



CSN Procedure

Facilities Management

Category: Environmental Health and Safety

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Radiation Safety Manual

# CSN RADIATION SAFETY MANUAL



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## 1.0 Purpose

This Radiation Safety Manual (the manual) establishes safe conditions for users of radiation sources, as well as bystanders, the facility, and the environment.

As mandated in the [Nevada Administrative Code, Chapter 459 'Hazardous Materials.'](#) this manual addresses administrative, engineering, and procedural controls to minimize employee, student, and members of the public's exposure to radiation.

## 2.0 Mission Statement

The College of Southern Nevada (CSN) is committed to the personal safety, health, and well-being of all members of the college community. It is the intention of Environmental Health and Safety (EH&S) that all employees, students, and visitors work and learn in an environment devoid, to the fullest extent feasible, of safety and health hazards. EHS aims to protect the safety of students, employees, visitors, the environment, and our facilities while promoting compliance with applicable laws, regulations, codes, and standards.

## 3.0 Nevada State Regulations

[The Nevada Department of Health and Human Services, Division of Public and Behavioral Health, Radiation Control Program](#) is the controlling authority for the safe use and operation of radiation sources. Regulations are outlined in [Nevada Administrative Code, Chapter 459](#). A copy of these regulations can be obtained online or by contacting the CSN Environmental Health and Safety office.

## 4.0 Persons Affected

Employees and students who have educational or occupational exposure to radiation in the following areas:

- 4.1 Dental Faculty Practice: dentists, dental assistants, dental hygienists
- 4.2 Dental Assisting educational program: faculty who teach radiographic technique in simulation labs or in the clinic setting, or supervise such activities
- 4.3 Dental Hygiene educational program: faculty who teach radiographic technique in simulation labs or in the clinic setting, or supervise such activities
- 4.4 Veterinary Nursing educational program: faculty who teach radiographic technique in simulation labs or in the clinic setting, or supervise such activities
- 4.5 Radiation Therapy educational program: faculty who teach radiographic technique in simulation labs or in the clinic setting, or supervise such activities
- 4.6 Environmental Science educational program: faculty who teach x-ray fluorescence (XRF) analytical technique in simulation labs or in the field setting, or supervise such activities
- 4.7 Students who participate in the following educational programs: Dental Hygiene, Dental Assisting, Veterinary Nursing, Radiation Therapy, and Environmental Science
- 4.8 Laboratory staff who work in the vicinity of radiation sources
- 4.9 Persons authorized to operate an electron microscope
- 4.10 Supervisor of employees and students in the above-mentioned areas

## 5.0 Policy on Radiation Exposure

It is the policy of CSN that programs where there is potential for occupational or educational exposure to radiation follow these recommendations and guidelines to reduce radiation exposure levels to employees, students, and members of the public as much as possible.

## 6.0 Background

Radionuclides used in education, medicine, industry, and research are valuable assets, which can benefit mankind if properly used. They can, however, present hazards because of their ability to irradiate and contaminate mankind and the environment. Therefore, persons who use radiation sources must understand the various types of radiation hazards and adhere to regulations and standard practices designed to ensure their safe use.

This manual describes the applicable regulations, policies, and procedures on which CSN's radiation safety program is based. Legally binding federal and state regulations require the maintenance of certain records and the fulfillment of certain obligations by all authorized users. Failure to meet these legal requirements will place CSN's licenses and registrations in jeopardy, and failure to comply with established policies and procedures could compromise radiation safety.

CSN is committed to maintaining personnel exposures and releases of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA). Individuals who are authorized to operate sources of radiation shall provide appropriate ALARA instructions to all individuals who work with or in the vicinity of radiation. The CSN ALARA philosophy is specifically delineated in APPENDIX A.

The State Radiation Control Program in accordance with the provisions of [NAC 459 Sections 320 to 374](#) regulates radiation sources at CSN and has specified its own rules and regulations for the control of radiation producing machines (RPMs). CSN as licensee for the possession and use of radiation sources under the academic (01) license or the service (02) license recognizes its responsibility to establish appropriate policies and procedure for the safe use of radiation sources. To this end, Environmental Health and Safety will be responsible for developing and implementing such policies and procedures. The Director of Environmental Health and Safety is responsible for all matters of radiation safety.

This Radiation Safety Manual describes the organization and responsibilities of CSN's comprehensive radiation safety program. The manual was prepared to be consistent with all applicable federal and state regulations.

## 7.0 Definitions

- 7.1 ALARA – As Low as Reasonably Achievable – The principle of reducing the radiation dose of exposed persons to levels as low as is reasonably achievable, economic and social factors being considered.
- 7.2 Authorized department - The specific educational department where employees and/or students are authorized to use radiation sources on CSN property and/or at community partner clinical sites.
- 7.3 Authorized user - An employee or student who has been authorized to use radiation sources.
- 7.4 Declared pregnant woman – A woman who is also a radiation worker or student and has voluntarily informed her employer or academic program, in writing, of her pregnancy and the estimated date of conception.
- 7.5 Digital radiography – A diagnostic procedure using an appropriate radiation source and imaging system that collects, processes, stores, recalls and presents image information in a digital array rather than on film.
- 7.6 Dose – A specific quantity or amount of radiation deposited into the tissues.
- 7.7 Dose equivalent - The product of absorbed dose in tissue multiplied by a quality factor, and then sometimes multiplied by other necessary modifying factors, to account for the potential for a biological effect resulting from the absorbed dose. It is expressed numerically in rems (traditional units) or Sievert (SI units).

