

University of Nevada Las Vegas

Protocol for Use of Radioactive Materials

1. AUTHORIZED USER

Name _____	Phone _____
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2. PROJECT NAME

3. FACILITY

	Building _____	Lab _____

4. PROJECT DESCRIPTION

5. AUTHORIZED RESEARCHERS

Name _____	Employee/ Student ID _____
Experience _____	
Name _____	Employee/ Student ID _____
Experience _____	
Name _____	Employee/ Student ID _____
Experience _____	

1 insert rows as needed.

6. RADIOACTIVE MATERIALS USED: List each radionuclide used and the maximum amount used in any single procedure. Indicate if there is a potential for airborne contamination. * Attachment 2, UNLV Risk Assessment and Control Guideline for Unsealed-Radioactive Materials. Note: If nuclide not listed, refer to 10 CFR20, Appendix B, Table 1.

Nuclide	<u>Maximum Activity per Use</u> (μ Ci)	ALI- Inhalation (μ Ci)	ALI- Ingestion (μ Ci)	ALI-Limiting (μ Ci)	Potential Airborne* (Y/N)	Risk Level** (1-4)	Physical Form / Chemical Name

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7. RADIATION SAFETY MATERIALS & EQUIPMENT: Check all items available to workers handling radioactive material.

- | | | |
|--|--|--|
| <input type="checkbox"/> Protective gloves | <input type="checkbox"/> Warning signs/tags/tape | <input type="checkbox"/> Personal dosimeters |
| <input type="checkbox"/> Lab coat | <input type="checkbox"/> Absorbent paper | <input type="checkbox"/> Survey meter |
| <input type="checkbox"/> Safety glasses | <input type="checkbox"/> Trays | <input type="checkbox"/> Swipe counter |
| <input type="checkbox"/> Face shield | <input type="checkbox"/> Secondary containers | <input type="checkbox"/> Other (list): |
| <input type="checkbox"/> Shoe covers | <input type="checkbox"/> Handling tongs | |
| <input type="checkbox"/> Respirator | <input type="checkbox"/> Shielding | |

8. ENGINEERING CONTROLS: Check all items that are required.

- | | | |
|---|---|---|
| <input type="checkbox"/> Fume hood - unfiltered | <input type="checkbox"/> Fume hood – filtered exhaust | <input type="checkbox"/> Glove box – positive/negative pressure |
| <input type="checkbox"/> Secondary containment | | |

9. EVALUATION OF AIRBORNE RADIOACTIVE MATERIALS: Indicate how radioactive materials could become airborne. Check all that apply.

Production or use of radioactive gas (e.g. methane, ¹⁴ CO ₂)	
Grinding, pulverizing and associated handling of dry dispersible unsealed radioactive material	
Volatile compound (e.g. Na ¹²⁵ I, ³ H ₂ O, labeled solvents, Na-Borohydride)	
Aerosols (e.g. evaporation of liquids)	
Use of powders and other finely divided solids	
Other (list):	
Other (list):	

10. AIR MONITORING: Check all items that are required. [Routine air monitoring required if > 0.01 ALI of dry, dispersible material. Continuous air monitoring required if >0.1 ALI of dry, dispersible material. Breathing Zone Air sampling (BZA) is required when working with ≥ 1 ALI dry, dispersible materials (airborne)]. (Note: For limits, see Attachment 1. If nuclide not listed, refer to 10 CFR20, Appendix B, Table 1).

- None
 Routine
 CAM
 BZA

11. BIOASSAY: Check all items that are required. [Baseline bioassay and quarterly bioassay required >5 ALI dispersible (airborne)].

- Baseline
 Quarterly
 Special
 Other

12. FACILITIES: List ALL rooms where ANY radioactive material will be used or stored. Briefly describe the use of each location. Insert rows as needed.

Building	Room #	Use

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13. **RISK ASSESSMENT:** Describe the expected radiation dose associated with this protocol. Describe the likelihood and seriousness of unexpected, but realistic, problems or accidents. (Consultation is available from Radiation Safety.)

14. **CONTROL MEASURES:** Describe the procedures and equipment used to limit external dose and/or contamination.

15. **MONITORING:** Describe the procedures and equipment used to assess external dose and/or contamination.

16. **RADIOACTIVE WASTE DISPOSAL:** Describe the radioactive waste that will be produced and how it will be managed.

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17. **EMERGENCY PROCEDURES:** Describe or reference.

