

SOP Number :	200.03
Title :	General X-Ray Safety

Revision Chronology			
Version Number	Effective Date	Review Date	Reason for Change
200.01	August 3, 2021	January 21, 2022	Initial Version
200.02	January 24, 2022	June 7, 2022	Facility Name Change
200.03	June 7, 2022	January 10, 2023	Updates to policies

 Director Signature

 Date

1. Scope

This SOP describes general x-ray safety procedures to minimize radiation dose to both research subjects and individuals working within the CenTRI facility.

2. Procedures

a. Introduction

X-rays are short-wavelength electromagnetic radiation that can undergo various interactions with matter. All equipment within the CenTRI is used in a clinical setting and produces x-rays to create images of humans, animals, and phantoms. X-rays have the potential for damaging healthy cells and tissues; therefore, all procedures within the CenTRI must be carefully managed. Although radiation doses with digital radiography are usually small, computed tomography and angiography can be significantly higher. Through a well-designed, installed and maintained facility, and through use of proper procedures by trained operators, unnecessary radiation exposure can be reduced significantly with no decrease in the value of information derived.

The need for radiation protection exists because exposure to ionizing radiation can result in deleterious effects in the exposed individuals with the possibility to manifest in their descendants. These effects are called somatic and genetic effects, respectively. Somatic effects are characterized by observable changes occurring in the body organs of the exposed individual. These changes may appear within a period of a few hours to many years, depending on the amount and duration of exposure to the individual. Genetic effects are an equal cause for concern at the lower doses used in the CenTRI. Although the radiation dose may be small and appear to cause no observable damage, the probability of chromosomal damage in the germ cells, with the consequence of mutations giving rise to genetic defects, can make such doses significant.

Since it is not possible to measure carcinogenic effects at low doses, estimates of the incidences of radiation effects at low doses are based on linear extrapolation from relatively high doses. Due to the uncertainties with respect to radiological risk, a radiation protection risk model assumes that the health risk from radiation exposure is proportional to dose. This is called the linear no-threshold hypothesis. The linear no-threshold hypothesis has been widely adopted in radiological protection and has led to the formulation of the ALARA (As Low As Reasonably Achievable) principle. The ALARA principle is an approach to radiation protection to manage and control exposures to radiation workers and the general public to as low as is reasonable.

b. Federal, Provincial, and Western University X-ray Safety Guidelines

- [Safety Code 35](#) (SC35) was created by Health Canada to set out safety requirements for the safe use of radiation-emitting equipment. This document is composed of three sections that sets: responsibilities of the owner/operators, requirements for the facility design, and requirements for quality assurance programs.
- During an X-ray exposure, a sign directly over the entrance to suite will be illuminated red with "X-RAY IN USE". Card access to the radiographic suites on the 1st floor (CT, XA, & DT) will be disabled when this sign is illuminated.



Figure 1: An example of the signs located outside the main entrance to each of the radiographic suites.

- [Healing Arts Radiation Protection Act](#) (HARP) governs the use of X-rays for the irradiation of human beings in the province of Ontario.
 - No person shall operate an X-ray machine for the irradiation of a human being unless the person meets the qualifications and requirements prescribed by the regulations.
 - No person shall operate an X-ray machine for the irradiation of a human being unless the irradiation has been prescribed by a legally qualified medical practitioner.
 - In the CenTRI, the operator for human studies must be a member of the College of Medical Radiation and Imaging Technologists of Ontario (CMRITO) or a legally qualified medical practitioner.
- The CMRITO regulates and represents medical radiation and imaging technologists who have been extensively trained to create diagnostic images of patient's bodies or administer radiation therapy, in five specialties: radiography, nuclear medicine, radiation therapy, magnetic resonance and diagnostic medical sonography.

