

# **ALARA (As Low As Reasonably Achievable) PROGRAM**

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## **1. Management Commitment**

- a. The goal of the ALARA program is to maintain ionizing radiation exposures to individuals and releases to the environment as far below the legal limits as is reasonably achievable. The sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level consistent with an expanding research program.
- b. We, the administration of Yale University, are committed to the program described herein for keeping individual and collective doses from ionizing radiation “as low as reasonably achievable” (ALARA). In accord with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policy, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC) and a Radiation Safety Officer (RSO).
- c. Management, through the Radiation Safety Committee will perform an annual review of the radiation safety program, including ALARA considerations. This will include reviews of operating procedures and past dose records, inspections, and consultations with Radiation Safety staff.
- d. Modifications to research protocols, maintenance procedures, equipment, and facilities will be made if they will reduce exposures unless the burden, in our judgment, outweighs the potential for dose reduction. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented when reasonable. If radiological design modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.

## **2. Radiation Safety Committee**

- a. Review of Proposed Users and Uses
  - (1) During the authorization approval process the RSC will review the qualifications of each applicant with respect to the types and quantities of materials and the methods of use for which application has been made, to ensure that the applicant will be able to maintain exposure ALARA.

- (2) The RSC will ensure that the users document their procedures and will review the efforts of the applicants to maintain exposure ALARA.
- (3) The RSC will review incidents, accidents and results of hazard evaluations as well as corrective actions taken.

b. Delegation of Authority

- (1) The University will delegate authority to the RSO for management of the ALARA concept.
- (2) A technically qualified staff of health physicists, reporting to the RSO, conducts inspections, hazard evaluations and interviews to make recommendations that will include radiological planning which will contribute to dose reduction. The health physicists are available for consultation with scientists and other involved university personnel concerning laboratory design, appropriateness of methods, and alternatives. The health physicists, representing the RSO, have the authority to prevent unsafe practices and stop work if necessary. EHS safety advisors may also participate in these reviews.
- (3) A technically qualified staff of EHS safety advisors and safety advisor technicians, representing the RSO, performs facility and laboratory radiation surveys and inspects facilities to enhance contamination control and reduction of radiation exposure. The safety advisors and safety advisor technicians, representing the RSO, have the authority to stop work if necessary when specific unsafe practices are identified.
- (4) The RSC will support the RSO when it is necessary for the RSO to assert authority. If the RSC has overruled the RSO, it will record the basis for its action in the minutes of its meetings.

c. Review of ALARA Program

- (1) During the authorization approval process the RSO will encourage all users to review procedures and develop new or revised procedures as appropriate to implement the ALARA concept.
- (2) The RSO, or his/her delegated senior staff, will review the exposure records on at least a quarterly basis and initiate investigations where indicated.
- (3) The RSC will perform an annual review of occupational radiation exposures. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality.

- (4) The RSC will evaluate Yale's overall efforts for maintaining doses ALARA on an annual basis. This review will include the efforts of the RSO, authorized users and ancillary groups as well as those of the administration.

### 3. **Radiation Safety Officer**

#### a. Reviews

- (1) Review records of radiation surveys. The RSO [or designee] will review radiation surveys to determine that dose rates, amounts of contamination, and releases to the environment were at ALARA investigational levels during the previous quarter.
- (2) Annual Review of occupational exposures. The RSO [or designee] will review at least annually the radiation doses of authorized users and workers to determine that their doses are ALARA in accordance with the provisions of Section 6 of this program.
- (3) Annual review of the radiation safety program. The RSO will perform an annual review of the radiation safety program for consistency with the ALARA philosophy.

#### b. Educational Responsibilities for ALARA Program

- (1) The staff of the EHS/Radiation Safety Section will inform authorized users of ALARA program efforts in its educational and training sessions.
- (2) The staff of the EHS/Radiation Safety Section will ensure that authorized users and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy and informed that the administration, the RSC, and the RSO are committed to implementing the ALARA concept.

#### c. Development of ALARA Procedures

Radiation workers will be given opportunities to participate in formulating the procedures that they will be required to follow.

- (1) The staff of the EHS/Radiation Safety Section will be in close contact with Principal Investigators and authorized users in order to develop ALARA procedures for working with radioactive materials.
  - (2) The RSO will establish procedures for receiving and evaluating the suggestions of individual radiation users for improving health physics practices and will encourage the use of those procedures when deemed appropriate.
- d. Reviewing Instances of Deviation from ALARA philosophy.

The RSO [or RSO's designee] will initiate investigations of all known instances of deviation from the ALARA philosophy and, if possible, will determine the causes. In the case where a cause has been determined and the process(es) may be modified to maintain doses ALARA, the RSO will recommend and work with the relevant individuals to implement such modification(s).

