin B. Mock, Ph.D.	All
James A. Rhodes, Ph.D.	All
Neil J. Sargentini, Ph.D.	All
William L. Sexton, Ph.D.	All
Melissa K. Stuart, Ph.D.	All
Lex C. Towns, Ph.D.	All
Nandor J. Uray, Ph.D.	All

Additional Information:

Current Investigators at KCOM (Not to be listed on license)

Vineet Singh, Ph.D. Supervised by Neil J. Sargentini, Ph.D. (RSO)

APPENDIX J: Safely Opening Packages Containing Radioactive Material

All packages containing radioactive materials are opened using the following procedures.

1. Wear gloves to prevent hand contamination.
2. Visually inspect package for any sign of damage (e.g., wetness, crushed or punctured). If damage is noted, stop and notify the RSO.
3. Check the DOT White I or Yellow II label or packing slip for activity of contents to verify that shipment does not exceed investigator possession limits approved by the RSO in accordance with the limits of the KCOM materials license.
4. Measure exposure rate at 3 feet (or 1 m) from package surface and record data on Form 2 (**Appendix H**). If greater than background (White I label) or >1 mR/hr (Yellow II label), stop procedure and notify RSO.
5. Measure exposure rate on the exterior surface of package and record data on Form 2 (**Appendix H**). If >0.5 mR/hr (White I label) or >50 mR/hr (Yellow II label), stop procedure and notify RSO.
6. Swab the surface of the container and monitor the swab for radioactivity. If the radioactivity is higher than background, stop the procedure and notify the RSO.
7. Open the outer package (following manufacturer's directions, if supplied) and remove packing slip. Open inner package and verify that contents agree with those on the packing slip and label on bottle or other container. Check integrity of final source container (i.e., inspect for breakage of seals or vials, loss of liquid, discoloration of packaging material and high count rate on wipe). Again, check that the shipment does not exceed license possession limits. If anything is found that is unexpected, stop and notify the RSO.
8. Monitor the packing material and packages for contamination before discarding. If contamination is found, treat as radioactive waste. If not contaminated, obliterate radiation labels before discarding in regular trash.
9. Maintain records of receipt, package survey, and wipe test results on Form 2 (**Appendix H**). Send a completed version of Form 2 (the top half of the page down through "Wipes of Pkg. Surfaces") to the RSO within 3 business days of receipt of radioactive materials.
10. If removable contamination exceeds 22 DPM/cm² averaged over the wiped surface (300 cm²), or if external radiation levels exceed 200 mR/hr at the package surface or 10 mR/hr at 3 feet (or 1 m), immediately notify the final carrier of the package and the Administrator of the NRC Regional Office (801 Warrenville Road, Lisle, IL, 60532-4351; 630-829-9500 or 1-800-522-3025).

APPENDIX K, continued:

- (1) The external surface of incoming packages containing isotopes should be monitored with a survey meter and the surface swabbed for detection of radioactivity prior to opening the package. If radioactivity is detected or if the package is wet or damaged, the package should not be opened and the RSO should be contacted. If the package appears to be undamaged, it may be opened. At that time, the internal surface of the package and the external surface of the radioisotope container should be monitored with a survey meter. Again, if radioactivity is detected, contact the RSO. Survey meters for monitoring of radiation levels are located in the Departments of Biochemistry, Microbiology/Immunology, and Physiology.
 - (2) Upon request or determination by the RSO, staff and students working with radioactive materials are provided and should wear a radiation monitoring badge and/or ring. Pregnant individuals, who elect to work with radioisotopes, should wear a waist badge to monitor fetal exposure to radiation. These monitoring devices are provided by KCOM on a quarterly basis (or monthly for waist badges used to monitor fetal exposure).
 - (3) Lab benches, hoods or other areas where radioactive materials are being used should be monitored on at least a monthly basis by swabbing a 100-cm² area and reading the radiation level in a scintillation counter. If the level of radioactive contamination is above 200 DPM/100 cm², the area should be decontaminated until the 200 DPM/100 cm² level is reached. The results of all swab tests should be recorded and maintained as a permanent record in the AU or Investigators' lab for review by the RSO or designee.
- D. All radioactive sources are stored in a shielded enclosure when not in use so that the radiation levels at accessible places are less than 2 mR/hr at a distance of one foot from the surface.
- E. Shielding and monitoring equipment are always available.
- F. All areas where radioactive materials are stored are locked to prevent unauthorized removal when not in use.
- G. When radioactive materials are in use, they must be under constant surveillance by the user of the materials, or they must be secured by locking entry doors to the use area so that individuals who are not using the radioactive material will not be contaminated by or exposed to the material, and to prevent unauthorized removal of the radioactive material from the area.

