

# ***RADIATION SURVEYS***

## **1. INTRODUCTION**

Radiation Surveys are performed in areas where radioactive materials or radiation-producing machines are used to ensure that radioactive contamination and/or exposure levels are as low as reasonably achievable (ALARA).

Contamination surveys are performed with wipe smear samples and are used to detect removable radioactive contamination, for example, radioisotopes such as  $^{32}\text{P}$  or  $^{35}\text{S}$ . Access to a liquid scintillation counter (LSC) or gamma counter is usually necessary to analyze wipe smear samples. Wipe smear samples analyzed with an LSC must have scintillation cocktail in the vial, preferably a cocktail that is biodegradable. Dry samples are not acceptable for contamination surveys.

Area surveys performed with an appropriate survey instrument such as a Geiger-Mueller counter are used to detect exposure levels from either a removable or fixed source. Area surveys are performed in laboratories using x-ray machines or sealed sources, and should be performed in conjunction with contamination surveys in laboratories using unsealed radioactive materials.

## **2. CONTAMINATION SURVEYS**

All laboratories should be kept clean to avoid contamination. **Laboratories using any unsealed radioactive materials are required to survey for contamination using a wipe smear.** Surveys should be taken on a regular basis to detect any contamination occurring from radiation work. It is strongly suggested that weekly surveys be conducted, using wipe smears and a LSC. The results should be submitted online monthly at <http://ehsonline.colorado.edu/radsurveys/>, the page should be printed and stored in the Radiation Safety Survey Logbook with the LSC print outs. The printed page can also be submitted by faxing it the Health Physics office at (303)-492-1322. The Radiation Safety Survey Logbook should be stored in an easily accessible location for review by Health Physics and Federal, State, or local Inspectors.

### **Conducting Contamination Surveys**

The laboratory contamination survey should include equipment and work areas used during the experiment. For example, the survey should check floors (especially near waste containers, desks, and doorways); doorknobs; telephone receivers; buttons on equipment; hood sashes, edges, handles and switches; sink handles, edges, and drains; and lab benches. Results should be reviewed when the surveys have finished running so

any contamination can be remediated without delay. If a contamination level in an area is more than twice background, e.g. 100 cpm if the background is 50 cpm, decontaminate the area and re-survey. Continue this process until the area is clean (less than twice background). Initial and final results should be included when submitting the Survey Report. Contact Health Physics for assistance with areas that are not able to be decontaminated.

Surveys should be completed **each week** that radioisotope is used to detect any contamination occurring from radiation work. *A week is defined as 7 days beginning Sunday and ending Saturday.* Each licensee using a “common room” is responsible for performing and recording surveys of the common room. An exception may be granted by Health Physics staff regarding inter-laboratory agreements to conduct surveys of common rooms. Surveyors should use wipe smears and a LSC with scintillation cocktail or, for certain isotopes, a gamma counter to analyze the results of the survey. Surveyors should complete Radiation Safety training for unsealed isotope users, even if they are not actively working with radioactive materials in other laboratory protocols.

Health Physics may perform secondary contamination surveys as well as exit surveys of laboratory areas where work with radionuclides has been discontinued. The secondary survey may include, but is not limited to, the following areas: floors (especially near waste containers and doorways); doorknobs; telephone receivers; buttons on equipment; hood sashes, edges, handles and switches; sink handles, edges, and drains; and lab bench edges. Laboratories will be notified if contamination levels exceed twice background. **If the contamination level in an area is more than twice background, the lab should decontaminate and re-survey the area. Health Physics may re-survey the area, as well.** See Appendix F for decontamination procedures.

### 3. AREA SURVEYS

For high energy  $\beta$  and any  $\gamma$  emitters, area surveys are conducted with a portable (hand-held) radiation survey meter in addition to routine contamination surveys. Area surveys are used to monitor for levels of increased radiation such as in unshielded areas or during relocation of radioactive materials. It is important to document a background radiation survey value for comparison to the measured radiation result.

Laboratories using unsealed radioactive materials should perform area surveys periodically before, during, and after an experiment. A final survey after completion of the experiment may be performed, but does not eliminate the requirements for taking wipe smears for the contamination survey mentioned previously. Results may be recorded in the Radiation Safety Survey Log with the contamination survey results.

Laboratories which use primarily radiation-producing machines and/or sealed sources should perform periodic area surveys using an appropriate survey instrument. This survey should be performed while the radiation-producing machine is “on,” in order to determine if there is leakage of x-rays. The results of the survey should be noted in a log and maintained in an easily accessible location for review by auditors.

#### 4. SURVEY INSTRUMENTS

Each laboratory using unsealed radioactive material other than  $^3\text{H}$  or  $^{14}\text{C}$  should either have two portable radiation survey instruments/meters or possess one instrument and have access to a second. This is to ensure availability of a survey instrument if one is damaged, out of calibration, or otherwise unable to be used.

