A. Scope of the Program
The Radiation Safety Program at Fort Lewis College provides assistance to radiation users on campus to ensure safety and to make certain that radiation exposures are reduced to levels that are as low as reasonably achievable (ALARA). The program includes radiation safety training, security of radiation sources, use authorizations for radiation sources, safety surveys, radiation dosimetry, and response to radiation-related emergencies. The program is based on requirements given by the U.S. Nuclear Regulatory Commission and the Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, 6 CCR 1007-1.

The following sources of radiation are included in the Fort Lewis College Radiation Safety Program:
   a. hand-held x-ray diffraction meters
   b. table-top XRD machine
   c. S8 Tiger x-ray spectrometer
   d. exempt quantities of radioisotopes

B. Definitions - Useful ionizing radiation safety terminology is presented below:
*Alpha Particle* - A charged particle having a mass and charge equal in magnitude to a helium nucleus (a cluster of two protons and two neutrons) that is emitted from the nucleus of an atom.

*Beta Particle* - Charged particle emitted from the nucleus of an atom, with a mass and charge equal in magnitude to that of the electron.

*Curie (Ci)* - The special unit of activity, where one curie equals 3.7 x 10^{10} nuclear disintegrations per second. Several fractions of the curie are in common usage:
   - Millicurie (mCi): One-thousandth of a curie (3.7 x 10^{7} disintegrations per second).
   - Microcurie (µCi): One-millionth of a curie (3.7 x 10^{4} disintegrations per second).

*Decay, Radioactive* - Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons.

*Detector, Radiation* - Any device for converting radiant energy to a form more suitable for observation and measurement. An instrument used to determine the presence, and sometimes the amount, of radiation.

*Dose* – A general term denoting the quantity of radiation or radiant energy absorbed.
**Dosimeter** - Instrument to detect and measure accumulated radiation dose.

**Exposure** - A measure of the ionization produced in air by x or γ radiation. It is the sum of the electrical charges on all ions of one sign produced in air when all electrons liberated by photons in a volume of air are completely stopped in air, divided by the mass of the air in the volume. The special unit of radiation exposure is the roentgen (R).

**Film Badge** - A pack of photographic film which measures radiation exposure for personnel monitoring. The badge may contain two or three films of differing sensitivity and filters to shield parts of the film from certain types of radiation.

**Gamma Ray** - Short wavelength electromagnetic radiation emitted from the nucleus of an atom during radioactive decay.

**Geiger-Mueller Counter** - Highly-sensitive, gas-filled radiation-detecting device. It operates at voltages sufficiently high to produce avalanche ionization.

**Half-Life, Radioactive** - Time required for a radioactive substance to lose 50 percent of its radioactivity by decay. Each radionuclide has a unique half-life.

**Ionization** - The process by which a neutral atom or molecule acquires a positive or negative charge.

**Ion Pair** - Two particles of opposite charge, usually referring to the electron and positively charged atomic or molecular residue resulting from the interaction of ionizing radiation with the orbital electrons of atoms.

**Monitoring** - Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region.

**Photon** - A quantity of electromagnetic energy (E) whose value in joules is the product of its frequency in Hertz and Planck’s constant.

**Rad** - The unit of absorbed dose in rads is equal to 0.01 J of energy deposited in a kilogram of any medium.

**Radiation or Ionizing Radiation** - Gamma rays and x-rays, alpha and beta particles, neutrons, protons, high-speed electrons and other nuclear particles, but not visible light, sound, radio waves, laser radiation, or microwaves.

**Radiation-Producing Machine** - Any device capable of producing radiation when the associated control devices are operated or electrical circuits are energized.

**Radioactive Material** - Any material which emits radiation spontaneously.
Radioactive Contamination - Deposition of radioactive material anywhere where it is not desired, particularly where its presence may be harmful. The harm may be in interfering with an experiment or a procedure, or in actually being a source of danger to personnel.

Rem - A special unit of radiation dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor QF.

Roentgen (R) - The unit of radiation exposure. One roentgen equals $2.58 \times 10^{-4}$ coulomb per kilogram of air.

Scintillation Counter - The combination of phosphor, photomultiplier tube, and associated circuitry for measuring light emissions produced by ionization in the phosphor.

Sealed Radiation Source - Any radioactive material permanently encapsulated in such a manner that it will not be released under the most severe conditions likely to be encountered in normal use. This encapsulation must meet rigid specifications.