- 7.8 Dose Limit (annual) – The maximum effective dose an individual may be permitted in any year from a given category of sources.
- 7.9 Dosimeter – A small portable instrument (such as a film badge) for measuring and recording the total accumulated dose of ionizing radiation for a specified period.
- 7.10 Dosimetry – The science or technique of determining radiation dose.
- 7.11 Electron microscope – Also known as Scanning Electron Microscope (SEM). A scientific instrument that uses a beam of highly energetic electrons to examine objects on a very fine scale.
- 7.12 Exposure – A general term used loosely to express what a person receives as a result of being exposed to ionizing radiation.
- 7.13 Filter – material in the useful beam that usually absorbs preferentially the less penetrating radiation.
- 7.14 Fluoroscopy – The process of producing a real-time image using x-rays. The machine used for visualization in which the dynamic image appears in real time on a display screen (usually video) is a fluoroscope.
- 7.15 Ionizing radiation – Any electromagnetic or particulate radiation capable of producing ions directly or indirectly in its passage through matter. In general, it will refer to gamma rays and x-rays, alpha and beta particles, neutrons, protons, high speed electrons, and other nuclear particles; not sound or radio waves or visible, infrared or ultraviolet light.
- 7.16 Lead apron – An apron made with lead, a radiation absorbing material used to reduce radiation exposure.
- 7.17 Millirem (mrem) – A unit to measure human dose equivalence as a result of exposure to ionizing radiation. A mrem is 1,000 time smaller than a rem (Roentgen Equivalent Man).
- 7.18 Patient – Person or animal being examined and is receiving the radiation dose.
- 7.19 Protective barrier – A barrier of radiation absorbing material(s) used to reduce radiation exposure.
- 7.20 Qualified expert – A medical physicist or medical health-physicist that is competent to design radiation shielding in x-ray facilities and to advise regarding other radiation protection needs of x-ray installations. The qualified expert is a person who is certified by the American Board of Radiology, American Board of Medical Physicists, American Board of Health Physics, or Canadian College of Physicists in Medicine.
- 7.21 Qualified operator – A person who has been educated in the proper operation of radiation generating devices and who has been given permission to do so by a federal, state, or local agency.
- 7.22 Quality assurance – The mechanisms to ensure continuously optimal functioning of both technical and operational aspects of radiologic procedures to produce maximal diagnostic information while minimizing patient radiation exposure.
- 7.23 Radiation – Electromagnetic radiation (x or gamma rays) or particulate radiation capable of producing ions by direct or secondary processes in passage through matter.
- 7.24 Radiation producing machine – Any device capable of producing ionizing radiation when the associated control devices are operated (e.g., x-ray machines but excluding devices which produce radiation only by the use of radioactive materials).

- 7.25 Radiation protection survey – Evaluation of the radiation protection in and around an installation that includes radiation measurements, inspections, evaluations and recommendations.
- 7.26 Radiation Safety Officer (RSO) – The person responsible for implementing the radiation safety program.
- 7.27 Radiography – the production of images on film or other record by the action of x-rays transmitted through the patient.
- 7.28 Roentgen Equivalent Man (rem) – The unit used to express human dose equivalency as a result of exposure to ionizing radiation. Historically a rem was a unit by which radiation was measured and referred to relatively large quantities of x-ray energy.
- 7.29 Roentgen (R) – A unit by which radiation is measured and refers to relatively large quantities of x-ray energy.
- 7.30 Sievert (Sv) –The new international system (SI) unit for dose equivalent equal to 1 Joule/kilogram. The Sievert has replaced the rem. One Sievert is equivalent to 100 rem or 100,000 mrems.
- 7.31 Useful beam – The radiation that passes through the opening in the positioning indicating device that is used for imaging.
- 7.32 X-rays – Penetrating electromagnetic radiation having a range of wavelengths (energies) that are similar to those of gamma photons. X rays are usually produced by excitation of the electron field around certain nuclei. Although once formed, there is no difference in x rays and gamma photons; however, there is a difference in their origin. X rays are produced by shifts in the electrons between the rings outside the nucleus of an atom whereas gamma photons are produced by reactions within the nucleus of an atom.

## 8.0 Responsibilities

Although overall responsibility of radiation safety rests with the college and is managed by the Radiation Safety Officer, basic responsibilities for the protection of life and property must remain with the authorized user of the radiation source or radiation producing device. The following are lists describing the responsibilities of various groups and individuals.

- 8.1 Authorized Department – Each authorized department shall:
  - 8.1.1 Ensure the equipment is used correctly and only by competent personnel.
  - 8.1.2 Establish safe operating procedures for the equipment and ensure operating personnel are adequately instructed in them. Ensure each employee operator signs an attestation that they have been adequately instructed in the safe operating procedures and are competent in the safe use of the department's radiation producing equipment. See APPENDIX B for a template of this attestation.
  - 8.1.3 Prescribe rules of radiation safety and ensure operating personnel are made aware of them.
  - 8.1.4 Post the [NRC-1 'Notice to Employees'](#) from the State of Nevada, Division of Public and Behavioral Health where it can readily be read by employees (e.g., lunchroom).
  - 8.1.5 Have information contained in [NAC 459](#) readily available to every employee and student in the form of a hard copy or an internet address.
  - 8.1.6 Post notices in full view of patients advising disclosure of pregnancy prior to taking x-rays. Bilingual signs are recommended.

- 8.1.7 Verbally advise female patients of reproductive age to disclose pregnancy prior to taking x-rays.
- 8.1.8 Ensure all authorized users wear a personal monitoring device (dosimeters) during radiological procedures or when occupational exposure is likely.
- 8.1.9 Arrange for monitoring radiation exposure via an appropriate monitoring service. Assign monitoring devices to authorized users and send devices to monitoring service for assessment and reporting.
- 8.1.10 Coordinate with EH&S for annual radiation safety training and annual review of CSN's Radiation Safety Manual for all department employees who have occupational exposure to radiation.
- 8.1.11 Ensure the equipment is maintained properly and functions correctly and that maintenance is performed by competent personnel.
- 8.1.12 Arrange for calibration of equipment at the frequency recommended by the equipment manufacturer, or at a minimum, every 3 years.
- 8.1.13 Provide budgetary support for repairs and maintenance of radiation equipment used by the authorized department and owned by CSN.
- 8.1.14 Notify EH&S when repairs or maintenance is needed and/or scheduled for equipment owned by CSN.
- 8.1.15 Notify EH&S if equipment will be placed in a stored status, moved, discarded, or replaced.
- 8.1.16 Provide EH&S with a copy of the final report following repairs or maintenance, movement, or removal.
- 8.1.17 Notify EH&S when installation of new equipment is being planned.
- 8.1.18 Provide EH&S with a copy of FDA Form 2579 Report of Assembly after new equipment is installed.

