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-Limiting Max. = **50** µCi	• General supervision by the Authorized User • Instruction to Workers on rad risks and proper handling procedures • In-procedure and post use surveys 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: • understanding and applying good health physics work practices and procedures • use of engineering and contamination control measures (**1 ALI intake = 5000 merm**)	**Non-Airborne** > **.01** to ≤1.0 ALI-Limiting **Airborne** ≤ **.01** ALI-Limiting **All** Max. = **5** mCi	• 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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Rad Safety Level	Risk Level	Activity per Experiment * (all apply)	Control Measures	Bioassay Requirement and Periodicity	Air Monitoring
3	**MODERATE RISK:** Likely to receive an annual dose in excess of 5 rem. Mitigated by: • 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	**Non-Airborne** > **1.0** to ≤ **50** ALI-Limiting **Airborne** > **.01** to ≤**50** ALI-Limiting **All** Max. = **50** mCi	• 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		
			Non-airborne **> 10** ALI (ingestion) **requires fume hood** **Airborne** • ≥ **0.01** ALI (Limiting), **requires fume hood** • ≥ **10** ALI (Limiting), **requires negative pressure glove box**	**Baseline bioassay and quarterly bioassay required:** **>5** ALI (limiting) dispersible material (potential airborne) **>100** ALI (ingestion) dispersible material. **Or unescorted access to RAD Level 3 or 4 labs.**	**Routine air monitoring required** if **> 0.01** ALI of dry, dispersible material (potential airborne). **Continuous air monitoring** required if **>0.1** ALI of dry, dispersible material (potential airborne). **Breathing Zone Air-sampling (BZA)** is required when working with ≥ **1** ALI of dry, dispersible material (potential airborne).

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Rad Safety Level	Risk Level	Activity per Experiment * (all apply)	Control Measures	Bioassay Requirement and Periodicity	Air Monitoring
4	**HIGH RISK:** Very likely to receive an annual dose in excess of 5 rem. Mitigated by: • 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	**Non-Airborne** **>50 to ≤ 1,000** ALI-Limiting **Airborne** **> 50** to **≤1,000** ALI-Limiting **All** Max. = **1000** mCi	• 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		
			Non-Airborne **≥100** ALI-Limiting, **requires negative pressure glove box** **Airborne** **≥ 10** ALI-Limiting, **requires negative pressure glove box** - 1,000 ALI-Lim maximum	**Baseline bioassay and quarterly bioassay required**. Work activity review by the Radiation Safety Office may increase bioassay frequency.	**Continuous air monitoring** required **Breathing Zone Air-sampling (BZA)** required .

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)."

UNLV Risk Assessment and Control Guideline for Radioactive Materials

Attachment 1 - Activity Limits for UNLV Radiation Safety Levels for Individual Experiments

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

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

* 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 not listed, refer to 10 CFR 20, Appendix B, Table 1