TLD (Thermoluminescent Dosimeter) - A crystalline material (e.g., lithium fluoride) which is used to measure an accumulated radiation dose. When exposed to radiation at ambient temperatures, electrons migrate to crystal lattice defects. When heated, the crystal releases this energy as light which can be detected by a photomultiplier tube and correlated to the amount of radiation dose received.

X-rays - Penetrating electromagnetic radiation whose wavelengths are shorter than those of visible light and ultraviolet radiation. X-rays are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions, it is customary to refer to photons originating in the nucleus as gamma rays, and those originating in the extra-nuclear part of the atom as x-rays. These rays are sometimes called roentgen rays after their discoverer, W.C. Roentgen.

C. Responsibilities
It is the policy of the College to maintain an environment for its students, faculty, staff and visitors that will neither adversely affect their health and safety nor expose them to avoidable risk of injury insofar as is reasonably achievable.

1. President, Fort Lewis College
The President is responsible for implementation of the College’s radiation safety policies and for establishing supplementary campus policies and standards. She has delegated her responsibilities to various campus committees, departments and individuals identified below.

2. Campus Radiation Safety Committee (RSC)
The Campus Radiation Safety Committee reports to the Dean of Arts and Sciences on all matters related to radiation safety and recommends such policies and procedures it deems appropriate to ensure an adequate radiation safety program. The committee is responsible for reviewing and approving all proposed uses of radiation and radioisotopes, and for advising and guiding the
Environmental Health and Safety (EH&S) Office in carrying out the campus radiation safety program.

The RSC has the authority to suspend or revoke the authorization of a faculty member or principal investigator (PI) to use radiation sources and direct the Radiation Safety Officer (RSO) to impound radioactive materials or stop the use of radiation-producing machines for violations of any of the provisions of the program.

The RSC is composed of the Dean of the School of Arts and Sciences, the Department Chair of the Biology Department, the Department Chair of the Geology Department, the Department Chair of the Physics and Engineering Department, at least one faculty member currently using a XRF device, at least one faculty member currently using the XRD machine, at least one faculty member using radioisotopes, one faculty member using the S8 Tiger, the Radiation Safety Officer, who serves as an *ex officio* member, and other members, as necessary, are appointed based on their experience with radiation.

Meetings will be held at least semi-annually based on the limited use of radioisotopes and radiation producing machines. Members will serve a 3-year term and may be re-appointed for additional terms. Members who miss three consecutive meetings without approval of the Chair for adequate cause shall be considered to have resigned.

The Chair may call additional meetings as necessary. Minutes of the meetings shall be recorded and distributed to selected persons and committee members. A quorum shall consist of half of the members plus one, and must include the Chair and the Radiation Safety Officer.

The RSC shall:
- Approve all applications for use of radiation devices and radioactive material by College personnel.
- Approve radiological hazard analyses of new protocols used by investigators. This includes:
  - Purpose
  - Description
  - Analysis of the possible radiation levels produced by the experiment
  - Hazards associated with the performance of the experiment
- Ensure any modifications or improvements it considers necessary in the interest of radiation safety or compliance with federal, state, or internal regulations are implemented.
- Review the radiation protection program content and implementation on an annual basis.
- Administer disciplinary actions for violations by an *ad hoc* sub-committee consisting of the Chair, Radiation Safety Officer and another member from the Radiation Safety Committee.

Before new equipment or radioactive sources are allowed on campus all proposed protocols and a radiological hazards analysis must be submitted to the Radiation Safety Officer for review. The review includes:
- Evaluation of training needs
• Evaluation of facilities and equipment
• Evaluation of operational and emergency procedures
• RSO review
• Consultation with the applicant
• RSC review

The applicant will be permitted to begin operations under terms of the Authorization upon receipt of a copy signed by the Radiation Safety Committee Chair and the RSO.

The RSO shall be notified of all changes of personnel, facilities, or operational changes affecting the use of radioisotopes and machines. This notification must be in the form of a written memo, email or web form submission. The RSO will notify the Responsible Faculty Member-Principal Investigator (RFM-PI) which changes have been approved.

Inactivation of Authorization is achieved when there is no use of radioactive material or equipment for 12 months. The following actions must take place when this occurs:
• An accurate current inventory of all radioactive materials inventories by the RFM-PI must be sent to the RSO.
• All material must be transferred to another RFM-PI or the RSO for storage or disposal.
• The RFM-PI and RSO must conduct a survey of the laboratory to ensure that there is no contamination of the facility above the levels permitted for unrestricted areas (background levels).