## 8.2 Supervisors

Supervisors of persons using radiation sources at CSN are responsible for the safe use of the radiation source(s) and strict compliance with the contents of the Radiation Safety Manual and the provisions and requirements of [NAC 459](#). Supervisors shall:

- 8.2.1 Ensure all persons with radiation exposure under his/her supervision have received proper training and are aware of the radiation hazards associated with their activities.
- 8.2.2 Ensure all persons with radiation exposure observe the guidelines and procedures set forth in this manual.

## 8.3 Environmental Health & Safety

- 8.3.1 Ensure that all components necessary for the radiation safety program are implemented. Based on the users of radiation producing equipment, these could include providing, developing, and conducting periodic inspections of personal monitoring, safety procedures, radiation surveys, material and equipment labeling, and required postings, warning signs, radioactive-source security, waste disposal and emergency-response procedures.
- 8.3.2 In consultation with authorized departments and authorized users, develop, review, and update this manual.
- 8.3.3 Publish this manual on EH&S page of the CSN website.

- 8.3.4 At least annually, conduct a review of the contents and implementation of this manual to determine whether the content and scope of the manual is adequate to support the purpose of the Radiation Safety Program. Document the annual review.
- 8.3.5 Serve as liaison with Nevada Division of Public and Behavioral Health (DPBH) Radiation Control Program. Relay pertinent information to CSN departments, programs, employees, and students.
- 8.3.6 Receive, review, and approve applications from persons/departments wishing to operate an electron microscope.
- 8.3.7 Inform staff members that sources of radiation can only be brought on campus with administration and EH&S approval.
- 8.3.8 Receive and review personnel monitoring records and reports from vendor.
- 8.3.9 Forward copies of all radiation monitoring reports to the appropriate programs/departments.
- 8.3.10 Maintain inventory of radiation sources on campus.
- 8.3.11 Prepare and submit initial registration to the State of Nevada for new radiation sources within 30 days of installation.
- 8.3.12 Submit annual renewal of radiation sources at least 10 days before expiration date.
- 8.3.13 Prepare and submit termination application or request for stored status for unused radiation sources when applicable.
- 8.3.14 Oversee the sale, lease, transfer, loan, storage, disposal, assembly, and installation of any sources of radiation.
- 8.3.15 Within 15 days of action, notify the Division of intent to sell, lease, transfer, lend, dispose, storage, assemble, and install any source of radiation.
- 8.3.16 Notify the Division of any changes relating to registrations.
- 8.3.17 Implement and monitor compliance with the ALARA principle.
- 8.3.18 Oversee the personal monitoring efforts by authorized departments.
- 8.3.19 Investigate reports of radiation exposure limits exceeding ALARA limits.
- 8.3.20 Notify employees and students of exposures exceeding ALARA limits.
- 8.3.21 Provide each employee with a year-end report of radiation exposure received in the previous year per NRS 459, NAC 459, and Nevada Division of Public and Behavioral Health Technical Bulletin dated March 27, 2015, Topic: Personnel Dosimetry Records for Licensees and Registrants.
- 8.3.22 Serve on committees that may impact or be impacted by the presence of radiation sources on campus.
- 8.3.23 Arrange radiation surveys to evaluate radiological conditions and potential hazards as needed.



## 9.0 Students or Operators-in-Training

All students, operators-in-training, and personnel not experienced in the use of x-ray equipment must work only under the director supervision of a qualified operator. Dose equivalent limits for students and operators-in-training should not be greater than the limits set for members of the public. Refer to APPENDIX A for limits.

## 10.0 Authorization to Expose Radiographs

Radiology examinations must be ordered by a physician, dentist, or a veterinarian.

## 11.0 Exposure Limits

It is CSN's policy to maintain human radiation exposure levels to 'As Low as Reasonably Achievable' (ALARA). See APPENDIX A.

11.1 No individual shall be permitted to receive an occupational effective dose in excess of **5 rems (50 mSv or 5,000 mrem)** annually.

11.2 ***For a pregnant individual***, the occupational dose shall not exceed **0.5 rems (5 mSv or 500 mrem)** to the embryo or fetus for the entire gestation period once pregnancy has been declared.

11.3 The annual occupational dose limit for **minors** shall not **exceed 10 percent** of the **annual dose limits** specified for **adult workers**.

11.4 The numerical value of the individual worker's lifetime occupational effective dose shall be limited to **10mSv times the value of his or her age in years**.

11.5 No student or operator-in-training shall be permitted to receive an occupational effective dose in excess of **0.1 rem (100 mrem)** annually.

11.6 The occupational dose limit allowed in the current year will be reduced by the amount of the occupational dose that the employee received during the year while employed by another employer.

11.7 The total effective dose equivalent to individual members of the public shall not exceed **0.1 rem (100 mrem)** annually, exclusive of the dose contributions from background radiation, voluntary participation in medical research programs, etc.

11.8 Doses received in excess of the annual limits, including those received during accidents or emergencies, shall be subtracted from the limits allowed during the individual's lifetime.

## 12.0 Training

12.1 All persons with occupational or educational exposure to radiation shall be trained appropriately in the safe conduct of his/her work.

12.2 Students and operators-in-training shall receive this training from knowledgeable department faculty as part of their academic program curriculum.

12.3 EH&S shall provide or arrange annual radiation safety training for those employees with occupational exposure to radiation. A method of gauging understanding shall follow the training (e.g., quiz or test).