18. **RSO Conditions/Comments:** Describe or reference.

Conditions:

Comments:

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DECLARATION by RESEARCHER(S)

I have read and understood the UNLV Radiation Safety Manual. I agree to read any additional rules or guidelines issued by UNLV or external regulatory agencies. I agree to abide by these rules or to discontinue working with radioactive material.

	Date	
	Date	

Insert additional boxes as needed.

PROTOCOL REVIEW AND WALKTHROUGH

Authorized User			
Print Name		Date	
Sign		Exp. Date	

PROTOCOL APPROVAL

Radiation Safety Officer (if required)			
Print Name		Date	
Sign		Exp. Date	

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ATTACHMENT 1
ACTIVITY LIMITS FOR UNLV RADIATION SAFETY LEVELS FOR RADIOACTIVE MATERIALS

Nuclide	Limiting Values - Radiological Health*				Rad Level 1**	Rad Level 2	Rad Level 3		Rad Level 4	
	ALI Ingestion (μCi)	ALI Inhalation (μCi)	Ratio Ingestion /Inhalation	Limiting ALI (μCi)	Less Than (μCi)	Not Airborne & Less Than (μCi)	If NOT Airborne Less Than (μCi)	If Airborne Less Than (μCi)	If NOT Airborne Less Than (μCi)	If Airborne Less Than (μCi)
Am-241	0.8	0.006	133	0.01	0.000060	0.80	40	0.30	800	6.00
Am-242m	0.8	0.006	133	0.01	0.000060	0.80	40	0.30	800	6.00
Am-243	0.8	0.006	133	0.01	0.000060	0.80	40	0.30	800	6.00
Ba-133	2,000	700	2.86	700	7.00	2,000	50,000	35,000	1,000,000	700,000
C-14	2,000	2,000	1.00	2,000	20	2,000	50,000	50,000	1,000,000	1,000,000
Cd-109	300	40	7.50	40	0.400	300	50,000	2,000	300,000	40,000
Cl-36	2,000	2,000	1.00	2,000	20	2,000	50,000	50,000	1,000,000	1,000,000
Cm-244	1.0	0.010	100	0.01	0.00010	1.00	50	0.50	1,000	10
Cm-248	0.2	0.002	100	0.002	0.000020	0.20	10	0.10	200	2.00
Co-57	4,000	700	5.71	700	7.00	4,000	50,000	35,000	1,000,000	700,000
Co-60	200	30	6.67	30	0.300	200	50,000	1,500	200,000	30,000
Cs-137	100	200	0.50	100	1.00	100	50,000	5,000	100,000	100,000
Eu-152	800	20	40	20	0.200	800	50,000	1,000	800,000	20,000
Eu-154	500	20	25	20	0.200	500	50,000	1,000	500,000	20,000
Eu-155	4,000	90	44	90	0.900	4,000	50,000	4,500	1,000,000	90,000
Gd-148	10	0.008	1,250	0.01	0.000080	10	500	0.40	10,000	8.00
H-3	80,000	80,000	1.00	80,000	50	5,000	50,000	50,000	1,000,000	1,000,000
Hf-175	3,000	900	3.33	900	9.00	3,000	50,000	45,000	1,000,000	900,000
I-125	40	60	0.67	40	0.400	40	2,000	2,000	40,000	40,000
I-131	30	50	0.60	30	0.300	30	1,500	1,500	30,000	30,000
Mn-54	2,000	800	2.50	800	8.00	2,000	50,000	40,000	1,000,000	800,000
Na-22	400	600	0.67	400	4.00	400	50,000	20,000	400,000	400,000
Np-237	0.5	0.004	125	0.004	0.000040	0.50	25	0.20	500	4.00
P-32	600	400	1.50	400	4.00	600	50,000	20,000	600,000	400,000
P-33	6,000	3,000	2	3,000	50	5,000	50,000	50,000	1,000,000	1,000,000
Pb-210	1.0	20	0.05	1.00	0.010	1.00	50	50	1,000	1,000
Po-210	3.0	0.60	5.00	0.60	0.0060	3.00	150	30	3,000	600
Pu-236	2.0	0.020	100	0.02	0.00020	2.00	100	1.00	2,000	20
Pu-238	0.9	0.007	129	0.01	0.000070	0.90	45	0.35	900	7.00
Pu-239	0.8	0.006	133	0.01	0.000060	0.80	40	0.30	800	6.00
Pu-240	0.8	0.006	133	0.01	0.000060	0.80	40	0.30	800	6.00
Pu-241	40	0.30	133	0.30	0.0030	40	2,000	15	40,000	300
Pu-242	0.8	0.007	114	0.01	0.000070	0.80	40	0.35	800	7.00
Ra-226	2.0	0.60	3.33	0.60	0.0060	2.00	100	30	2,000	600
Sb-125	2,000	500	4.00	500	5.00	2,000	50,000	25,000	1,000,000	500,000
Sm-147	20	0.070	286	0.07	0.00070	20	1,000	3.50	20,000	70
Sr-85	3,000	2,000	1.50	2,000	20	3,000	50,000	50,000	1,000,000	1,000,000
Sr-90	30	4.00	7.50	4.00	0.040	30	1,500	200	30,000	4,000
Tc-99	4,000	700	5.71	700	7.00	4,000	50,000	35,000	1,000,000	700,000
Tc-99m	80,000	200,000	0.40	80,000	50	5,000	50,000	50,000	1,000,000	1,000,000
Th-229	0.6	0.001	667	0.001	0.000009	0.60	30	0.05	600	0.90
Th-230	4.0	0.006	667	0.01	0.000060	4.00	200	0.30	4,000	6.00
Th-232	0.7	0.001	700	0.001	0.000010	0.70	35	0.05	700	1.00
Tl-204	2,000	2,000	1.00	2,000	20	2,000	50,000	50,000	1,000,000	1,000,000
U-232	2.0	0.008	250	0.01	0.000080	2.00	100	0.40	2,000	8.00
U-233	10	0.040	250	0.04	0.00040	10	500	2.00	10,000	40
U-235	10	0.040	250	0.04	0.00040	10	500	2.00	10,000	40
U-238	10	0.040	250	0.04	0.00040	10	500	2.00	10,000	40
Zn-65	400	300	1.33	300	3.00	400	50,000	15,000	400,000	300,000
Zr-95	1,000	100	10	100	1.00	1,000	50,000	5,000	1,000,000	100,000