Reactivation of authorization can be accomplished by submitting a request to the RSO requesting reactivation, in conjunction with a documented review of training designated by the RSO, participation in an oral review on current or updated procedures and completion of the current year’s refresher training.

3. Environmental Health and Safety (EH&S) Office

The Environmental Health and Safety (EH&S) Office is responsible for surveillance of all uses of radioactive materials and radiation-producing machines and providing consultation and radiation safety services in conformance with accepted policies and standards, government regulations, license conditions, and national radiation protection standards and recommendations.

a. Director, Environmental Health & Safety is responsible for reviewing campus performance regarding policies and procedures of all environmental health and safety programs not specifically assigned elsewhere. Additionally, the director has the responsibility of assuring that the College administration is adequately informed of its responsibilities on matters related to radiation safety.

b. Radiation Safety Officer (RSO) is responsible for administering the radiation safety program; for assuring that use of radiation is in conformance with College policies and with applicable governmental regulations; and for referring to the Radiation Safety Committee matters requiring its review and approval. The RSO is an ex-officio member of the Radiation Safety Committee. The RSO has the authority to immediately terminate any operation involving the use of radiation which in his/her judgment presents a significant hazard to the health and safety of FLC students,
staff, faculty, visitors, or the general population. This position is currently held by the Director, Environmental Health & Safety.

Duties of the RSO include:
- Work with Responsible Faculty Members and Principal Investigators (RFM-PI) to insure that personal monitoring, training, maintenance of exposure records, radioactive material inventories, survey methods, waste disposal and inspections are completed and in compliance with recognized radiological safety practices.
- Approve in writing all activities and procedures that involve actual or potential exposure of personnel to radiation or the release of radioactive materials to the environment, and ensure such activities are brought before the Committee for review and approval.
- Conduct radiological hazard analyses on all new procedures used by laboratories.
- Be available to consult with all users of ionizing radiation and give advice in radiological safety practices.
- Suspend any operation causing, or believed capable of causing, and excessive radiation hazard as rapidly as possible.
- Perform routine and special radiation surveys as considered necessary in the interest of radiation safety.
- Provide the RSC a semi-annual report on radioisotope, XRF and XRD use to include a summary of exposures, a current list of authorized users, and any abnormal occurrences.

4. Purchasing Department
A buyer, designated by the campus Purchasing Director, is responsible for control of the acquisition, through established procedures, of all radioactive materials and machines capable of producing ionizing radiation. He or she is assisted by EH&S in determining whether the person submitting the request is authorized for its possession and use. This designated buyer is an ex-officio member of the Radiation Safety Committee.

5. Deans and Department Chairs
Deans and Department Chairs are responsible for review and approval of proposed uses of radioisotopes and radiation-producing machines within their jurisdiction. Such approval signifies that the department will provide the resources necessary to control hazards and will assist in the enforcement of pertinent College and governmental standards and regulations. Each department shall evaluate their specific equipment, and if needed, secure a radiation survey instrument(s) capable of detecting the types of radiation that are used in that department. These instruments shall be continuously available for routine monitoring and emergency uses, and shall be calibrated/operationally checked on a routine basis as defined by the State of Colorado, Department of Public Health & Environment.

6. Responsible Faculty Member or Principal Investigator (RFM-PI)
The Responsible Faculty Member or Principal Investigator is personally responsible for compliance with campus and governmental regulations as they pertain to his/her authorized use of radioactive materials or radiation producing machines. This person is usually a permanent faculty member. A research associate (faculty status) or a sufficiently experienced staff member can be designated if the Department Chair specifically assigns them responsibility for radioisotopes and radiation producing machines or a specific laboratory.
Specific responsibilities for the RFM-PI include the following:

- The safe operation of all work with radioactive material or instruments performed under his or her authorization.
- All faculty and staff personnel working under their supervision complete a required radiation safety training course before using radioisotopes or radiation producing machines.
- All students working under their supervision will complete a basic (student version) radiation safety training course before using radioisotopes or radiation producing machines.
- All laboratory non-users are aware of the radioactive nature of the radioisotopes, radiation producing machines, use areas, storage areas and methods to avoid the associated radiation hazards.
- All users are familiar with the procedures of operation of the machines before using them.
- All required instrument test/surveys are conducted and appropriate records maintained.
- Proper security of radioisotopes or the machines is maintained at all times.
- All users under the authority of the RFM-PI are informed of any/all changes to procedures and regulations as they are received.
- The RSO is notified whenever an individual may require personnel monitoring and whenever the need for personnel monitoring is terminated.