12.4 A review of radiation safety by employees shall occur at intervals not to exceed 12 months.

12.5 Radiation safety instructions shall comply with NAC 459.784, including but not limited to the following topics:

- 12.5.1 Risks related to radiation and to other hazards in the workplace
  - 12.5.2 Dose limits
  - 12.5.3 Sources of exposure
  - 12.5.4 Basic protective measures
  - 12.5.5 Security for radiation sources
  - 12.5.6 Warning signs, postings, labeling and alarms
  - 12.5.7 Responsibility of each person
  - 12.5.8 Overall safety in the workplace
  - 12.5.9 Specific facility hazards
  - 12.5.10 Special information for women of reproductive age
  - 12.5.11 Regulatory licensure requirements
  - 12.5.12 Infection control
  - 12.5.13 The ALARA principle
- 12.6 Initial training shall take place at the time of hire before use of any source of radiation.
- 12.7 Individuals shall be given an opportunity to ask questions of the instructor.
- 12.8 All female personnel with occupational exposure to radiation shall receive training orally and in printed form satisfying the recommendations [of NRC Regulatory Guide 8.13 Instruction Concerning Prenatal Radiation Exposure](#).
- 12.9 Supervisory personnel are also required to receive annual radiation safety training.
- 12.10 Records of radiation training shall be kept in the authorized department or in a central database (e.g., CSN's CAPE learning management system).

### 13.0 Hazard Communication

Radiation hazards shall be communicated to employees in the following ways.

- 13.1 State of Nevada Division of Public and Behavioral Health, [NRC-1 'Notice to Employees'](#) shall be posted where employees who have occupational exposure to radiation can readily see the notice when going to and from their place of work.
- 13.2 The control panel containing the main power switch must bear the warning statement, legible and accessible to view: "WARNING: Hazardous x-radiation is emitted when this equipment is in operation."
- 13.3 The electron microscope shall be labeled with a sign bearing the words "CAUTION RADIATION – This equipment produces radiation when energized."
- 13.4 The [NRC Regulatory Guide 8.13, Instructions Concerning Prenatal Exposure](#) shall be distributed to each female employee at the time of hire or each female student at the start of the academic program. The notice of understanding must be signed and returned to the authorized department. The department shall keep the records of the current employees and students on file.

### 14.0 Postings

- 14.1 A current registration certificate must be posted conspicuously in the room containing the source of radiation.
- 14.2 Notice to the public to suggest disclosure of pregnancy prior to having x-rays taken shall be posted in full view of a patient prior to taking x-rays.
- 14.3 In the vicinity of each control panel or an x-ray system, a technique chart shall be provided which specifies for all examinations which are performed by that system a listing of

information, including but not limited to the following, for each projection within that examination.

- 14.3.1 Patient's anatomical size versus technique factors to be utilized
- 14.3.2 Type of and size of the film or film-screen combination to be used
- 14.3.3 Type of grid to be used, if, any and focal distance; and
- 14.3.4 Source to image receptor distance to be used.

## 15.0 Dosimetry

Dosimetry is a legal record of the dose a person working with radioactive materials may receive while on the job. Film badges must not be loaned to another person or stored in areas where normal radiation levels are above background levels. Individuals are responsible for the condition and use of assigned dosimeters.

- 15.1 The following persons are required to wear a dosimeter while performing the duties of their jobs or participating in clinical educational activities involving radiation: dentists, veterinarians, veterinary nurses, dental assistants, dental hygienists, veterinary nursing students, radiation therapy technology students, dental assisting students, dental hygiene students, clinical assistants, environmental science students using XRF analyzers, and clinical and laboratory support staff.
- 15.2 Employees and students requiring dosimetry shall initially complete a form indicating all locations where previous radiation exposures may have occurred.
- 15.3 Personnel monitoring devices will be issued through the authorized department.
- 15.4 Dosimeters shall be worn only by persons to whom they are issued.
- 15.5 The dosimeter should be worn at the anatomical location indicated on the face of the dosimeter with the sensitive side toward the source of radiation.
- 15.6 Workers and students who have declared pregnancy shall wear two dosimeters: one at the collar level and one at the level of the abdomen (under any protective shield).
- 15.7 Dosimeters shall not be worn during non-occupational or non-educational activities.
- 15.8 Dosimeters shall not be removed from the CSN facility unless a CSN sponsored off campus educational experience indicates a need for radiation monitoring.
- 15.9 When not in use, each monitoring device shall be stored away from sources of exposure. A control device shall be kept in the same location. This control device shall also be shipped with the dosimeters when they are processed.
- 15.10 When protective clothing is worn (i.e., protective apron), the dosimeter shall be worn at the collar outside the apron.
- 15.11 If a fetal monitor is being worn, it shall be worn at abdomen level under any protective clothing (i.e., protective apron).
- 15.12 If a dosimeter is exposed to non-occupational or non-educational activities that may affect the exposure record, the dosimeter should be returned to the authorized department designee with an explanatory note from the wearer. The dosimeter shall be returned to the vendor for exchange without delay. The authorized department shall inform EH&S without delay.
- 15.13 Time interval between processing dosimeters shall be determined by the authorized

department.

- 15.14 Exposure of a dosimeter to deceptively indicate a dose delivered to a person is prohibited.
- 15.15 Dosimeters shall be processed by a vendor that is accredited by the National Voluntary Laboratory Accreditation Program of the National Institute of Standards and Technology that utilizes a process appropriate for the type of radiation for which the individual wearing the dosimeter is monitored.

## 16.0 Dosimeter Survey Report

- 16.1 Dosimeter survey reports are available on the vendor website via an authorized user login. EH&S can assist authorized departments with gaining access to the system.
- 16.2 EH&S shall download, review and file the reports from the vendor. EH&S shall send copies of the reports to the authorized department, as requested.
- 16.3 The authorized departments shall maintain a file of all reports in a format readily accessible to the authorized user.
- 16.4 Each employee shall be advised of the recorded amount of radiation he/she received in one year at the end of the year in which he/she was monitored as outlined in NRS 459 and NAC 459 and Nevada Division of Public and Behavioral Health Technical Bulletin dated March 27, 2015, Topic: Personnel Dosimetry Records for Licensees and Registrants.
- 16.5 Personnel exposure data shall be maintained by EH&S.
- 16.6 A person may request in writing a report of his/her radiation exposure history at any time. The report shall be furnished within 14 days after which time the request is made.

