

**Section 7 Radiation Safety Plan**

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## **7.0 Purpose**

The goal of the LAPD-FSD Criminalistics Laboratory Radiation Safety Plan is to ensure a safe environment for the personnel that use, or may become exposed to, x-radiation from equipment located in the Criminalistics Laboratory.

Exposure to high levels of x-radiation may cause serious adverse health effects. However, acknowledging the potential dangers and adopting safe practices may eliminate this risk.

The LAPD-FSD Criminalistics Laboratory Radiation Safety and Protection Plan, hereinafter referred to as the “radiation safety plan,” is designed to comply with:

- California Code of Regulations (CCR), Title 17, Division 1, Chapter 5, Subchapter 4: (herein abbreviated “CCR Title 17”)
- United States Nuclear Regulatory Commission (US NRC) Regulations, Title 10, Part 20: (herein abbreviated “NRC Title 10, Part 20”)

See the References section for the locations of these regulatory codes.

## **7.1 Scope**

The radiation safety plan aims to limit exposure to potentially dangerous x-radiation by outlining a training program, dosimetry monitoring, and emergency procedures. This plan applies to all personnel who may use x-radiation generating instruments, as well as persons who may visit the areas containing these instruments.

The radiation safety plan only covers instruments that generate x-radiation, not UV radiation. The radiation safety plan also does not cover handling of hazardous chemicals or samples that are to be analyzed using x-radiation generating instruments. For correct handling techniques, please refer to the Chemical Hygiene Plan of the Laboratory Safety Manual.

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### 7.2 Definitions

- ALARA (acronym for “As Low As Reasonably Achievable”) – a safety protocol that makes every reasonable effort to keep radiation exposures as far below the dose limits as is practical
- dosimetry – measurement of the absorbed dose of radiation exposure by personnel
- ionizing radiation – radiation that carries enough energy to release an electron from an atom or molecule, sources include gamma rays, x-rays, alpha and beta particles, other nuclear particles
- “mrem” –abbreviation for millirems. Rem is a unit of a radiation dose. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor. The quality factor for x-radiation is one; therefore, one rem is equal to one rad.
- occupational dose limit - annual occupational dose limits for adults is 5rems or 5000mrems (NRC Title 10, Part 20)
- rad – a unit of absorbed dose. One rad is equal to an absorbed dose of 100 erg/gram or 0.01 joule/kilogram.
- radiation generating instrument – any analytical device that utilizes x-radiation.
- x-radiation – energy ranging in wavelength from 0.01 nanometer to 10 nanometers. X-rays lie between UV rays and gamma rays in the electromagnetic spectrum.

### 7.3 Emergency Procedures

#### **FOR RADIOLOGICAL EMERGENCY ASSISTANCE (24/7) telephone 1-800-852-7550**

Immediately report any radiation emergencies to the TAU supervisor or, if not available, to one of the criminalists listed on the General Operating Procedures sign posted near the radiation generating instrument. The supervisor must report to the Department of Public Health Radiological Health Branch (DPH/RHB) within 24 hours. Emergency events include:

- uncontrolled contamination requiring restricted access to the area

- disabled equipment that cannot be rendered safe using manufacturer's safety locks or any other equipment
- radiation exposure requiring medical attention
- a fire, explosion, or earthquake damaging the equipment

## **7.4 Organization and Administration Responsibilities**

### **7.4.1 Supervising Criminalist**

Supervising criminalists of units that have radiation generating instruments are tasked with the following:

- initial training of instrument operators
- registration, re-registration, or disposal of the instruments
- review of the bimonthly (every other month) dosimetry monitoring reports
- annual training and review of the radiation safety plan
- reporting emergency exposures or radiation accidents and subsequent follow up with medical liaison (213-486-4600) or DPH/RHB and the Safety Officer
- record keeping (for example, radiation dosimetry reports)

### **7.4.2 Laboratory Safety Officer**

The Quality Manager is responsible for the laboratory safety program. The Quality Manager designates the Laboratory Safety Officer to administer the laboratory's safety program through the Laboratory Safety Committee.

### **7.4.3 Laboratory Personnel**

All laboratory personnel who use radiation generating instruments are responsible for:

- reviewing the radiation safety plan
- wearing an assigned dosimetry badge when near radiation generating instruments

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- instrument maintenance and scheduling preventive maintenance
- reporting any malfunctions or suspected radiation exposure

### 7.4.4 California Department of Public Health Radiation Health Branch (DPH/RHB)

The DPH/RHB maintains the guidelines stated in CCR Title 17 and is also responsible for, but not limited to, the following:

- review of the radiation safety plan
- periodic inspection of x-radiation generating instruments, including leak tests
- review of dosimetry reports
- corrective course of action after an emergency

## 7.5 Occupational Doses of Radiation

An employee is limited to an annual exposure of 5000mrems. (NRC Title 10, Part 20 §20.1201 Occupational dose limits for adults). If an employee becomes pregnant, the total dose equivalent to an embryo/fetus cannot exceed 0.5rem or 500mrem.