7. Radiation User
All persons must be adequately trained regarding, and comply with, the College’s radiation safety requirements and any specific rules prescribed by the RFM-PI. When a person knows or suspects that an accident has occurred involving a radioisotope or a radiation-producing machine, that person must immediately inform the RFM-PI, and if the RFM-PI is not available, the person is to notify the campus RSO. Radiation users are responsible for performing all work in accordance with the FLC Radiation Program Safety requirements.

D. Program Components
The major elements of the FLC Radiation Safety Program are listed below.

a) Providing information dealing with the recognition, evaluation and control of the hazards associated with ionizing radiation:
   - FLC Radiation Safety Manual
   - Prenatal Radiation Exposure Policy
   - Radiation Safety Training Materials
   - XRF Safety Manual
   - XRD Safety Manual
   - S-8 Tiger Spectrometer Safety Manual
   - State of Colorado Notice to Employees

b) Training radiation users regarding the related safety principles.
   - For Radiation-producing Machine Users
E. Reporting Requirements
The FLC Radiation Safety Officer (RSO) must be notified well in advance whenever a radiation source will be brought onto campus, unless it is purchased through FLC Purchasing Department, in which case the RFM-PI will already have been authorized to receive the device or material.

If a radiation-producing machine is modified or moved such that the hazards attendant to its use might have increased, the RSO must be notified before the machine is operated again in order to ensure that external radiation readings are still within safe limits.

If a person knows or suspects that he/she has been over-exposed to radiation or contaminated with radioactivity, EH&S must be notified as soon as possible.

If somebody is observed to be handling radioactive material or operating a radiation-producing machine in an irresponsible manner, EH&S must be notified immediately.

F. Information - For information regarding the various aspects of ionizing radiation safety, contact the EH&S director, Terry Richardson at 7272.

G. Training and Testing
The training program consists of the following elements: Radiation Safety, XRF meter theory and use, XRD machine theory and use, S8 Tiger Spectrometer machine theory and use, and hands-on training/on-the-job training. Regulations issued by the State of Colorado Department of Public Health & Environment set minimum training requirements for hand-held, x-ray generating devices.

Initial Training – includes the following:
- Review the Radiation Safety Training Manual
  - Fundamentals of Radioactivity
  - Nuclear Reactions
  - Interactions of Radiation with Matter
  - Radiation Detection instrumentation (theoretical)
  - Radiation Detection Instrumentation (practical)
  - Federal, State Regulations
  - Biological Effects
- View videos
- Attend radiation safety training and successfully pass (>85% correct) a written examination.

Hands-On and On-The-Job Training - New users of radioisotopes and radiation-producing machines are required to be adequately trained in the safe handling of radioactive materials, shielding and operation of the machines they will be using. The RFM-PI is responsible for this aspect of the training. On-the-Job Training form must be submitted upon completion of the training and before the trainee begins working with radioactive materials, or a specific machine. At a minimum, training should include:
- Observing actual procedures conducted by experienced personnel.
• Practicing techniques of mock sample analysis using the XRF meter, S8, or XRD machine.
• Performing actual procedures while experienced RFM-PI are present to provide immediate feedback and assistance if needed.
• Specific information about contamination monitoring and record keeping.
• Specific machine electrical safety information is understood.
• Security concerns of storage, use and transportation of XRF meter.
• Security concerns for use of the XRD or S8 machine.
• Safety and secure storage of radioisotopes.

Refresher Training – All individuals actively using radioisotopes, the XRF meter, the S8, and XRD machine must complete annual refresher training conducted by the RSO and the RFM-PI. The refresher training will include:
• Concentrate on awareness of radiation safety concerns
• Provide regulatory updates – wither federal, state or local
• Review problems noted during the last year

Documentation of Training and Experience – At a minimum, RFM-PI must have a bachelor’s degree or equivalent training and experience in the physical sciences, biological/chemical sciences or in engineering. Experience includes safe handling of radioactive material, characteristics of ionizing radiation, radiation meter use, radiation detection devices, and understanding of biological hazards associated with radiation exposure inherent to radioisotopes and radiation producing machines.

