

Radiological Safety Section

The ALARA principle

The ALARA principle currently refers to the management of radiation dose to the patient while ensuring the medical purpose is fulfilled. Its application is widely used when referring to medical exposures to radiation. This was not the initial intent of the use of the term ALARA. The initial intent of the principle was based on occupational radiation exposures and exposures to members of the public. It wasn't until ICRP publication 73 (1996) that the ALARA principle was applied to medical exposures. The publication introduced the use of diagnostic Reference Levels (DRLs) in place of dose limits.



Charlene Bremer, MS

Per 10 CFR 20.1003 (paraphrased): ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits with technologic advancements, economic and socioeconomic considerations taken into account.

The ALARA principle is equivalent to the principle of optimization of protection of the ICRP. The concept of reference levels, not limits, were discussed in ICRP publication 26. The most common forms of reference levels noted were recording levels, investigation levels and interventional levels.

Each NRC licensee is responsible for setting their own ALARA action levels (called "Investigation Levels") below the occupational dose limits. In Nuclear Medicine, Investigation Levels are typically set at 10% and 30% of the annual occupational dose limits (see Reg. Guide 10.8, appendix G). These Investigational Levels have also been applied to occupational exposure due to ionizing radiation produced by radiation machines. The exposure to fluoroscopy accounts for most exposure from machine radiation.

Annual Occupational Exposure levels: (per 10 CFR 20.1201 and state of Michigan R 333.5057)

- Effective dose equivalent – 5 rems (0.05 Sv)
- Dose equivalent to an individual organ/tissue other than the lens of the eye – 50 rems (0.5 Sv)
- Shallow dose equivalent – 50 rems (0.5 Sv)
- Lens dose equivalent – 15 rems (0.15 Sv)

ALARA limits:

Dose Equivalent (location where assigned exposure was received)	ALARA I Notification (10% Regulatory limit) (per quarter)	ALARA II Notification (30% Regulatory limit) (per quarter)	Regulatory limit (per annum)
Deep Dose Equivalent DDE – 1 cm	125 mrem	375 mrem	5000 mrem
Lens Dose Equivalent LDE – 0.3 cm	375 mrem	1125 mrem	15000 mrem
Shallow Dose Equivalent SDE – 0.007 cm	1250 mrem	3750 mrem	50000 mrem

**Note that the annual exposure level regulations are states in both SI units (Sv) and traditional (rem) but only reported in rem and mrem on the Occupational Dose Record (NRC Form 5).

Radiological Safety (cont.)

The investigational levels are typically evaluated on a quarterly basis in order to identify exposure trends. The Radiation Safety Officer (RSO) performs these reviews and prepares a summary report to present to the Radiation Safety Committee (RSC). The following actions may be taken by the RSC:

- Exposures below Investigational Level I are considered ALARA.
- Exposures above Investigational Level I but below Investigational Level II should be reviewed by the RSO in comparison with others performing the same tasks and reported at the next RSC meeting. No action is necessary unless deemed appropriate by the RSO and/or the RSC.
- Exposures above Investigational Level II should be investigated in a timely manner and, if warranted, action taken. The exposure and actions taken should be reported at the next RSC meeting.
- If a worker or group of workers' doses need to exceed an Investigational Level, a new, higher level may be established for that individual or group on the basis that it is consistent with good ALARA practices. The new levels must be justified and approved by the RSC.

Although the ALARA principle relating to occupational exposures has its roots in nuclear medicine, RSOs may also be responsible for reviewing the dosimetry reports for employees in radiology departments. Effective January 2019 The Joint Commission (TJC) has added an Element of Performance to the Leadership accreditation requirements:

Standard LD.04.01.05 #25:

The hospital designates an individual to serve as the radiation safety officer (rso) who is responsible for making certain that radiologic services are provided in accordance with law, regulation, and organizational policy. This individual has the necessary authority and leadership to do the following:

- Monitor and verify compliance with established radiation safety practices (including oversight of dosimetry monitoring)
- Provide recommendations for improved radiation safety.
- Intervene as needed to stop unsafe practices
- Implement corrective action.

Note that this radiation safety officer (little rso) is not to be confused with the RSO mentioned above. The RSO can serve as the rso but it doesn't necessarily have to be the same individual.

In addition, per Standard EC.0202.01 #17, organizations that provide CT, PET and NM or fluoroscopy services, the results of staff dosimetry monitoring must be reviewed quarterly. This is to assess whether staff radiation exposure levels are ALARA and below regulatory limits.