Employees that become pregnant may submit a Declaration of Pregnancy (Appendix C). Declaration of pregnancy is not required.

## 7.6 ALARA Exposure Control

An ALARA program is a safety protocol aimed at minimizing radiation exposure to a level As Low As is Reasonably Achievable. The procedures outlined in this radiation safety plan satisfy an ALARA program.

### 7.6.1 Entry Controls

Access to the rooms containing the radiation generating instruments is restricted to LAPD-FSD personnel and Los Angeles Sheriff's Department personnel. Access is controlled with individually issued electronic access cards.

To protect the public from x-radiation exposure, these rooms will be excluded from public tours whenever possible. Persons not employed by the LAPD-FSD Criminalistics Laboratory may be accompanied by laboratory personnel whenever they enter or work in these rooms.

### 7.6.2 Posting of Warnings

Radiation warnings are designated by a trefoil (see Figure 1). Rooms containing radiation generating instruments have warning signs posted in plain view outside the entrance.

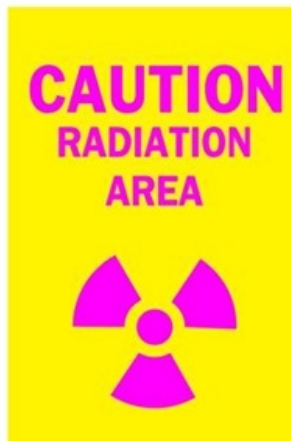


Figure 1, an example of a warning sign

### 7.6.3 Instrument User Instructions

To ensure that radiation exposure is ALARA, radiation generating instrument users should ALWAYS:

- operate instruments according to manufacturers' instructions
- wear their designated dosimetry badges
- immediately report malfunctions or suspected radiation exposure to the supervisor

In addition, users should NEVER:

- disable, tamper with, or disengage any safety locks or safety controls that are designed to prevent potentially dangerous exposure
- use an instrument that is known to be malfunctioning

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- allow untrained personnel to use radiation generating instruments

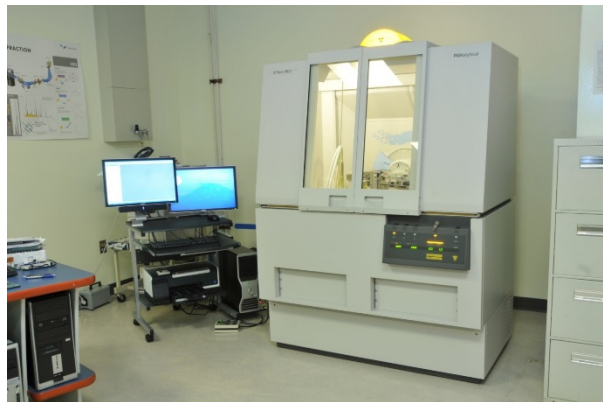
### 7.7 Engineering and Safety Controls

The LAPD-FSD Criminalistics Laboratory, room 130, is equipped with the following radiation generating instruments:

- PANalytical X'Pert Pro MPD X-Ray Diffractometer (XRD)
- TESCAN Vega XMU Scanning Electron Microscope (SEM) with Oxford Inca X-sight Energy Dispersive X-Ray Spectrometer (EDX)

The radiation generating instruments have safety controls designed to prevent unsafe radiation emission. The engineering controls for each instrument are as follows:

Figure 2, XRD



XRD: When the sample chamber is exposed to x-rays, the doors of the sample chamber will lock. Should the doors be unlocked or be forced open, the x-ray source will automatically turn off. A light mounted on the diffractometer labeled with a trefoil and states "X-rays On" will illuminate when x-rays are being produced.

Figure 3, SEM



SEM-EDX: Electrons bombard the sample in the SEM chamber and produce x-rays that are detected by the EDX. Should the SEM chamber be exposed to the ambient atmosphere, the electron source and subsequent x-ray emissions are automatically turned off.

## 7.8 Personal Dosimetry/Employee Monitoring

The LAPD-FSD Criminalistics Laboratory uses Landauer® Luxel+® brand radiation dosimetry badges to measure personal radiation exposure (Figure 4). These badges monitor acute or cumulative radiation exposure caused by the radiation generating instruments used at the laboratory. The badges are collected and sent for analysis to Landauer every other month. A control dosimetry badge is also analyzed to determine a background level. The records of these analyses (Landauer® Radiation Dosimetry Reports) are stored in the Trace Analysis Unit.