APPENDIX M: Procedures Involved with Research on Small Lab Animals

Procedures for Using Radioactive Materials in Small Lab Animals

1. The RSO will be kept informed on experiments using radioisotopes in animals.
2. The RSO must approve and post animal rooms to be used for radioisotopic studies. Cages will be labeled to state information on radionuclide, quantity administered, administration date, and the name of the AU or Investigator.
3. All radioactive waste will be collected in approved containers.
4. The AU or Investigator will monitor the animal rooms for radioactivity on a monthly basis, and record results with a floor diagram showing areas surveyed for the RSO.
5. The RSO will provide disposal for all animals, which have been given radioisotopes.
6. AU shall instruct caretaker personnel of the proper procedures for handling animals, which have been administered radioisotopes. The procedure should be explained verbally and also posted in the relevant room of the Animal Care Facility.

Waste Disposal

1. The RSO will verify that radioactive waste, solid and liquid, are disposed of in accordance with NRC regulations. The RSO or his delegate will maintain records of all waste releases to include dates, radioisotopes, quantities, and disposal methods.
2. No radioactive waste shall be disposed of by the conventional methods for disposing of non-radioactive material. In particular, no solid waste shall be placed in standard waste containers that are collectable by housekeeping personnel.
3. Sufficient radioactive waste receptacles shall be provided by the users of radioactive material at all locations where wastes are being produced. These shall be appropriately labeled "animal carcasses, radioactive" or "animal waste, radioactive" and shall be placed in polyethylene bags for disposal.
4. Organic waste containing hydrogen-3 or carbon-14 shall be protected from microbial decomposition while in storage by appropriate preservatives such as formaldehyde, phenol, etc., to prevent generation of volatile radioactivity.
5. Animal carcasses, body parts and excreta that have been exposed to radioisotopes shall be disposed of via incineration and/or shipment to an authorized dumpsite.

Instruction to Animal Caretakers Concerning Radioactivity in Animals

1. Personnel must wear lab coats and gloves whenever handling animals or carcasses.
2. Animal cages will be decontaminated by washing with detergent.
3. Rubber gloves will be worn by personnel.
4. The animal room will be surveyed for contamination by the RSO or delegate after each use of radioactive material.
5. All relevant animal caretakers must wear total body film badges, upon request or if determined by the RSO.
6. All relevant animal caretakers will be instructed in accordance with Parts 3, 19 and 20 of the NRC regulations at the start and semi-annually during periods of use of radioactivity in the animal care facility.

APPENDIX Q: Allowed Incinerator Emissions of Radionuclides

Radionuclides may be released into the air from KCOM at no more than the values for Allowed Incineration of Radioactive Materials Per Day (shown below). Data are derived from the Code of Federal Regulations 10, Part 20, Appendix B, Table 2 (Effluent Concentrations, Air), p336-385. Note: total aggregate quantities of radionuclides released per day may be no more than one daily limit, e.g., 1/2 daily limit of C-14 + 1/2 daily limit of H-3.

Nuclide	Allowed Effluent Concentrations in Air ($\mu\text{Ci/ml}$)	Allowed Incineration of Radioactive Materials Per Day (μCi)*
Carbon-14 (CO_2 upon incineration)	3.00E-07	3,900
Hydrogen-3	1.00E-07	1,300

*Calculations: Allowed Incineration of Radioactive Materials per Day (μCi) = NRC Allowed Effluent Concentrations in Air ($\mu\text{Ci/ml}$) x Flow rate ($2,550 \text{ ft}^3/\text{min}$) x Conversion Factor ($28,317 \text{ ml/ft}^3$) x Incineration Time (180 min/day)

Example for C-14:

$$(3.00\text{E-}09 \mu\text{Ci/ml}) \times (2,550 \text{ ft}^3/\text{min}) \times (28,317 \text{ ml/ft}^3) \times (180 \text{ min/day}) = 3,900 \mu\text{Ci/day}$$

Values can be averaged over the number of days in a given week that incineration is performed at the effluent flow rate cited above. Thus, if two incinerations are performed in one week, the allowed values for incineration cited above may be doubled.

APPENDIX R: Allowed Release of Radionuclides to Sanitary Sewer – TBR Building

Radionuclides may be put into the sanitary sewer of the Timken-Burnett Research Building complex, in soluble form, at no more than the Allowed Activity per Day (shown below). Data are derived from allowed Monthly Average Concentrations from the Code of Federal Regulations 10, Part 20, Appendix B, Table 3 (Releases to Sewers), p336-385. Note: total aggregate quantities of radionuclides released per day may be no more than one daily limit averaged over a month, e.g., 1/2 daily limit of Cr-51 + 1/4 daily limit of P-32 + 1/4 daily limit of H-3.