## 17.0 Exposure Limits Exceeded

If a positive reading greater than 20% of the recommended dosage is found in a report, EH&S shall contact the authorized department designee and the individual directly to conduct an investigation.

- 17.1 Within 5 working days from the notification that exposure limits were exceeded, the worker/student will be asked to file a report with the RSO describing any condition or activities which may have led to the exposure.
- 17.2 In cooperation with the authorized department, a review of the individual's radiation work procedures will be conducted by the RSO to determine if the exposure was due to mishandling of the dosimeter, or possibly a malfunction of the radiation source.
- 17.3 The RSO will work cooperatively with the authorized department to ensure that unsafe practices are discontinued and/or radiation sources are operating correctly.
- 17.4 Occupational doses received in excess of the annual exposure limits mentioned in APPENDIX A, including doses received during accidents, emergencies and planned special exposures, will be subtracted from the limits for planned special exposures that a person may receive during a current year and during his/her lifetime.

## 18.0 Suspected Exposure to Excessive Radiation

A dosimeter will be processed immediately if serious exposure to radiation is suspected. Contact the RSO immediately if such circumstances arise.

## 19.0 Prenatal Radiation Exposure

- 19.1 Upon initial hire or at the beginning of the academic program, a female with occupational or educational exposure to radiation shall be provided with a copy of the [NRC Regulatory Guide 8.13](#).

[Instructions Concerning Prenatal Exposure](#) which contains a form letter for voluntarily declaring pregnancy. This regulatory guide is intended to provide information to pregnant women to help them make decisions regarding radiation exposure during pregnancy.

- 19.2 Declaration of pregnancy is completely voluntary. If pregnancy is declared, it shall be in writing using the form Declaration of Pregnancy included in [the NRC Regulatory Guide 8.13, Instructions Concerning Prenatal Exposure](#).
- 19.3 The '*Declaration of Pregnancy*' form shall be kept on file in the authorized user department.
- 19.4 Following declaration of pregnancy, a lower radiation dose limit will apply to the embryo/fetus.
- 19.5 Once a pregnancy has been declared, measures shall be taken to limit the dose to the embryo/fetus to **0.5 rem (5mSv or 500 mrem)** during the entire pregnancy. This is one tenth of the dose an occupational worker may receive in a year.
- 19.6 A declared pregnant woman shall be provided with two dosimeters. One shall be worn at the level of the neck and the other at the level of the abdomen.
- 19.7 Records of individual monitoring results shall be received and maintained by the RSO.
- 19.8 The declared pregnant worker may ask the employer for a job that does not involve exposure to occupational radiation. However, the employer is not obligated to provide the declared pregnant worker with a job involving *no* radiation exposure.
- 19.9 Declaration of pregnancy remains in effect until the woman withdraws the declaration in writing or is no longer pregnant.

## **20.0 Protection of a Human Patient**

- 20.1 Though there are no human patient dose limits, the amount of radiation exposure should always be optimized to the minimum amount required to achieve the medical objective of the procedure using ALARA principles and guidelines.
- 20.2 The goal of protection of the human patient shall be to obtain the required clinical information while avoiding unnecessary patient exposure.
- 20.3 For each new or referred human patient, a good faith attempt shall be made to obtain recent, pertinent radiographs from the patient's previous dentist.
- 20.4 Radiographic examinations shall be performed only when indicated by patient history, physical examination, or laboratory findings.
- 20.5 For symptomatic patients, radiographic examination shall be limited to those images required for diagnosis and planned treatment (local or comprehensive) of current disease.
- 20.6 For asymptomatic patients, the extent of radiographic examination of new patients, and the frequency and extent for return patients shall be prescribed only when the patient's history and physical findings suggest a reasonable expectation that radiographic examination will produce clinically useful information.
- 20.7 Administrative use of radiation to provide information not related to the health of the patient shall not be permitted.
- 20.8 Students shall not be permitted to perform radiographic exposures of patients, other students, or volunteers solely for purposes of their education or licensure.
- 20.9 The fastest available image receptor consistent with the imaging requirements of each specific examination shall be chosen.

- 20.10 Each patient shall be draped with a protective apron of not less than 0.25 mm lead equivalent to cover the gonadal area and the thyroid gland.
- 20.11 Lead aprons and thyroid collars shall be visually inspected for defects at monthly intervals or more frequently if it is warranted.

## 21.0 Minimum Exposure Techniques

- 21.1 All radiographic examinations shall be performed only on direct prescription from the dentist or veterinarian. Radiographic procedures shall be prescribed only after performing a clinical history and physical examination and determining a reasonable expectation of a diagnostic or health benefit to the patient.
- 21.2 Radiographic exposure shall be performed only by a qualified operator or a student under direct supervision of such personnel.
- 21.3 The fastest and most appropriate film should be used to reduce radiation dosage to the lowest possible level.
- 21.4 The radiation exposure shall be the minimum exposure required to produce images of good diagnostic quality.
- 21.5 The x-ray machine should be operated at the most optimum setting for minimum exposure for the specific discipline.
- 21.6 X-ray beams shall be appropriately filtered to remove undesirable rays that do not contribute to the quality of the image.
- 21.7 Collimation shall be used to restrict the beam of x-ray at the area being surveyed.
- 21.8 The radiographic system shall allow a preset radiation exposure to the image receptor.
- 21.9 Timers on an x-ray machine shall be electronic and shall shut the machine off immediately, regardless of timer setting unless pressure is applied continuously on the timer switch throughout the desired exposure.
- 21.10 Each x-ray control must be located to meet the following criteria:
  - 21.10.1 A protective barrier for the operator or allow the operator to stand at least 6 feet from the patient and well away from the useful beam; and allow visual indication observable at or from the operator's protected position whenever x-rays are produced.
  - 21.10.2 Provide an audible signal to the operator that indicates the exposure has terminated.
- 21.11 Neither the tube housing nor the BID may be handheld during exposure.
- 21.12 The x-ray system shall be arranged and operated in such a manner that the useful beam at the patient's skin does not exceed the dimensions mentioned above.
- 21.13 For extraoral dental radiographs, high speed film and rare earth intensifying screens shall be used.
- 21.14 Panoramic x-ray machines shall be capable of operating at exposures appropriate for high-speed (400 or greater) rare-earth screen-film systems or digital image receptors of equivalent or greater speed.
- 21.15 Fluoroscopy shall not be used for static imaging in dental radiography.