Users are responsible for their own badges. Users are encouraged to:

- clip their dosimetry badges to their shirt, lapel, or ID badge when near a radiation generating instrument
- store their dosimetry badges in a safe location (for example, in a desk drawer)
- report damaged or lost dosimetry badges
- return their dosimetry badges to the designated Trace Analysis Unit Criminalist on the final date marked on the front of the badge

Users are encouraged to NOT:

- take their dosimetry badges out of the building.



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- repeatedly expose their dosimetry badges to intense heat, sunlight, or moisture (for example repeatedly leaving their badges on a car windshield). This may cause false positives.
- loan their dosimetry badge to another user.

Users that exceed the annual exposure limit will be contacted immediately by the Supervising Criminalist and will have their access to radiation generating instruments temporarily suspended. A medical examination may be deemed necessary. An employee may be provided dosimetry reports upon request.

*Note: Radiation dosimetry badges are not considered personal protective equipment and do not shield the wearer from radiation.*

## 7.9 General Operating Procedures and Required Postings

A copy of the General Operating Procedures (Appendix A) is posted in room 130 with an up-to-date copy of the California DPH "Notice to Employees Standards for Protection Against Radiation", Radiologic Health Branch form RH-2364 (Appendix B). Any notice of violation involving radiological working conditions or any order issued pursuant to the Radiation Control Law and any required response from the LAPD-FSD Criminalistics Laboratory will be posted inside of Room 130.

## 7.10 Training

Before operating any radiation generating instrument, the user must successfully complete the Radiation Safety Training Program and receive instruction on the operation of the instrument. The safety training program is based on the requirements by the California Radiologic Health Branch and covers:

- health problems associated with exposure to x-radiation
- proper procedures to minimize radiation exposure
- purpose and function of safety equipment
- protection of personnel that are non-users of radiation generating equipment

- reporting any emergency situation or instrument condition that may cause or lead to an emergency situation
- response to and actions during radiation contamination

After passing the radiation safety training program, the user will be granted a radiation dosimetry badge and allowed access to the instrument. A refresher shall be completed annually.

## 7.11 Equipment

Newly acquired radiation generating equipment will be registered with the California DPH/RHB. The disposal of any unwanted radiation generating instrument also must be reported to DPH/RHB.

## 7.12 Records

The TAU is responsible for recordkeeping. The following documentation will be stored in the TAU:

- registration and disposal documentation
- up-to-date training records
- certificate of registration
- dosimetry reports

## 7.13 References

California Code of Regulations (CCR), Title 17, Div. 1, Chapter. 5, Subchapters 4 and 4.5. <http://www.dir.ca.gov/dlse/ccr.htm>

Code of Federal Regulations, NRC Title 10, Part 20 <http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/>

Los Angeles Police Department, Forensic Science Division, Safety Manual

Manufacturers' operating manuals for PANalytical X'Pert Pro MPD X-Ray Diffractometer (XRD) and Tescan Vega XMU Scanning Electron Microscope (SEM) with Oxford Inca X-sight Energy Dispersive X-Ray Spectrometer (EDX)

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Forensic Science Division, Trace Analysis Unit Manual

## Appendix A—General Operating Procedures Notice

### **GENERAL OPERATING PROCEDURES for RADIATION GENERATING INSTRUMENTS**

Radiation in the form of x-rays may cause severe adverse health effects. To ensure safety, users of the XRD and SEM-EDX are REQUIRED to:

1. Receive official training before using any of these instruments.
2. Possess their radiation dosimetry badges at all times when using, or in close proximity to, these instruments.
3. Follow the proper safety procedures for each instrument.
4. Exercise caution when performing maintenance on an instrument.
5. NEVER disable, tamper with, or disengage any safety locks or safety controls that are designed to prevent potentially dangerous exposure.
6. NEVER use a radiation generating instrument that is known to be malfunctioning.
7. NEVER grant untrained personnel access to radiation generating instruments.

In case of emergency, call 1-800-852-7550. If you have any questions, please contact:

Eric Wahoske  
Supervising Criminalist  
LAPD Trace Unit  
Phone: 323-415-8859

Matthew Franzman  
Criminalist  
LAPD Trace Unit  
Phone: 323-415-8856

updated May 2019

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**Appendix B—Notice to Employees**

# NOTICE TO EMPLOYEES

## STANDARDS FOR PROTECTION AGAINST RADIATION

### CALIFORNIA RADIATION CONTROL REGULATIONS (CALIFORNIA CODE OF REGULATIONS, TITLE 17, SECTION 30255)

The California Radiation Control Regulations include standards for protection against radiation hazards. The California Department of Public Health has primary responsibility for administering these standards which apply to both employers and employees. Enforcement is carried out by the California Department of Public Health or its authorized inspection agencies.