Radionuclide	Monthly Average Concentration (μCi/ml)	Allowed Activity per Day (μCi)*
Carbon-14	3.00E-04	395
Cerium-141	3.00E-04	395
Chromium-51	5.00E-03	6,585
Cobalt-57	6.00E-04	790
Gadolinium-153	6.00E-04	790
Hydrogen-3	1.00E-02	13,170
Indium-114 ^m	5.00E-05	66
Iodine-125	2.00E-05	26
Iodine-131	1.00E-05	13
Manganese-54	3.00E-04	395
Niobium-95	3.00E-04	395
Phosphorus-32	9.00E-05	119
Phosphorus-33	8.00E-04	1,054
Rubidium-86	7.00E-05	92
Ruthenium-103	3.00E-04	395
Scandium-46	1.00E-04	132
Strontium-85	4.00E-04	527
Sulfur-35	1.00E-03	1,317
Technicium-99 ^m	1.00E-02	13,170
Tin-113	3.00E-04	395

*Calculations: Allowed Activity Per Day (μCi) = NRC allowed Monthly Average Concentration of releases to sewers (μCi/ml) x Sewer Outflow (2,830 ft³/month) x (12 month/y) (28,317 ml/ft³) (1/365 y/day) x Flow Reduction Factor (0.5). The one variable in these calculations is the Sewer Outflow. The value used here is the lowest monthly value over the last 42 months of data (Jan. 2005 thru May 2008), where values averaged 5,482 ft³/month and ranged from 2,830 to 9,620 ft³/month.

Example for C-14:

$$(3.00E-04 \text{ } \mu\text{Ci/ml}) (2,830 \text{ ft}^3/\text{mo}) (12 \text{ mo/y}) (28,317 \text{ ml/ft}^3) (1/365 \text{ y/day}) (0.5) = 395 \text{ } \mu\text{Ci/day}$$

Values can be averaged over 1 month with prior permission of the RSO such that 11,850 μCi of C-14 (i.e., 30 x 395 μCi) could be disposed in one day if no other radioactive materials were to be disposed over the 1-month period.

APPENDIX S: Allowed Release of Radionuclides to Sanitary Sewer – Admin. Building

Radionuclides may be put into the sanitary sewer of the old Administration Building, in soluble form, at no more than the Allowed Activity per Day (shown below). Data are derived from allowed Monthly Average Concentrations from the Code of Federal Regulations 10, Part 20, Appendix B, Table 3 (Releases to Sewers), p336-385. Note: total aggregate quantities of radionuclides released per day may be no more than one daily limit averaged over a month, e.g., 1/2 daily limit of Cr-51 + 1/4 daily limit of P-32 + 1/4 daily limit of H-3.

Radionuclide	Monthly Allowed Concentration (µCi/ml)	Allowed Activity per Day (µCi)
Carbon-14	3.00E-04	545
Cerium-141	3.00E-04	545
Chromium-51	5.00E-03	9,077
Cobalt-57	6.00E-04	1,089
Gadolinium-153	6.00E-04	1,089
Hydrogen-3	1.00E-02	18,154
Indium-114 ^m	5.00E-05	91
Iodine-125	2.00E-05	36
Iodine-131	1.00E-05	18
Manganese-54	3.00E-04	545
Niobium-95	3.00E-04	545
Phosphorus-32	9.00E-05	163
Phosphorus-33	8.00E-04	1,452
Rubidium-86	7.00E-05	127
Ruthenium-103	3.00E-04	545
Scandium-46	1.00E-04	182
Strontium-85	4.00E-04	726
Sulfur-35	1.00E-03	1,815
Technicium-99 ^m	1.00E-02	18,154
Tin-113	3.00E-04	545

*Calculations: Allowed Activity Per Day (µCi) = NRC allowed Monthly Average Concentration of releases to sewers (µCi/ml) x Sewer Outflow (3,900 ft³/month) x (12 month/y) (28,317 ml/ft³) (1/365 y/day) x Flow Reduction Factor (0.5). The one variable in these calculations is the Sewer Outflow. The value used here is the lowest monthly value over the last 42 months of data (Jan. 2005 thru May 2008), where values averaged 4,822 ft³/month and ranged from 3,900 to 5,750 ft³/month.

Example for C-14:

$$(3.00E-04 \text{ } \mu\text{Ci/ml}) (3,900 \text{ ft}^3/\text{mo}) (12 \text{ mo/y}) (28,317 \text{ ml/ft}^3) (1/365 \text{ y/day}) (0.5) = 545 \text{ } \mu\text{Ci/day}$$

Values can be averaged over 1 month with prior permission of the RSO such that 16,350 µCi of C-14 (i.e., 30 x 545 µCi) could be disposed in one day if no other radioactive materials were to be disposed over the 1-month period.



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