

VU & VUMC ALARA Policy – Dosimetry Badge Monitoring Program

Purpose: This Policy establishes criteria for monitoring, assessing, and responding to occupational radiation dosimetry badge results in support of efforts to keep occupational radiation exposure as low as reasonably achievable (ALARA).

Scope: This policy is limited to occupational dosimetry results and does not apply to monitoring for other purposes.

Policy: VEHS will conduct a quarterly review of dosimetry results and compile a summary report based on the investigational level framework below. The RSO will investigate doses exceeding Level III, and unexpected doses exceeding Level II. The VU RSC will review biannually a summary of radiation dose records (ALARA report) as specified by the VU Radiation Safety Manual. The VUMC RSC will review quarterly a summary of radiation dose records (ALARA report) as specified by the VUMC Radiation Safety Manual.

Quarterly Investigational Levels:

Level I (10% of Quarterly Dose Limit): occupational dose for which regulations require personnel monitoring¹; the number of workers exceeding level 1 indicates roughly the number of people Vanderbilt is required to monitor.

Level II (25% of Quarterly Dose Limit): occupational dose for which scientific consensus guidance² requires personnel monitoring; also, NRC guidance³ recommends applying correction factors to doses of those workers whose only exposure is from diagnostic X-ray machines, and who wear leaded personal protective equipment (Pb PPE). Measured doses exceeding Level II should be corrected to account for Pb PPE in such cases.

Level III (80% of Quarterly Dose Limit): occupational dose for which the worker may potentially exceed a regulatory dose limit if exposure patterns are allowed to persist; such cases will be investigated by the RSO when feasible.

Quarterly Investigational Level	Quarterly Investigational Levels			
	DDE mSv (mrem)	LDE mSv (mrem)	SDE mSv (mrem)	DPW mSv (mrem)
I	1.25 (125)	3.75 (375)	12.5 (1,250)	0.15 (15)
II	3.12 (312)	9.37 (937)	31.2 (3,120)	0.4 (40)
III	10 (1,000)	30 (3,000)	100 (10,000)	1.2 (120)
Quarterly Dose Limit*	12.5 (1,250)	37.5 (3,751)	125 (12,500)	1.5 (150)

Occupational Exposure Categories: DDE = deep dose equivalent; LDE = lens of the eye dose equivalent; SDE = shallow dose equivalent, whole body (skin) or maximally exposed extremity (hand); DPW = declared pregnant worker (fetal dose).

***Quarterly Dose Limits** are defined as one fourth of the regulatory annual occupational dose limits; exceeding this value within a calendar quarter does not by itself constitute noncompliance.

Annual Action Levels:

Level I (80% of Annual Dose Limit): any worker exceeding this limit must *either* cease working around ionizing radiation sources for the remainder of the calendar year, or wear instantly readable dosimetry devices in addition to their assigned dosimetry badges, and coordinate with VEHS to have the instantly readable dosimeter results reviewed at a frequency sufficient to allow timely assessment of the worker's current accumulated dose for the calendar year.

Level II (90% of Annual Dose Limit): any worker exceeding this limit must immediately cease working around ionizing radiation sources for the remainder of the calendar year.

Action Level	Annual Action Levels			DPW Full Term
	DDE mSv (mrem)	LDE mSv (mrem)	SDE mSv (mrem)	DPW mSv (mrem)
I	40 (4,000)	120 (12,000)	400 (40,000)	4 (400)
II	45 (4,500)	135 (13,500)	450 (45,000)	4.5 (450)
Annual Dose Limit⁴	50 (5,000)	150 (15,000)	500 (50,000)	5 (500)*

*DPW full term Dose limit is based off of a 10 month gestation period and is not restricted to one calendar year.

Modification of Measured Dose to Account for Leaded (Pb) Personal Protective Equipment (PPE)

For radiation workers whose only occupational exposure comes from diagnostic X-ray devices, and who wear Pb PPE during the X-ray procedures, dosimetry badges worn outside the Pb PPE provide a significant overestimation of occupational dose. Several recognized methods⁵ exist for correcting these measured DDE doses to more accurately reflect the worker's actual occupation dose, but the two recognized by the NRC² are:

- Single Badge (worn outside Pb PPE at collar): $Dose_{reported} = 0.3 Dose_{measured}$
- Double Badge (one worn outside Pb PPE at collar, one under PPE at waist): $Dose_{reported} = 0.04 Dose_{collar} + 1.5 Dose_{waist}$

The State has approved Vanderbilt's use of a LDE correction factor for such radiation workers who also wear leaded eye protection:

- $LDE Dose_{reported} = 0.5 LDE Dose_{measured(collared)}$

Radiation workers whose exposures meet this criterion should have these correction factors applied if their dose exceeds 25% of the regulatory limit for a monitoring period.

¹ TN: 0400-20-05-.71; NRC: 10cfr20.1502

² See e.g. NCRP Report 105 (1989), p. 19

³ See e.g. C.3 of NRC RegGuide 8.40; CRCPD SPAR Part D, vol. 1 (1995); NRC Reg. Issue Summary 2002-06 (2002)

⁴ TN: 0400-02-05-.50 [workers], 0400-02-05-.56 [DPW]; NRC: 10cfr20.1201 [workers], 10cfr20.1208 [DPW]

⁵ See e.g. Table 1 of Jarvinen et al (2008), NCRP Report 122 (1995)