While appropriate survey instruments must be available for activities involving radiation at the University of Colorado, it is the responsibility of each laboratory to supply the instrument. Ideally, the instrument should read out in units of mR/hr and/or counts per minute (cpm) and the probe should be one which is most appropriate for the type of work performed in the laboratory. Health Physics is available to assist with appropriate instrument selection. Health Physics has a limited supply of loaner meters available for temporary use.

Health Physics maintains a database of all survey instruments on campus and provides calibration services for most of the models used at the University of Colorado. Calibration is required at least once each year. Health Physics collects and calibrates the survey instruments every six months to ensure compliance with the annual calibration requirement. If a survey meter has not been calibrated within the last six months, contact Health Physics at (303) 492-6523.

If a new instrument is obtained, contact Health Physics as soon as possible to have it placed on the calibration schedule. If an instrument requires major repairs or more complicated calibration techniques, it will be sent to the manufacturer for these services at the expense of the laboratory. Minor repairs may be provided by Health Physics at little to no charge to the laboratory. Additional repair costs may be recovered from the laboratory.

Survey instruments/meters are calibrated to a National Institute of Standards and Technology (NIST) traceable  $^{137}\text{Cs}$  gamma source. Correction factors are indicated on the calibration label for use with beta emitting radionuclides. When using  $\beta$  emitters, multiply the reading on the instrument by this correction factor to obtain an accurate reading.

The following types of instruments are most commonly used on campus:

Geiger-Mueller counter with thin-end window probe	Used for $^{32}\text{P}$ , $^{86}\text{Rb}$ , $^{125}\text{I}$
Geiger-Mueller counter with "pancake" probe	Used for $^{32}\text{P}$ , $^{33}\text{P}$ , $^{35}\text{S}$

These are available from several companies, including the following (Health Physics has catalogs and price lists available):

Ludlum Instruments	1-800-622-0828	<a href="http://www.ludlums.com">www.ludlums.com</a>
Eberline	1-505-471-3232	<a href="http://www.thermoeberline.com">www.thermoeberline.com</a>
Victoreen	1-800-850-4608	<a href="http://www.elimpex.com">www.elimpex.com</a>

## 5. FREEZER FROST SURVEYS

Freezers used to store tritium ( $^3\text{H}$ ), may be contaminated by the radionuclide due to hydrogen exchange with water. The escaped tritium ( $^3\text{H}$ ) is then incorporated into the freezer frost (or condensation in a frost-free freezer) in the form of tritiated water (HTO). A heavily contaminated freezer could contain several MBq (mCi) of HTO in the frost.

Freezers used to store tritium ( $^3\text{H}$ ) are checked every six months by Health Physics personnel. Excessive contamination ( $\geq 10,000$  dpm/100 cm<sup>2</sup> or dpm/ml) requires defrosting and decontamination of the freezer by laboratory personnel. Any liquid generated by defrosting should be considered radioactive liquid waste and collected for disposal through Health Physics. Paper towels used to blot liquid are considered solid radioactive waste. Please refer to the Waste chapter for additional information.

Health Physics encourages laboratories to dispose of tritium ( $^3\text{H}$ ) that is not being used. This will decrease the chances of freezer contamination. If a concern arises about excessive build-up of tritium ( $^3\text{H}$ ) contamination in a storage freezer, call Health Physics at (303) 492-6523 to discuss techniques for reducing the contamination. See Appendix G for procedures for defrosting a contaminated freezer.

## 6. EQUIPMENT TRANSFER / DISPOSAL / RESALE SURVEYS

Equipment such as refrigerators, freezers, centrifuges, and other laboratory items used with radioactive materials must be surveyed prior to transfer or disposal to assure that they are free from radioactive contamination. Refrigerators and freezers used for tritium, which may have become incorporated into the plastic of the unit, are two specific examples. **Contact Property Services at (303) 492-6524 or visit <http://www.colorado.edu/facilitiesmanagement/distmail/property/disposal.html> to transfer or dispose of equipment associated with radioactivity.** A contamination survey of both the inside and outside of the unit will be required. Maintain the survey records, including LSC print-outs, with the contamination survey results in the Radiation Safety Survey Log. Once the unit is determined to be free from radioactive contamination, all radioactive signs and symbols must be obliterated or removed.

Equipment such as liquid scintillation counters which contain radioactive sources should have the source and any lead shielding removed by the manufacturer prior to disposal. Radiation-producing machines should have the x-ray tube removed and/or destroyed prior to disposal. All radioactive signs and symbols must be obliterated or removed. Contact Health Physics at (303) 492-6523 for additional assistance with disposal of these items.