H. Personnel Monitoring
Personal monitoring will be worn by all who use the XRF meter, the S8 Spectrometer, or XRD machine. Normally this will be the RFM-PI or a student operating the equipment for a research project. Students sharing the equipment during a training class will share the monitors before using the XRF meter, S8 Spectrometer, or XRD machine. Student exposure is anticipated to be non-recordable during the few minutes the equipment is used. A complete exposure of the group is also expected to be non-detectable for the duration of the laboratory period.

The personnel monitoring devices will consist of a body badge and a finger badge. Monitoring devices will be worn as follows:
• Monitoring devices must be worn at body locations where the highest potential doses are expected.
• Body badges are normally worn in the upper chest area.
• Finger badges should be worn on the hand closest to the source of radiation and usually facing inward.
• When not in use the devices must be stored in areas where they will not be exposed to radiation.
• Badges must not be worn during non-occupational exposure, e.g., medical x-rays.
I. Exposure Reporting
The RSO maintains all personnel monitoring records. RFM-PIs must provide all prior records of radiation exposure. Radiation exposure results will be reported within 30 days of receipt from an approved laboratory.

### Occupational Limits

<table>
<thead>
<tr>
<th>Type of Individual</th>
<th>Region of the Body</th>
<th>Limit (per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults (≥ 18 years)</td>
<td>Total effective dose equivalent (TEDE) Whole body; head, trunk, gonads, arms above the elbow or legs above the knee; external and internal dose</td>
<td>5,000 mRem</td>
</tr>
<tr>
<td></td>
<td>Lens dose equivalent (LDE) Lens of the eye</td>
<td>15,000 mRem</td>
</tr>
<tr>
<td></td>
<td>Shallow dose equivalent (SDE) Skin of the body; extremities – hand, elbows, arm below the elbow, foot, knee, leg below the knee</td>
<td>50,000 mRem</td>
</tr>
<tr>
<td>Declared pregnant worker</td>
<td>TEDE</td>
<td>500 mRem per pregnancy</td>
</tr>
<tr>
<td>Minors (&lt; 18 years)</td>
<td>TEDE</td>
<td>500 mRem</td>
</tr>
<tr>
<td></td>
<td>LDE</td>
<td>1,500 mRem</td>
</tr>
<tr>
<td></td>
<td>SDE</td>
<td>5,000 mRem</td>
</tr>
<tr>
<td>General Public</td>
<td>TEDE</td>
<td>100 mRem</td>
</tr>
</tbody>
</table>

J. The ALARA Program
Fort Lewis College is committed to keeping radiation exposures *As Low As Reasonably Achievable* (ALARA). Under the ALARA program certain exposure levels require investigation.

### ALARA Investigation Levels

<table>
<thead>
<tr>
<th>Individual</th>
<th>Body Site</th>
<th>Level I (per year)</th>
<th>Level II (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>TEDE</td>
<td>500 mRem</td>
<td>1,250 mRem</td>
</tr>
<tr>
<td></td>
<td>LDE</td>
<td>1,500 mRem</td>
<td>3,750 mRem</td>
</tr>
<tr>
<td></td>
<td>SDE</td>
<td>5,000 mRem</td>
<td>12,500 mRem</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Declared pregnant</td>
<td>TEDE</td>
<td>50 mRem</td>
<td>125 mRem</td>
</tr>
<tr>
<td>worker</td>
<td></td>
<td>per pregnancy</td>
<td>per pregnancy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minors</td>
<td>TEDE</td>
<td>50 mRem</td>
<td>125 mRem</td>
</tr>
<tr>
<td></td>
<td>LDE</td>
<td>150 mRem</td>
<td>375 mRem</td>
</tr>
<tr>
<td></td>
<td>SDE</td>
<td>500 mRem</td>
<td>1,250 mRem</td>
</tr>
<tr>
<td>General Public</td>
<td>TEDE</td>
<td>10 mRem</td>
<td>25 mRem</td>
</tr>
</tbody>
</table>

The RSO will review and record results of personnel monitoring at least quarterly. The following actions will be taken:
- For personnel dose levels less than Level I, no further action is needed.
- For personnel dose equal to or greater than Level I but less than level II:
  - RSO will review dose results
  - Report the results of the reviews at the first RSC meeting following the quarter when the level was exceeded
  - RSC reviews doses of other performing similar tasks as a comparison index of ALARA program quality
  - The review will be recorded in the RSC minutes
  - No further action is necessary unless requested by the RSC or RSO
- For personnel dose equal to or greater than level II:
  - RSO will investigate into the causes and take any necessary action
  - RSO will provide an investigation report, actions taken, and a copy of the individual’s exposure record to the RSC at its first meeting following completion of the investigation.