- 21.16 For mobile or portable x-ray systems:
  - 21.16.1 The exposure switch cord must be at least 6 feet long.
  - 21.16.2 All individuals in the environment shall be protected as members of the public.
  - 21.16.3 CSN's safe operating procedures for handheld dental x-rays are outlined in APPENDIX C. All handheld x-ray operators must review and sign an acknowledgement of the safe operating procedures.
  - 21.16.4 CSN's safe operating procedures for handheld x-Ray fluorescence (XRF) analyzers are outlined in APPENDIX D. All XRF analyzer operators must review and sign an acknowledgement of the safe operating procedures.
- 21.17 Radiographic films shall be developed according to the film manufacturer's instructions, using the time/temperature method and recommended chemistry or its equivalent. Sight or visual developing techniques shall not be used.
- 21.18 Digital imaging shall be adjusted for the minimum patient dose required to provide image quality to meet the purpose of the examination.

## 22.0 Radiation Protection Surveys

A radiation protection survey of a facility is intended to demonstrate not only that the x-ray equipment itself functions properly and according to applicable standards, but also that the equipment is installed and used in a way that maximizes safety for operators and others. A radiation protection survey shall be performed under the following circumstances:

- 22.1 At regular intervals required, ordered, or recommended by the State of Nevada Radiation Control Program.
- 22.2 Following receipt of a dosimeter survey report that exposure limits had been exceeded.
- 22.3 A radiation protection survey shall include:
  - 22.3.1 *Investigation* – Collection and examination of information regarding the facility design, including original shielding design, current architectural drawings showing layout and construction of barriers, the type, location and workload of all x-ray equipment and manufacturer's documentation concerning radiation protection features and specification of x-ray equipment and applicable written radiation protection procedures and policies.
  - 22.3.2 *Inspection* – A qualified expert personally verifies the presence of the x-ray equipment and integrity of physical safeguards and the adherence of personnel to established procedures.
  - 22.3.3 *Measurements* – Radiation measurements are obtained to evaluate the performance of x-ray equipment to assess typical radiation hazards during routine operation of equipment and to assess adequacy of radiation barriers.
  - 22.3.4 *Evaluation* – The results of the inspection and measurements are converted into a form that can be directly compared with applicable shielding design goals or effective dose limits. The results of this comparison, together with the information obtained during the inspection form the basis for an evaluation of the radiation protection status of the installation and for recommendations regarding remedial action and resurvey after corrective action has been taken.
- 22.4 A re-survey shall be made after any change in the installation, workload, or operating conditions that might significantly increase occupational or public exposure, including x-ray

machine service or repair that could affect the x-ray machine output or performance.

### **23.0 Records of Prior Occupational Exposure**

- 23.1 Authorized departments shall attempt to obtain the records of the lifetime accumulative occupational dose received by the employee.
- 23.1.1 Acceptable as a record of the occupational dose that the person received during the current year, is a signed written statement from the person or from his/her most recent employer for work involving exposure to radiation, that discloses the nature and the amount of any occupational dose that the person received during the current year OR:
- 23.1.2 Acceptable as a record of lifetime cumulative dose received by a person, is a current form regarding the dose equivalent of a person from his/her most recent employer for work involving exposure to radiation.
- 23.1.3 If a complete record of the current and previously accumulated occupational dose is not available, assume the allowable limits for the person are reduced by 1.25 rems for each quarter for which records are unavailable and the person was engaged in activities that could have resulted in occupational exposures.
- 23.1.4 The occupational dose that an authorized user is allowed to receive in a current year will be reduced by the amount of the occupational dose that user received during the year while employed by another employer.
- 23.1.5 Departments shall retain the records regarding history of cumulative occupational exposure until the Division terminates each license or registration requiring the records.

### **24.0 Educational Use of Radiation**

- 24.1 Any student operating an x-ray machine must be under the direct supervision of an authorized user. An authorized user must be within proximity to assure the student user is following all appropriate safety procedures.
- 24.2 Each student operating an x-ray machine shall be instructed by their academic program in the following topics prior to beginning work with each machine:
- 24.2.1 Use of time, distance, positioning and shielding to keep exposure to radiation ALARA.
- 24.2.2 Knowledge of the radiographic facilities and the nature of the x-ray beam and scattered radiation.
- 24.2.3 Regulations of the Nevada Radiation Control Program that apply to the use of x-rays in his/her specific discipline.
- 24.2.4 Proper use of personnel monitoring devices.
- 24.2.5 The possible health risks to children of women who are exposed to radiation during pregnancy and other reproductive health issues.
- 24.3 Prior to exposing x-rays, the authorized department shall establish policies and procedures for safe use of radiation and train students prior to use of x-ray machine. The policies and procedures should include:
- 24.3.1 Use of technique charts to minimize exposure consistent with obtaining the required diagnostic information and image quality.



- 24.3.2 Assure exposures are prescribed by a qualified user.
- 24.3.3 Only students directly supervised by staff instructors are authorized to operate the diagnostic x-ray equipment.
- 24.4 Personal protective equipment appropriate to discipline shall be furnished to staff and students.
- 24.5 No member of the general public may enter the restricted area.

## 25.0 Radiographic Exposures

- 25.1 Except for the patient, only the staff and ancillary personnel required for the procedure or training may be in the room during the radiographic exposure. Other than the patient being examined:
  - 25.1.1 All persons must be positioned so that no part of the body which is not protected by 0.5 mm lead equivalent will be struck by the useful beam.
  - 25.1.2 Staff and ancillary personnel must be protected from direct scatter of radiation by protective aprons or whole-body protective barriers of not less than 0.25 mm lead equivalent.
  - 25.1.3 Mechanical film holding devices shall be used when a film or patient requires auxiliary support during radiation exposure.
  - 25.1.4 Occupational-exposed personnel shall not restrain uncooperative patients or hold the image receptor in place during x-ray exposure. Members of the public who restrain patients or hold receptors during exposure shall be provided with shielding (e.g., leaded aprons, gloves).