#### EMPLOYEES' RESPONSIBILITIES

You should know and understand those California radiation protection standards and your employer's operating and emergency procedures which apply to your work. You should comply with these requirements for your own safety and the safety of others. Report promptly to your employer any condition which may lead to or cause a violation of these standards or employer's operating and emergency procedures.

#### SCOPE OF THE STANDARDS

The Standards for Protection Against Radiation define:

1. Limits on exposure to radiation and radioactive materials;
2. Actions to be taken after accidental exposure;
3. Working conditions requiring personnel monitoring, safety surveys, engineered controls, and safety equipment;
4. Proper use of caution signs, labels, and safety interlock devices;
5. Requirements for keeping worker exposure records and reporting of such exposures;
6. The requirement for specific operating and emergency procedures for radiation work; and
7. The rights of workers regarding safety inspections.

#### EMPLOYERS' RESPONSIBILITIES

Your employer is required to:

1. Comply with the requirements of the California Radiation Control Regulations, departmental orders, and license conditions;
2. Post or make available to you copies of the Radiation Control Regulations, any license issued thereunder, and your operating and emergency procedures;
3. Post any notice of violation of radiological working conditions; and
4. Provide you with information on your exposure to radiation.

#### REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. California Radiation Control Regulations require your employer to give you a written report if you receive an exposure greater than the limits set in the radiation safety standards. Basic limits for occupational radiation exposure can be found in section 30253 referencing title 10, Code of Federal Regulations, part 20 (10 CFR 20). Limits on exposure to radiation and exposure to concentrations of radioactive material in air are specified in 10 CFR 20, subpart C.
2. If the radiation protection standard, under 10 CFR 20 (subpart F) requires that your radiation exposure be monitored, your employer must, upon your request, give you a written report of your exposures upon termination of your employment, and make available to you the information in your dose records (as maintained under the provisions of 10 CFR 20.2106).
3. Your employer is required to provide you with an annual report of the dose you received in that monitoring year if the dose exceeds 100 millirem, or if you request an annual report.

#### INSPECTIONS

The Department or one of its contractors will inspect your workplace from time to time to ensure that health and safety requirements are being followed and that these requirements are effective in protecting you. Inspectors may confer privately with you at the time of inspection. At that time you may direct the inspector's attention to any condition you believe is or was a violation of the safety requirements.

In addition, if you believe at any time that any health and safety requirements are being violated, you or your workers' representative may request that an inspection be made by sending a complaint to the Department of Public Health or other official agency. Your complaint must describe the specific circumstances of the apparent violation and must be signed by you or your workers' representative. The Department is required to give your employer a copy of any such complaint. Names may be withheld at your request. You should understand, however, that the law protects you from being discharged or discriminated against in any way for filing a complaint or otherwise exercising your rights under the California Radiation Control Regulations.

#### POSTING REQUIREMENTS

Copies of this notice must be posted in a sufficient number of places in every establishment where employees are employed in activities regulated by the California Radiation Control Regulations, to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

FOR RADIOLOGICAL EMERGENCY ASSISTANCE (24/7), PHONE 1-800-852-7550  
To contact the Radiologic Health Branch, phone (916) 327-5106 or go to: <http://www.cdph.ca.gov/rhb>

RH 2384 (04/17)

## Appendix C—Declaration of Pregnancy Form

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**DECLARATION OF PREGNANCY**

In Accordance with Section 206 of 10 CFR 835, I am voluntarily declaring that I am pregnant for the purposes of lowering the radiation dose received by my embryo/fetus. I realize that work restrictions may be imposed to ensure that the embryo/fetus does not receive a dose in excess of 500mrem or 0.005 Sv during the entire gestation period, given in 10 CFR 835. I also realize that supplemental dosimetry may be supplied to me, along with periodic reports of the dose received by my embryo/fetus.

Estimated date of conception (month and year): \_\_\_\_\_

Name of worker (Print): \_\_\_\_\_

Name of worker (Signature): \_\_\_\_\_

Date: \_\_\_\_\_

Name of Supervisor (Print): \_\_\_\_\_

Name of Supervisor (Signature): \_\_\_\_\_

Date: \_\_\_\_\_

Submission of this form will in no way affect the benefits, seniority, or potential for promotion of the person signing this form. This declaration may be withdrawn at any time by written notification to the supervisor.

\_\_\_\_\_