K. Pregnant Radiation Workers
A faculty or staff member, as well as students, have the option to declare a pregnancy to their supervisor in order to take advantage of reduced occupational exposure limits for the entire term of the pregnancy. This declaration is voluntary and can be kept confidential. The RSO is available to answer any questions that may arise whether or not a formal declaration of pregnancy is made. To declare as a pregnant worker the supervisor needs the following information:
- Estimated month of conception
- Expected date of birth

Upon notification of the declaration, the RSO will:
- Will review the past history of dose exposure and insure present exposure is below Level.
- If the declared pregnant worker has received more than 450 mRem (TEDE) when the pregnancy is declared, then she cannot receive over 50 mRem (TEDE) during the remainder of the pregnancy.
L. Disciplinary Procedures
Violations of the radiation safety guidelines found in this document may result in disciplinary procedures initiated against a RFM-PI or student as follows:

- **Class I** – Violations in this category are considered administrative or procedural in nature, representing minor violations. If three (3) violations are documented within a one (1) year period permission to use any x-ray device will be suspended, pending a review by the RSC.
  - The RSO will explain the nature of the violation and the potential for incurring further disciplinary actions. At the discretion of the RSO either a warning or first citation can be issued. A copy of the violation will be kept on file by the RSO.
  - First Citation – The Chairman of the Radiation Safety Committee will issue a letter of reprimand with a copy to the department head.
  - Second Citation – An immediate cessation of operations under an Authorization will be required, normally in effect for two weeks. This action may be changed, pending a review by the Radiation Safety Committee. A letter of reprimand will be issued by the Chairman of the Committee and will be copied to the Department Head and the Dean.
  - Third Citation – An immediate cessation of operations under an Authorization will be required, pending review of the incident by the Radiation Safety Committee. A suspension letter will be sent by the Chairman of the Committee and will be copied to the Department Head and the Dean. After a period of no more than one year, the Committee will review reinstatement of the Authorization.

- **Class II** – Major violations that could result in excessive radiation exposures to personnel or willful and repeated negligence will invoke an immediate cessation of operations and a review by the Radiation Safety Committee. A suspension letter will be sent by the Chairman of the Committee and will be copied to the Department Head. After a period of no more than one year, the Committee will review reinstatement of the Authorization.

Any cited individual has the right to appear before the subcommittee to assist in the determination of the class of citation and to appeal any action of the Radiation Safety Committee.

M. Receipt of Radioactive Devices or Material
- The RSO should receive all radioactive devices for review and documentation.
- Prior approval from the RSO is necessary for any radioactive material to be received at Fort Lewis College.

N. Records
The RSO will maintain the following information:
- Current list of approved Users
- Personnel Exposure
- Radioactive device inventory
  - Receipt
  - Assignment
  - Status
• Final Disposition
  o Instrument Calibration Documentation
  o A record of contamination and/or radiation surveillance

O. Posting
Rooms, areas, and equipment where radioactive materials are used or stored must be clearly marked with appropriately worded and designated standard radiation signs. The immediate work area will be posted where the radioactive device is in use.

P. Laboratory Inspections
The RSO will conduct both announced and unannounced inspections of each active laboratory. Labs using sealed sources will be inspected at least annually.
Inspections will include:
  o Review of facility conditions
  o Contamination surveys
  o Records review
  o Follow-up inspections on identified concerns
# Appendix 1: Emergency Contacts

<table>
<thead>
<tr>
<th>Name</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phil Shuler – Public Health Department Chair</td>
<td>970.247.7192</td>
</tr>
<tr>
<td>David Blake – Biology Department Chair</td>
<td>970.247.7458</td>
</tr>
<tr>
<td>Gary Gianniny - Geology Department Chair</td>
<td>970.247.7378</td>
</tr>
<tr>
<td>David Gonzales - Professor</td>
<td>970.247.7462</td>
</tr>
<tr>
<td>Ryan Haaland - Physics Department Chair</td>
<td>970.247.7514</td>
</tr>
<tr>
<td>Gerald Crawford - Professor</td>
<td>970.247.7489</td>
</tr>
<tr>
<td>Terry Richardson – RSO</td>
<td>970.247.7272</td>
</tr>
<tr>
<td></td>
<td>970.403.2605</td>
</tr>
<tr>
<td>FLC Police Department</td>
<td>970.247.7491</td>
</tr>
<tr>
<td></td>
<td>970.749.6581</td>
</tr>
</tbody>
</table>
Appendix 2: Radiation References