## 26.0 Electron Microscope

- 26.1 EH&S shall oversee the use, registration, and maintenance of electron microscopes used at CSN.

## 27.0 Inventory of Sources of Radiation

In order to maintain proper control of radiation sources and to meet licensure requirements, it is necessary to maintain an accurate inventory. Such an inventory shall be maintained by EH&S and include the following:

- 27.1 Unit registration status
- 27.2 Unit make, model, serial number, unit type, CSN inventory code
- 27.3 Physical location of source; campus, building, room/area number, department user

## 28.0 Acquisition of Radiation Producing Equipment

Acquisition of a radiation producing machine (whether through purchase or as a gift), shall be well coordinated with EH&S. The following shall be considered prior to the equipment being purchased or received by an authorized department:

- 28.1 The expense of putting the system into operation (such as replacement of missing or damaged components), required facility modifications (such as electrical and shielding requirements), initial and periodic radiation surveys, maintenance of the device, etc.
- 28.2 Specialty staff required to operate the equipment.

- 28.3 Additional specialty equipment needed to support the use of the system.
- 28.4 Consideration of potential byproducts of the equipment operation (such as waste disposal).

## 29.0 Recordkeeping

- 29.1 The authorized department shall maintain the following records for its respective students and employees:
  - 29.1.1 Training records. EH&S will request copies of training records annually to review for completion.
  - 29.1.2 Documentation of all female students and employees who receive the [NRC Regulatory Guide 8.13, Instructions Concerning Prenatal Exposure](#).
  - 29.1.3 Records of declared pregnancies.
  - 29.1.4 Records of results of surveys and calibrations for a period of 3 years after the record is made.
- 29.2 EH&S shall maintain the following records:
  - 29.2.1 Sale, lease, transfer, loan, disposal, assembly, and installation of any source of radiation.
  - 29.2.2 Dosimeter survey reports.
  - 29.2.3 Inspection reports.
  - 29.2.4 Records of surveys and calibrations for a period of 3 years.

## 30.0 Inspections by the Nevada State Radiation Control Program

- 30.1 The Nevada Department of Health and Human Services, Division of Public and Behavioral Health (DPBH), Radiation Control Program conducts site inspections at intervals of every 3-5 years.
- 30.2 All licensed or registered activities are subject to inspection by representatives of the Division.
- 30.3 CSN shall make available to the Division for inspection, upon reasonable notice, records maintained pursuant to the Radiation Safety Program.
- 30.4 Division inspectors may consult privately with employees.
- 30.5 EH&S may accompany the inspectors during all phases of the inspection except for private meetings with employees.
- 30.6 The director of EH&S and/or the RSO shall coordinate and supervise all scheduled inspections by authoritative groups. If an agency conducts a non-scheduled inspection, the Director of EH&S and RSO shall be notified immediately.
- 30.7 Any worker who believes a violation of chapter 459 of NAC has occurred may request an inspection by giving written notice of the alleged violation to the Division.

## 31.0 Maintenance and Calibration of Equipment

- 31.1 The authorized department is responsible for locating an appropriate vendor and arranging for maintenance of x-ray systems.
- 31.2 The authorized department is responsible for maintaining the radiation equipment per the manufacturer's recommendations.

- 31.3 Radiation equipment should be calibrated at the frequency recommended by the equipment manufacturer, or at a minimum, every 3 years.
- 31.4 Maintenance and calibration records shall be kept in the authorized department and made available to EH&S and to the Division when indicated.
- 31.5 If an inspection reveals damage to or other problems with an x-ray system, or any component thereof, the x-ray system shall be removed from service until repairs have been made.
- 31.6 The authorized department is responsible for costs incurred from repair, maintenance, and calibration of radiation equipment.

## 32.0 Facilities, New

- 32.1 Prior to the beginning of a design phase, plans to construct or remodel x-ray facilities shall be communicated to EH&S.
- 32.2 When designing or remodeling x-ray facilities, the department shall obtain guidance from a qualified expert in the design of dental or veterinary facilities and establishment of radiation protection policies and procedures.
- 32.3 Facility design, x-ray equipment performance and operating procedures shall be such that no individual exposure exceeds the recommended dose limits.
- 32.4 Personnel responsible for the purchase and operation of x-ray equipment shall ensure that such equipment meets or exceeds all federal and local performance standards.

## References

*Hazardous Materials* [Nevada Administrative Code \(NAC\) 459](#). State of Nevada, 2022.

*Instruction Concerning Prenatal Radiation Exposure* [NRC Regulatory Guide 8.13](#), United States Nuclear Regulatory Commission, June 1999.

*Instruction Concerning Risks from Occupational Radiation Exposure* [Regulatory Guide 8.29, Revision 1](#), United States Nuclear Regulatory Commission, February 1996.

*Radiation Protection in Educational Institutions* Report No. 157, National Council on Radiation Protection & Measure (NCRP), 2007.



**CSN Radiation Safety Manual**

**APPENDIX A  
ALARA Philosophy**

The College of Southern Nevada is committed to maintaining radiation exposure as low as is reasonably achievable (ALARA). Individuals who operate a source of radiation or work near radiation shall be trained in radiation safety upon initial hire and at least annually thereafter. CSN faculty and staff shall follow procedures developed to ensure safety and shall promptly report incidents and potential problems to the Director of Environmental Health and Safety.

The Director of Environmental Health and Safety will encourage all users to review current procedures and recommend additional, modified, or new procedures as appropriate to implement the ALARA concept.

Environmental Health and Safety will perform regular review of occupational radiation exposures with particular attention to instances in which investigational levels are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when investigational levels are exceeded.

