Radio-Bioassays: Internal Exposure Monitoring

The UAB Radiation Safety Program (RSP) must evaluate the need for personnel monitoring (dosimetry) and radio-bioassays for all personnel who work with radioactive materials or exposure to producing machines. The use of radioactive materials does not necessarily require the need for dosimetry or bioassay. All staff who handle or otherwise work with radioactive materials must be authorized to do so under an established, approved UAB Radioactive Materials License that is in good standing or listed as a user of exposure producing machines through the appropriate Radiation Worker Registration. Additionally, no one is allowed to work with radioactive materials or radiation producing devices without proper radiation safety training.

Bioassay is defined as the determination of kinds, quantities or concentrations, and, in some cases, the location of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body. For purposes of these rules, "radiobioassay" is an equivalent term[1]. For purposes of assessing dose used to determine compliance with occupational dose equivalent limits and as required by the Alabama Department of Public Health Office of Radiation Control, the licensee shall take suitable and timely measurements of:

- Concentrations of radioactive materials in air, in work areas
- Quantities of radionuclides in the body
- Quantities of radionuclides excreted from the body
- Combinations of the measurements above

The UAB Radiation Safety Program (RSP) assesses and evaluates internal monitoring by way of the urine and thyroid bioassay. Those who work with radio-chemicals are required to schedule the bioassays with the RSP based upon applicable threshold use levels for the isotope(s) in question.

Additionally, bioassays may be required in response to a spill or accidental release, external or internal personnel contamination. The Radiation Safety Officer (RSO) shall determine whether such monitoring is no longer necessary. Appropriate information concerning changes in radiochemical use, worker exposure and containment must be submitted to the RSO or designate for ongoing evaluation of monitoring.

Pre-Operational Baseline Bioassay?

For those whose work with radioactive materials require participation in the bioassay program, a pre-operational baseline bioassay must be performed before the initiation of work with radioactive materials.

Who must submit a Thyroid Bioassay?

Thyroid bioassays are required of all personnel handling unsealed radioiodine quantities in single operations that exceed the thresholds for monitoring. The thyroid bioassay must be submitted by the Radiation Safety Program within 24 hours but not more than 72 hours. Individuals beginning radio-iodine work for the first time for quantities that require monitoring must schedule a pre-operational baseline bioassay before use of the radio-iodine. Please contact (205) 934-6214 or charvill@uab.edu to schedule your bioassay.

Activity above which a bioassay for I-125 or I-131 is required or recommended (in an unsealed form)[2].

	Volatile or dispersible*	Bound to non- volatile agent
Processes in open room or bench, with the possible escape of iodine from process vessels.	not allowed	1 mCi
Processes with the possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability	1 mCi	10 mCi
Processes carried out within glove boxes, ordinarily closed, but with the possible release of iodine from the process and occasional exposure to the contaminated box and box leakage.	10 mCi	100 mCi

** Quantities in this table are cumulative amounts handled for three months.

Whenever the thyroid burden at the time of the measurement exceeds 0.12 µCi of I-125 or 0.04 µCi of I-131, the following actions may be taken by the Radiation Safety Office:

- Investigates to determine the cause.
- If the investigation indicates that further work in the area might result in significant additional thyroidal accumulation, the individual is restricted from further radioiodine work until the source of exposure is discovered and corrected.
- Corrective actions that will eliminate or lower the potential for further exposure are considered and implemented, if practical.
- A repeat bioassay is taken within two weeks of the previous measurement.
- The USNRC is notified if required

Who must submit a Urine Bioassay?

The urine bioassay is required of personnel who experience or anticipates the potential for exposure to airborne/volatile forms of radioactivity, other than I-125 or I-131, personnel or internal contamination. Bioassay shall be performed by the Radiation Safety Office or other facility approved by the Radioisotope & Radiation Safety Committee (RRSC) using a calibrated Liquid Scintillation Counter (LSC) and calibrated High Purity Germanium Detector (HPGe).

Tritium (H-3)

Bioassay must be submitted for any form of H-3 use of 8 mCi or greater. The chart below is

Radioisotope	Threshold (in mCi)	Bioassay Interval	Action Threshold (in mCi)	Action Bioassay Interval
H-3	8.0 to 80	Monthly	> 80 mCi	Within 1 week after use
Other More Commonly Used Radionuclides				
C-14	0.2 to 2.0	Quarterly	> 2.0 mCi	Monthly
S-35	0.2 to 2.0	Quarterly	> 2.0 mCi	Monthly
P-32	0.05 to 0.4	Monthly	> 0.4 mCi	Within two weeks after use

Urine bioassay may be required based upon the use, activity and biological clearance rate of the particular radioisotope.

References

[1]*Alabama Department of Public Health Office of Radiation Control*

[2]Quantities in the chart above should consider the cumulative amount of the radioactivity in the process handled by a worker during a 3-month period. When the cumulative amount of radioactivity of iodine in unsealed forms during any 3-month period exceeds the specified quantities in Column 2 and Column 3 above, then bioassay is necessary. (2) the quantities in Column 3 may be used when it can be shown that the radioactive materials in the process are always chemically bound and processed in such a manner that all iodine compounds will remain in a nonvolatile form and will be diluted to a concentration of less than 100 mCi/g (3.7 GBq/g) of nonvolatile agent. (3) Capsules (such as gelatin capsules given to patients for diagnostic tests) may be considered to contain the iodine in sealed form, and bioassay would not be necessary unless a capsule was inadvertently opened (e.g., dropped and crushed). (4) If there is a breach in standard procedures during the administration of ^{131}I, for example, spillage from the vial that exceeds the capacity of the absorbent pad, a bioassay would be necessary. (5) Certain compounds where radioiodine is normally bound are known to release radioiodine when the material is processed, and in this scenario Column, 2 may be applicable. (6) For laboratories that only work with ^{125}I in radioimmunoassay (RIA) kits, the quantities of ^{125}I are very small and in less volatile forms; thus, Column 3 may be used for bioassay requirements. (7) In field operations, where reagent containers are opened outdoors for simple operations such as pouring liquid solutions, the above table does not apply; however, bioassay should be performed whenever an individual employee handles an unsealed source (e.g., an open bottle or container) of more than 50 millicurie (mCi) (1.8 gigabecquerel (GBq)) at any one time.

‡ Ventilated fume hoods with face velocities that meet the design criteria in the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual designed criteria, or equivalent.

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