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* USNRC 10 CFR20 Appendix B Table 1. Revised Aug 11 2010.

** See "UNLV Guideline for Risk Assessment and Control of Radioactive Materials" for details on derivation of risk level limits.

Note: If nuclide is not listed, refer to 10 CFR 20, Appendix B, Table 1

Note: Green indicates limit is set to control the potential for FACILITY contamination.

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ATTACHMENT 2
UNLV RISK ASSESSMENT and CONTROL GUIDELINE for
UNSEALED-RADIOACTIVE MATERIALS

Rad Safety Level	Risk Level	Activity per Experiment * (all apply)	Control Measures	Bioassay Requirement and Periodicity	Air Monitoring
1	MINIMAL RISK: Unlikely to produce a dose to a Worker greater than 100 mrem. (1 ALI intake = 5000 mrem, 0.01 ALI intake = 50 mrem)	≤ .01 ALI-Ingestion Max. = 50 μCi	<ul style="list-style-type: none"> General supervision by the Authorized User Instruction to Workers on rad risks and proper handling procedures In procedures and post use survey by Worker Monthly inspection and quarterly survey by Radiation Safety Office 	None	None
2	LOW RISK: Possible to receive an annual dose in excess of 5 rem. Mitigated by the Worker: <ul style="list-style-type: none"> understanding, and applying good health physics work practices and procedures use of engineering and contamination control measures (1 ALI intake = 5000 mrem)	<u>Non Airborne</u> >.01 to ≤ 1.0 ALI-Ingestion <u>Airborne</u> ≤ .01 ALI-Limiting <u>All</u> Max. = 5 mCi	<ul style="list-style-type: none"> Instruction to Worker on rad risks and proper handling procedures Review, understand and apply research protocol Lab specific training by Authorized User followed by routine supervision In-procedure monitoring and post use surveys by Worker Monthly inspection and quarterly survey by Radiation Safety Office 	None	None
				None	None

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ATTACHMENT 2
UNLV RISK ASSESSMENT and CONTROL GUIDELINE for
UNSEALED-RADIOACTIVE MATERIALS (cont.)