The Director of Environmental Health and Safety or RSO will evaluate CSN’s overall efforts for maintaining doses ALARA on an annual basis. This review will include the efforts of the Director of Environmental Health and Safety, authorized users, and workers as well as those of management to determine whether the program content is still adequate, and if the program is being properly implemented.

<b>Permissible Dose Equivalent Limits</b>		
<b>Whole body, blood forming organs, gonads Deep Dose Equivalent (DDE)</b>	<b>5 Rem/yr</b>	<b>5,000 mRem/yr</b>
<b>Lens to eye Lens Dose Equivalent (LDE)</b>	<b>15 Rem/yr</b>	<b>15,000 mRem/yr</b>
<b>Extremities and skin Shallow Dose Equivalent (SDE)</b>	<b>50 Rem/yr</b>	<b>50,000 mRem/yr</b>
<b>Fetal /entire gestation period (Declared Pregnant Worker)</b>	<b>0.5 Rem</b>	<b>500 mRem/yr</b>
<b>Members of the public Students &amp; operators-in-training</b>	<b>0.1 Rem/year</b>	<b>100 mRem/yr</b>



**CSN Radiation Safety Manual**

**APPENDIX B**

**Attestation Signatures for Radiation Producing Machine Employee Operators**

**Department:** \_\_\_\_\_

As per NAC 459.321 and 459.552, our staff which operate radiation producing machines have been adequately instructed in the safe operating procedures and are competent in the safe use of the radiation producing equipment.

Each employee is required to:

- Learn the instructions provided by the department.
- Employ all safety procedures in daily work to avoid unnecessary exposure to radiation.
- Prevent any unnecessary radiation exposure to fellow workers, students, patients, and/or members of the public.
- Complete annual radiation safety training and annual review of CSN's Radiation Safety Manual.

**By signing below, you attest that you have received adequate instruction on the department's safe operating procedures, with all questions satisfactorily addressed by the department. You understand all relevant regulations, acknowledge the annual training and program review requirements, and can demonstrate competence in the safe use of the department's radiation-producing equipment.**

Name	Position/Title	Signature	Date



## CSN Radiation Safety Manual

### APPENDIX C

#### Safe Operating Procedures for Dental Handheld X-Ray Equipment

##### 1. Operator Training and Qualifications

- Only trained and qualified personnel should operate the handheld x-ray equipment.
- Operators must be familiar with the equipment's user manual and safety guidelines.
- Training on the use of the equipment must be documented and include:
  - Proper positioning of the equipment to ensure adequate protection of the patient and operator.
  - Diagrams of the protected position and location in relationship to the equipment.
- Operators must comply with provisions outlined in Nevada Administrative Code 459 and CSN's Radiation Safety Manual.

##### 2. Use of Handheld X-ray Equipment

- The handheld equipment must comply with the applicable performance standards of 21 CFR 1020 to 1020.40, inclusive of which were in effect at the time the unit was manufactured.
- Use of the equipment must be consistent with the manufacturer's manual.
- Use secondary radiation block or protection features if the unit was designed with such features.
- Regularly inspect the handheld equipment for damage or malfunction before each use.
- Ensure that the equipment is not used in uncontrolled areas, such as hallways.
- Handheld equipment should be held without motion during the radiograph.
- Ensure that there are no ancillary persons with a radius of 6 feet from the portable equipment tube head.
- When using portable handheld equipment, operators shall wear:
  - Lead apron and thyroid collar.
  - Whole body and ring type extremity monitoring dosimeters.

##### 3. Prevent Unauthorized Use

- Portable equipment that is handheld must be kept in a secured location when not in use.
- The equipment may only be used at the location where it is registered unless a statewide use application is obtained.
- The sell, lease, transfer, lend, disposal, assembly, or acquisition of portable handheld dental x-ray equipment must be reported to the Nevada Division of Public and Behavioral Health, Radiation Control Program within 15 days and include information contained under NAC 459.166.

**Acknowledgement of Safe Operating Procedures for Handheld Dental X-Ray Equipment:**

Department: \_\_\_\_\_

Name	Position/Title	Signature	Date



## APPENDIX D

### Safe Operating Procedures for Handheld X-Ray Fluorescence (XRF) Analyzers

#### 1. Operator Training and Qualifications

- Operators must be familiar with the equipment's user manual and safety guidelines.
- Only trained personnel should operate the XRF analyzer equipment.
- Training on the use of the equipment must be documented and include:
  - Principles of radiation safety and ALARA
  - Principles of XRF analysis
  - Potential hazards associated with XRF analyzers
  - Proper handling and operation of XRF analyzers
  - Safety precautions and emergency procedures
- Operators must comply with provisions outlined in Nevada Administrative Code 459 and CSN's Radiation Safety Manual.

#### 2. Use of Handheld XRF Analyzer Equipment

- Use of the equipment must be consistent with the manufacturer's manual.
- Never point the analyzer at yourself or others when the primary beam (x-ray on) lights are illuminated.
- Keep all body parts as far away as possible from the radiation beam during analysis. If someone else needs to be in the area, they should position themselves as far away from the equipment or sample as possible.
- Don't run the analyzer (pull the trigger) without a sample in place. Keep the instrument at a 90° angle in direct contact with the sample. Never hold the instrument away from the sample.
- Maintain all labels and safety interlocks on the equipment.
- Consult with the manufacturer regarding equipment maintenance or repair. Never open or service the unit yourself.

#### 3. Emergency Procedures

- Any damage to the device or shielding may lead to unnecessary radiation exposure.
- Turn off the analyzer. Remove battery or other power source.
- Remove unit from service and lock it up.
- Consult with manufacturer for repair or replacement.
- Report any radiation emergencies to CSN Radiation Safety Officer.

#### 4. Prevent Unauthorized Use

- Store the XRF equipment in a secure location, under lock and key, when not in use.
- The sell, lease, transfer, lend, disposal, assembly, or acquisition of portable XRF analyzer equipment must be reported to the Nevada Division of Public and Behavioral Health, Radiation Control Program within 15 days and include information contained under NAC 459.166.