- Western University is currently registered with the [Ontario Ministry of Labour](#) to use and store x-ray equipment, and is compliant with [Occupational Health and Safety Act and X-ray Safety Regulation](#).
- All Level 1 CenTRI Personnel must meet the following requirements:
 1. Be 18 years of age.
 2. Complete the Western University [X-ray Safety Training Program: X-ray Safety Training Course](#) and specific training on X-ray equipment by the CenTRI facility manager.
 3. Wear the mandatory TLD dosimeters (see Section E).
 4. Be familiar with the [Western University X-ray Safety Manual](#).
- All Level 2 (Operators) CenTRI Personnel must meet the following requirements:
 1. Be 18 years of age.
 2. Complete the Western University [X-ray Safety Training Program: X-ray Safety Training Course](#) and specific hands-on training on X-ray equipment by the CenTRI facility manager.
 3. Be designated as [X-ray Worker](#).
 4. Have or work under an Internal Permit.
 5. Wear the mandatory dosimeters ([TLD badges](#)).
 6. Be familiar with the [Western University X-ray Safety Manual](#).
 7. Pregnant X-ray worker must inform her Permit Holder and the Radiation Safety Coordinators soon as she is aware of her condition.

c. CenTRI Regulations

- Operators for any human studies must be a member of the College of Medical Radiation and Imaging Technologists of Ontario (CMRITO) or a legally qualified medical practitioner.
- All occupational radiation doses shall be limited by the ALARA (As Low As Reasonably Achievable) principle and to within dose equivalent annual limit of Schedule [1] in X-ray Safety Regulation 861.
- Everyone should be within the control room during a radiographic examination with exception to the angiographic suite and specific CT procedures.

d. Safety issues due to hardware

- There are dangerous and potentially lethal levels of electricity in the X-ray equipment within the CenTRI. It is imperative that all individuals working around the system are aware of the dangers and knowledgeable of electrical safety issues. There is a risk of electric shock for high-voltage generators that may damage the X-ray system, or possibly cause serious injury or death. Only trained personnel should handle hardware and cables within the CenTRI.
- If a person or an operator is electrocuted within the CenTRI facility and has no pulse, unable to respond, or not breathing, one of the CenTRI personnel present must follow the procedure outlined in *SOP # 205 Emergency Code Blue Procedure*.
- In case of a fire, the operator, or if the operator is incapacitated, one of the experimental support personnel must follow the procedure outlined in *SOP # 210 Emergency Fire Procedure*. The operator (or experimental support personnel) must keep their own safety in mind, as a priority, while removing the patient from the radiographic examination area. If at this time the patient is not responding, not breathing, and has no pulse, the operator (or experimental support personnel) must follow the procedure outlined in *SOP # 205 Emergency Code Blue Procedure*. After all parties are safe, it is appropriate to seek to minimize damage to the system.
- If the fire cannot be contained by the operator or experimental support personnel using the fire extinguisher, the operator must dial 911 and follow the procedures outlined in *SOP # 210 Emergency Fire Procedure*.

e. Dosimeter Logbook

- To track any inadvertent radiation exposure, all Level 1 personnel must wear a visitor TLD badge.
- Record your name, date, time, and badge number in the online logbook located at <https://forms.office.com/r/JfXR220QEg> or by scanning the labelled QR code at the operators' console.

f. Safety Zones

Zone I

- Consists of all areas freely accessible to the general public. This zone includes the entrance to the Translational Imaging Research Facility (TIRF), and patient waiting room where there is no risk of being exposed to ionizing radiation. It also includes all other areas of Robarts Research Institute excluding the X-ray and MRI facilities.

Zone II

- Interface between Zone I and the more restrictive Zones III and IV.

Zone III

- Zone III is the radiographic imaging area within each of the suites. This area within the imaging suites is where the patient, animal, or phantom is irradiated to obtain an image.
- Level 1 and 2 personnel have access to Zone III, but should not be in this zone during an X-ray exposure.
- Access to Zone III is controlled by security keycard access. Only Level 1 and 2 CenTRI personnel may have security access to Zone III as outlined in *SOP # 105 Facility Access Approval Procedure*. All others may enter under the supervision and permission of level 1 or 2 CenTRI personnel.

