

SAN DIEGO STATE UNIVERSITY

Radiation Safety Training
For Personnel Using
Radiation Producing
Machines

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Training for Radiation Producing Machines

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PART 1 - ORGANIZATION AND RESPONSIBILITIES

License:

San Diego State University has a Broad Scope Radioactive Materials License issued by the State of California. The license contains the specific terms and conditions of radioactive material use at SDSU, including types, forms, quantities, uses, locations and specific procedures that will be followed. The licensing branch may also impose special licensing conditions for radiation producing machines. The license requires a full-time Radiation Safety Officer and an active Radiation Safety Committee.

Radiation Safety Program:

The purpose of the Radiation Safety Program is to ensure that work with radiation producing machines is conducted in such a manner as to protect health and keep radiation exposure ALARA (As Low As Reasonably Achievable). Responsibility for enforcement of this policy is vested in the Radiation Safety Committee (RSC) and should be consistent with the goals of the University, while allowing the user freedom in work that is safe and legal.

Radiation Safety Manual:

The Radiation Safety Manual is a formal statement of policy, operating procedures and standards of conduct for San Diego State University set forth by the RSC and the Radiation Safety Officer. The purpose of the manual is to establish policy and provide guidance for individuals using or having responsibility for the use of radiation producing machines to comply with university policy, university license conditions, the Code of Federal Regulations 10 CFR 20, and the California Code of Regulations Title 17.

Each Principal Investigator (PI) who is authorized to use radioactive material or radiation producing machines is issued a Radiation Safety Manual and is responsible for complying with its policies. The PI must keep a current copy of the Radiation Safety Manual in the laboratory.

Radiation Safety Officer:

The Radiation Safety Officer (RSO) is responsible for maintaining the Radiation Safety Program and administering the policies set forth by the University and the RSC. The RSO is responsible for assuring that use of ionizing radiation meets all applicable government regulations and is responsible for the safety of the students, faculty, staff and general public regarding radiation exposure. The RSO has the authority to immediately terminate any procedure involving radiation producing machines which is judged to be a hazard to the health and safety of the worker or general public. Specifically the RSO is directly responsible for:

1. Reviewing and evaluating projects.

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2. Providing any necessary dosimetry.
3. Providing training materials.
4. Performing radiation surveys.
5. Calibrating survey meters.

Principal Investigator:

The Principal Investigator is personally responsible for compliance with University and governmental regulations as they pertain to their authorized use of radiation producing machines. The PI's specific responsibilities include, but are not limited to:

1. Adhering to all requirements contained within the Radiation Safety Manual and the Radiation Use Authorization (RUA).
2. Ensuring that procedures involving radiation producing machines are performed only by personnel who have read and understand this document and have been properly instructed on the operation of the machine.
3. Notifying Radiation Safety promptly of changes in personnel, locations, procedures and proposed RUA changes.
4. Notifying Radiation Safety immediately in cases of suspected occupational radiation exposure, accidents or unusual events.

Individual Users:

Each user of radiation producing machines has a responsibility to:

1. Log each use of the machine in the required log for each machine to include date, operating parameters and duration of use.
2. Contact PI or RSO with any questions regarding radiation safety or radiological concern.
3. Wear external dosimeters, if assigned, while using the machine.

Specific precautions for analytical x-ray machines:

1. Know the location and/or presence of the primary and diffracted beams at all times.
2. Do not intercept the primary or diffracted beams with any portion of the body.
3. Provide and periodically inspect the shielding of the unit.
4. Never disassemble shielding, uncover or remove the x-ray tube, or otherwise perform maintenance without first determining that the tube is not energized.
5. Perform checks of any safety devices at least yearly.

PART 2 - DOSE LIMITS & ALARA

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On January 1, 1994, the revised Code of Federal Regulations, 10 CFR 20, "Standards for Protection Against Radiation," became law. The State of California has also adopted the revised regulation and implementation date. A summary of the entire revision is not presented here. Concepts which may affect radiation safety at SDSU are given below. If there are any questions regarding the revised 10 CFR 20, please contact Radiation Safety.

External Dose Terms and Annual Limits (Adult Occupational)

Deep Dose Equivalent - (DDE) - Whole body dose from penetrating radiation.

Penetration depth 1 cm (1000 mg/cm^2). Limit is 5 rem/yr

Lens Dose Equivalent - (LDE) - Dose to the lens of the eye from penetrating radiation.

Penetration depth = 0.3 cm (300 mg/cm^2). Limit is 15 rem/yr

Shallow Dose Equivalent, Whole Body - ($\text{SDE}_{(\text{WB})}$) - Dose to the skin of the whole body

from non-penetrating radiation. Penetration depth = 0.007 cm (7 mg/cm^2). Limit is 50 rem/yr

Shallow Dose Equivalent, Max Extremity - ($\text{SDE}_{(\text{ME})}$) - Dose to the maximally exposed extremity. Limit is 50 rem/yr

ALARA (Defined in part by 10 CFR 20)

"Acronym for **As Low As Reasonably Achievable**, means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the license activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and license materials in the public interest."

Means of Controlling Exposure

1. Three principles that can be used to reduce external exposure are:
 - a) Time.
 - b) Distance.
 - c) Shielding.

Posting

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1. *Caution x-Rays*: access to a room or area where x-rays are being generated.
2. *Radiation Area*: area accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mrem in one hour at 30 cm.
3. *High Radiation Area*: area accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 100 mrem in one hour at 30 cm.
4. *Very High Radiation Area*: area accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 500 rem in one hour at 1 meter.

Biological effects common to analytical x-ray exposure

The majority of radiation exposures from analytical x-ray equipment are localized to specific parts of the body, usually the hands and fingers, rather than to the whole body. Such exposures are usually delivered acutely and during a one-time exposure. Therefore, the biological effects of concern are primarily prompt, somatic effects to the skin.

For x-rays at energies of about 5 - 30 keV, irradiation of the fingers or hands does not result in significant damage to blood-forming tissue. However, at high exposures, some general somatic effects to the skin can occur.

PART 3 – Dosimetry

Personnel Monitoring

Personnel radiation monitoring at SDSU consists of an external program for deep and shallow radiation doses.

External Radiation Monitoring

Under the revised 10 CFR 20, personnel dosimetry is required for those workers who are likely to receive 10% of the regulatory dose limit for external sources. Even though the occupational workers at SDSU rarely approach 10%, dosimetry is used on a case by case basis. The dosimeters should be worn only by the worker to whom they were assigned, and only at SDSU, as the exposure data becomes part of the worker's permanent exposure history record.

Dosimeters should remain on campus and be stored in a designated location in the workers primary laboratory. New dosimeters will be issued in the beginning of each calendar quarter by the Radiation Safety Office. It is important to keep dosimeters in the proper location in order to expedite the exchange process.

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1. The external monitoring program uses body dosimeters for determining deep dose, lens dose, and shallow dose and finger rings for determining extremity dose.
2. Dosimeters measure x-ray and gamma radiation.