1. Colorado Department of Public Health & Environment:
   http://www.colorado.gov/cs/Satellite/CDPHE-Main/CBON/1251583470000

2. State of Colorado X-Ray Certification Staff Contact Information:

   Brian Vamvakias, Supervisor  (303) 692-3427
   Susan Lebron, Inspector  (303) 692-3433
   Tracey Luty, Inspector  (303) 692-3446
   Christine Irving, Inspector  (303) 692-3448
   Erin Wood, Administrative  (303) 692-3443
   X-ray Certification Fax #  (303) 759-5355

3. State of Colorado Radiation Management Unit Staff Contact Information:

   Jennifer Opila, Unit Leader  (303) 692-3403
   Linda Bartish, Program Assistant  (303) 692-3420
   Mark Dater, Licensing and Inspection  (303) 692-3457
   Chas Etherton, Licensing and Inspection  (303) 692-3382
   James Grice, Licensing Lead  (303) 692-3371
   Cheri Hall, Licensing and Inspection  (303) 692-3444
   Phillip Peterson, Licensing and Inspection  (303) 692-3402
   Carrie Romanchek, Licensing and Inspection  (303) 692-3431
   Ed Stroud, Inspection Lead  (303) 692-3418
Appendix 3: Colorado’s Facility Registrant’s Responsibilities

This guide is distributed to facility registrants to assist them in complying with the Colorado Rules and Regulations Pertaining to Radiation Control (Regulations). This guide does not list all of the facility registrant’s responsibilities as specified in the Regulations. If you have any questions regarding this document, please contact the X-Ray Certification Unit at (303) 692-3448 or by FAX at (303) 759-5355, Attention: Radiation-XRC.

1. **Regulation Requirements.** The registrant shall ensure that the requirements of the regulations are being complied with for the operation of a radiation machine facility. (Part 2, 2.4.1.1)

2. **Registration of a Radiation Machine Facility.** The person possessing or using a radiation machine must be registered with the Department prior to operation of the radiation machine facility. (part 2, 2.4.1)

3. **Designated Radiation Safety Officer (RSO).** The registrant must designate on the application form an individual who is responsible for radiation protection at the facility. (Part 2, 2.4.1.1(3)(a))

4. **Changes in Registration.** The registrant must maintain a current registration with the Department. Notification of significant changes must be made to the department within thirty (30) days of the change. These changes include but are not limited to: placing a radiation machine in disabled/inactive (still in possession); removing a machine from your possession by sale, transfer or final disposal; relocation of a radiation machine facility; or installation of additional radiation machines. (Part 2, 2.4.6.4)

5. **Machine and Facility Evaluation.** The registrant must have their radiation machine(s) and facility evaluated by a Department-approved qualified inspector or registered medical physicist (RMP) in accordance with the frequency established in the Regulations. (Part 2, 2.5.1)

6. **New Installation Evaluation.** The registrant must have all new installations of machines, or replacement of components which could affect the radiation output of a machine, evaluated by a qualified inspector or registered medical physicist (RMP) within three (3) months of the installation. (Part 2, 2.5.1.5)

7. **Unsafe for Use.** The registrant cannot use any machine determined to be unsafe for use until the machine has been repaired and a subsequent certification evaluation is completed by a qualified inspector or registered medical physicist (RMP) which certifies the machine safe for use. (Part 2, 2.5.2.3)

8. **Compliance Time Limit.** The registrant must correct any violations noted in an R-59-1 machine certification evaluation or an R-59-2 Facility certification evaluation within thirty (30) days of the date of inspection. (Part 2, 2.6.3.1 and 2.6.4.1)

9. **Compliance Documentation.** The registrant will submit documentation to the Department showing the items(s) of violation noted in a certification evaluation have been corrected. A completed form R-59-1, Certification report, along with a copy of the service repair order and endorsement by the service person, in most cases, will be sufficient to document compliance. (Part 2, 2.6.3.1 and 2.6.4.1)
10. **Required Records.** The registrant must maintain records required by the Regulations. For example: shielding evaluations; certification evaluations and service reports for x-ray equipment; personnel monitoring; an operator’s manuals. (Part 2, 2.6.5)

11. **Machine servicing or services.** The registrant must use a radiation machine servicing or services company that provides evidence they are currently registered with the Department as a provider or services in accordance with the regulations. (Part 2, 2.4.2.1 and 2.6.3.3)

12. **Radiation Protection standards.** The registrant will meet the standards for protection against radiation specified in Part 4 of the Regulations. (Part 4, 4.5)

13. **Posting of Notices.** The registrant will post notices and provided instructions to workers in accordance with Part 10, 10.1.3 of the Regulations.