Zone IV

- Zone IV is the operator's console within each of the radiographic suites, located behind lead-lined glass.
- The chance of any interactions with ionizing radiation is the lowest while behind the lead-lined windows of the operator's consoles within the suites.



Figure 2: Dosimeter Badge and Contact Tracing QR Code

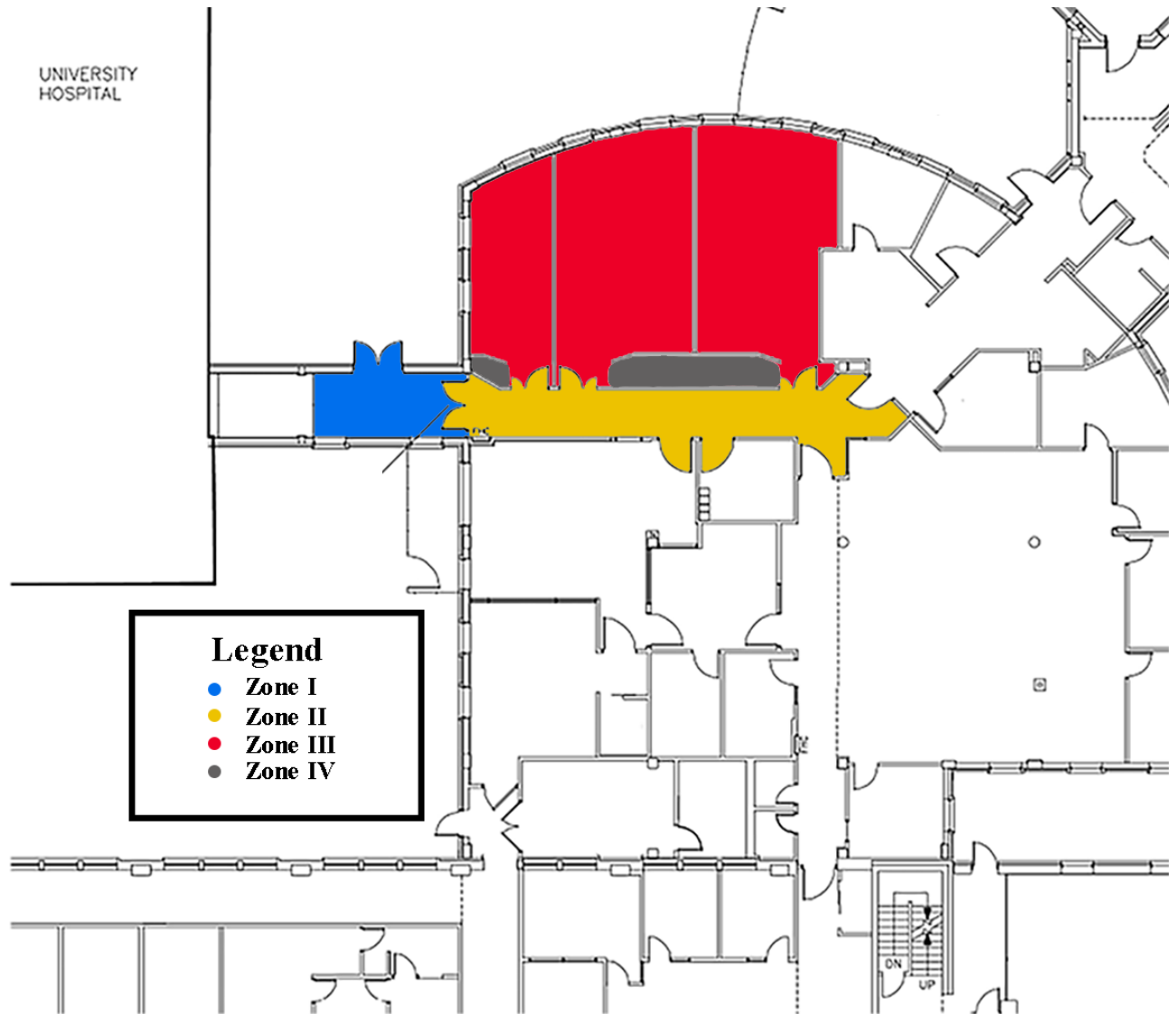


Figure 3: 1st Floor

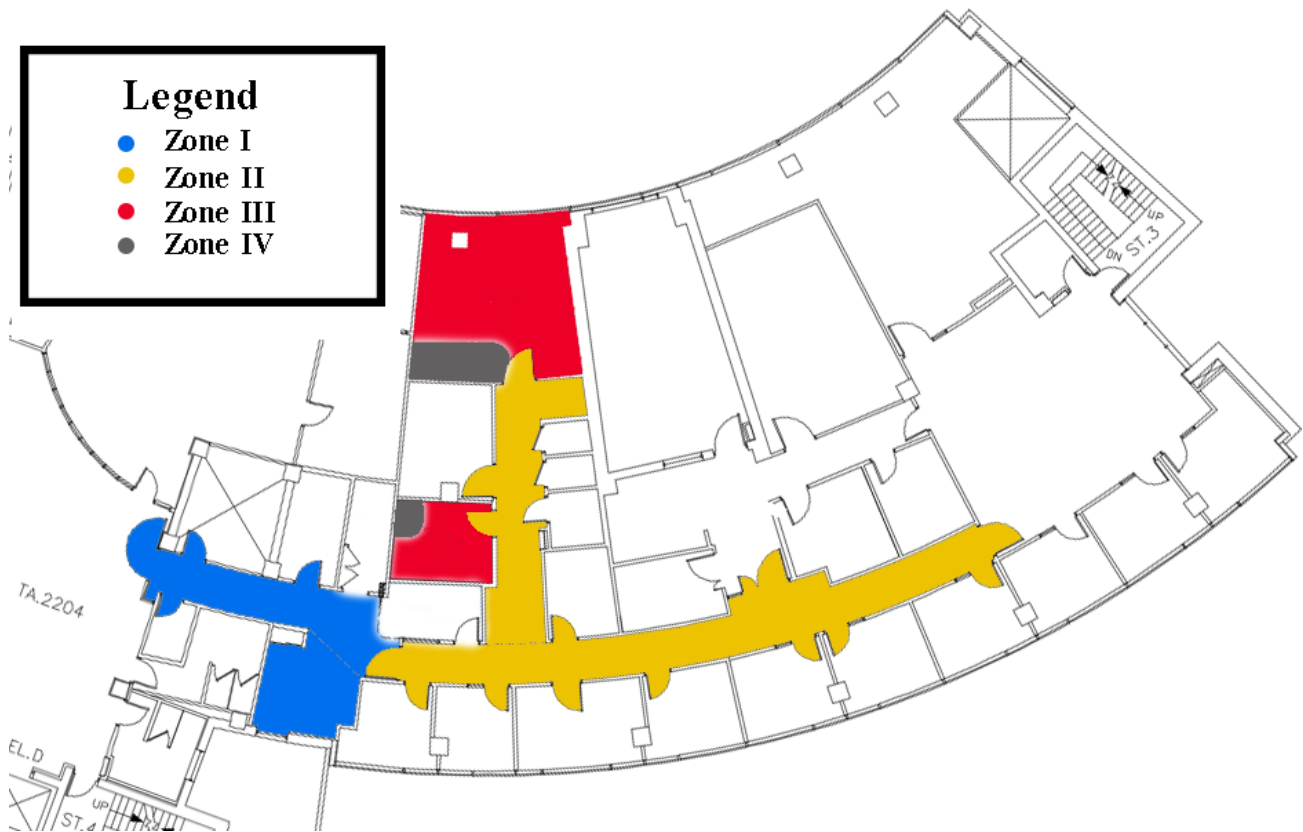


Figure 4: 2nd Floor