4. **Principal Investigators**

- a. Principal Investigators will apply to the RSC for authorization to use radioactive materials.
- b. Principal Investigator responsibility to supervised individuals:
  - (1) The Principal Investigators will explain the ALARA concept and the need to maintain exposures ALARA to all supervised individuals.
  - (2) The Principal Investigators will ensure that supervised individuals who are subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.
  - (3) The Principal Investigator is accountable for radiation protection practices in his/her laboratories.

5. **Other Individuals Who May Receive Occupational Radiation Doses**

- a. Individuals will be instructed in the ALARA concept and its relationship to work procedures and work conditions.
- b. Individuals will be responsible for following all safety requirements and reporting any problems to his/her supervisor.

6. **Establishment of Investigational Levels in Order to Monitor Individual Radiation Doses**

Yale has established conservative investigational levels for radiation doses and releases to the environment which, when exceeded, will initiate review or investigation by the RSC and/or the RSO. The investigational levels that Yale has adopted are listed in Table 1. Investigational levels are based on fractions of the legal exposure limits. These levels apply to both internal and external exposure of individuals.

To ensure prompt reporting (by our dosimetry vendor) and review of investigational level exceedances, only one value is used for both the quarterly and monthly investigational level. The RSO [or designee] chooses the most appropriate monitoring period (quarterly or monthly) based on several factors, including potential exposures, work practices, work environment, historic exposures, review findings, badge sensitivity, and other physical monitoring considerations. Note that investigational levels are set to trigger an ALARA review and are not meant to be protective measures in themselves.

The RSO [or designee] will review and record results of personnel monitoring periodically throughout the year. The following actions will be taken at the investigational levels as stated in Table 1:

a. Personnel dose less than Investigational Level

Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's dose is less than the values for the Investigational Level.

b. Personnel dose equal to or greater than Investigational Level

The RSO or the RSO's designee, will investigate in a timely manner the causes of all personnel doses equaling or exceeding the monthly and/or quarterly Investigational Levels and, if warranted, will take action. A report of the investigation, and any actions taken, will be presented to the RSC. A copy of the individual's exposure history may be included in this report. The details of these reports will be included in the RSC minutes without identifying the specific individual. In addition, the RSO or the RSO's designee will investigate in a timely manner any year end cumulative results if no ALARA investigations were already conducted that calendar year for that individual.

c. Re-establishment of Investigational Level

The RSC may, if appropriate, raise or lower the investigational levels to achieve a desirable level of review. Justification for new investigational levels will be documented. The RSC will review the justification for and must approve or disapprove all revisions of Investigational Levels.

# Yale University ALARA Investigational Levels

<b>Designated* PET Research Center Staff</b>			
<b>Monitoring Category</b>	<b>Exposure Limit mRem/year</b>	<b>Monthly Investigational Levels mRem</b>	<b>Cumulative Investigational Levels Levels (Calendar YTD) mRem</b>
<b>Whole Body</b>	5000	100	300
<b>Eye</b>	15000	300	900
<b>Skin and/or Extremity</b>	50000	1000	5000
<b>Any Declared Pregnant Individual</b>			
<b>Monitoring Category</b>	<b>Exposure Limit mRem/year</b>	<b>Monthly Investigational Levels mRem</b>	<b>Cumulative Investigational Levels Levels (Calendar YTD) mRem</b>
<b>Embryo/Fetus</b>	500/9 months	20	30
<b>All Other Individuals</b>			
<b>Monitoring Category</b>	<b>Exposure Limit mRem/year</b>	<b>Quarterly Investigational Levels mRem</b>	<b>Cumulative Investigational Levels Levels (Calendar YTD) mRem</b>
<b>Whole Body</b>	5000	100	300
<b>Eye</b>	15000	300	900
<b>Skin and/or Extremity</b>	50000	1000	3000
<b>Minors Under 18 Years of Age (Whole Body)</b>	500	20	30
<b>Member of Public</b>	10 mRem constraint level for air emissions 100 mRem/year (Whole Body)	10 % of constraint limit for any one operation or facility	10% of constraint limit from any one operation or facility

<b>Environmental Release Level Goals</b>			
<b>Monitoring Category</b>	<b>Release Limit</b>	<b>Release Goals</b>	<b>Cumulative Release Investigational Levels (Calendar YTD)</b>
<b>Sewer Disposals</b>	Limits in 10 CFR 20.2003  (5 Ci H-3, 1 Ci C-14, 1 Ci All Others)	10% of limits in 10 CFR 20.2003  (500 mCi H-3, 100 mCi C-14, 100 mCi All Others)	20% of limits in 10 CFR 20.2003  (1000 mCi H-3, 200 mCi C-14, 200 mCi All Others)
<b>Releases to Environment</b>		10% of any limit 50% of any limit for PET Research Center	

\*"Designated PET Research Center Staff" are those working in the Radiochemistry Lab and Imaging Facility, and include radiochemists, cyclotron operators, cyclotron engineers, research scientists and assistants, postdoctoral associates, research technicians, and nuclear medicine technologists.

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