Rad Safety Level	Risk Level	Activity per Experiment * (all apply)	Control Measures	Bioassay Requirement and Periodicity	Air Monitoring
3	<p>MODERATE RISK: Likely to receive an annual dose in excess of 5 rem. Mitigated by:</p> <ul style="list-style-type: none"> the Worker has thorough knowledge of radiation safety principles and practices, plus task specific training use of engineering and contamination control measures consistent use of task specific control measures demonstrating ability to effectively control radiation hazards 	<p><u>Non-Airborne</u> > 1.0 to ≤50 ALI-Ingestion</p> <p><u>Airborne</u> > .01 to ≤50 ALI-Limiting</p> <p><u>All</u> Max. = 50 mCi</p>	<ul style="list-style-type: none"> Protocol approval by Authorized User and RSO Lab specific training of Worker by Authorized User followed by routine supervision In-procedure monitoring and post use surveys by Worker Monthly inspection and survey by Radiation Safety Office 		
			<p><u>Non-airborne</u> > 10 ALI (ingestion) requires fume hood</p> <p><u>Airborne</u></p> <ul style="list-style-type: none"> ≥ 0.01 ALI (limiting), requires fume hood ≥ 10 ALI (limiting), requires negative pressure glove box 	<p>Baseline bioassay and quarterly bioassay required:</p> <p>>5 ALI (limiting) dispersible material (potential airborne)</p> <p>>100ALI (ingestion) dispersible material.</p> <p>Or unescorted access to RAD Level 3 or 4 labs.</p>	<p>Routine air monitoring required if > 0.01 ALI of dry, dispersible material (potential airborne).</p> <p>Continuous air monitoring required if >0.1 ALI of dry, dispersible material (potential airborne).</p> <p>Breathing Zone Air-sampling (BZA) is required when working with ≥ 1 ALI of dry, dispersible material (potential airborne).</p>

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ATTACHMENT 2
UNLV RISK ASSESSMENT and CONTROL GUIDELINE for
UNSEALED-RADIOACTIVE MATERIALS (cont.)

Rad Safety Level	Risk Level	Activity per Experiment * (all apply)	Control Measures	Bioassay Requirement and Periodicity	Air Monitoring
4	<p>HIGH RISK: Very likely to receive an annual dose in excess of 5 rem. Mitigated by:</p> <ul style="list-style-type: none"> the Worker has advanced knowledge in radiation safety principles and practices, plus task specific training and procedures consistently using task specific control measures demonstrating the ability to effectively control radiation hazards 	<p><u>Non-Airborne</u> >50 to ≤ 1,000 ALI-Ingestion</p> <p><u>Airborne</u> > 50 to ≤1,000 ALI-Limiting</p> <p><u>All</u> Max. = 1000 mCi</p>	<ul style="list-style-type: none"> Protocol approval by Authorized User and RSO Authorized User MUST be present in lab Initial applied training of Worker by Authorized User followed by routine supervision In-procedure monitoring and post use surveys by Worker Weekly survey by Authorized User/Staff Monthly inspection and survey by Radiation Safety 		
			<p><u>Non-Airborne</u> ≥100 ALI-(limiting), requires negative pressure glove box</p> <p><u>Airborne</u> ≥ 10 ALI (limiting), requires negative pressure glove box - 1,000 ALI (limiting) maximum</p>	<p>Baseline bioassay and quarterly bioassay required.</p> <p>Work activity review by the Radiation Safety Office may increase bioassay frequency.</p>	<p>Continuous air monitoring required</p> <p>Breathing Zone Air-sampling (BZA) required</p>

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ATTACHMENT 2 UNLV RISK ASSESSMENT and CONTROL GUIDELINE for UNSEALED-RADIOACTIVE MATERIALS (cont.)

NOTE:

* See Attachment 1, Activity Limits for UNLV Radiation Safety Levels for Radioactive Materials, for listing of activity levels by individual nuclide.

Abbreviations:

ALI Annual limit on intake.

ALI-Limiting Lowest ALI for either ingestion or inhalation for a given nuclide.

Assumed Protection Factors:

- Airborne:	Open Bench	1X	Fume Hood	1,000X	Negative Pressure Glove Box	100,000X
- Non-Airborne:	Open Bench	1X	Fume Hood	10X	Negative Pressure Glove Box	1,000X

Definitions –

Annual limit on intake (ALI): As defined in **Title 10, Section 20.1003, of the Code of Federal Regulations** (10 CFR 20.1003), ALI is "the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2, of appendix B to §§ 20.1001-`20.2401)."