14. **Operator Training.** The registrant must ensure that each operator of a radiation machine is adequately trained in the proper use of the machine. (Part 2, 2.6.1.4 – 2.6.1.15)
Appendix 4: Training Requirements

Radiation Safety Orientation Topics for Discussion:

1. Introduction to Radiological, Chemical Hazards and Emergency Response
2. Understanding ionizing radiation
3. State of Colorado, Department of Public Health and Environment’s Radiation Safety Standards
4. Assumption of Risk
5. External Hazard Analysis
6. Units of Measure (Roentgen, rad, rem Gray, Sievert)
7. Explanation of Radiological Terms (physical, biological, half-life decay, radiation emission, types, range and penetrating capabilities, effective shielding)
8. Activity Definition/Units (Curie vs. Becquerel)
9. Inverse Square Law
10. Maximum Permissible Exposure in an Occupational Setting (whole body, extremities, organs, body burden)
11. Pregnancy Guidelines (limits, declaration, sensitivity to fetus)
12. ALARA
13. Posting and Signage (State of Colorado poster, NRC posters, Lab Rules, Security and Transport)
14. Personal Monitoring (film badges, finger ring badge)
15. Laboratory Inspections and Reporting
16. Proper use of X-Ray Diffraction Meter and Operations Demonstration
17. Manufacturer’s Information and Review
18. Reporting of Mechanical Problems with Meter
19. Written Examination (85% correct to pass).
20. Certificate of Completion
Appendix 5: Training Documentation

Print Name: ____________________________ FLC ID#: ____________________

FLC Address: ____________________________ Campus Phone: ________________

E-mail Address: _________________________ Gender: [ ] Male [ ] Female

Check One: [ ] Faculty [ ] Staff [ ] Student [ ] Graduate Student

A. Have you ever received **formal training** in the following topics: radiation safety courses at other colleges, universities or private businesses? (Courses in physics, chemistry or biology covering radiation topics would be considered formal training.)

- Principles and practices of Radiation Protection [ ] Yes [ ] No
- Radioactivity measurement, monitoring techniques and instrumentation [ ] Yes [ ] No
- Mathematics and calculations basic to the use and measurement of radioactivity [ ] Yes [ ] No
- Biological effects of radiation [ ] Yes [ ] No

If you circled **Yes** for any of the above items, please complete the table below:

<table>
<thead>
<tr>
<th>Name of the course</th>
<th>Date and location where training was received</th>
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B. If you ever operated x-ray producing equipment before and thereby received **on the job training** in the above topics, complete the table below:

<table>
<thead>
<tr>
<th>Equipment Used</th>
<th>Maximum kVp Used</th>
<th>Location of Equipment Used</th>
<th>Length of Time Equipment Used</th>
<th>Procedures Performed</th>
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I authorize Fort Lewis College to request and received all past radiation exposure history records from prior employers, including other colleges, universities, businesses or military installations.

Signature: ______________________________________________________ Date: _______________
Appendix 6: Film Badge Request

Name: _____________________________________________         Male _____ Female _____
FLC ID#: ___________________________________________          Birth Date: ________________
Department: ________________________________   Supervisor: ___________________   

Dosimetry
1. _____ Assign the following: _____ Film Badge     _____ Ring Badge     _____ Fetal Badge 
2. _____ Delete existing Film Badge # ____________ 
3. _____ Reactivate Film Badge # ________________ 

Authorized by: _____________________________________________ Date: ________________
Approved by: _____________________________________________ Date: ________________
Appendix 7: Ordering Film Badges

Film badges, both whole body and ring finger badges, can be ordered through:

Sierra Dosimetry Services, Inc.
7301 N, FM 620
STE 155-347
Austin, TX 78726

Website:  http://www.sierradosimetry.com/pricelist.aspx

E-mail:  info@sierradosimetry.com

Client Services:  866.897.8707 or 512.212.7183

Call Customer Service for pricing, or order on-line.
Appendix 8: Radiation Safety Training Program