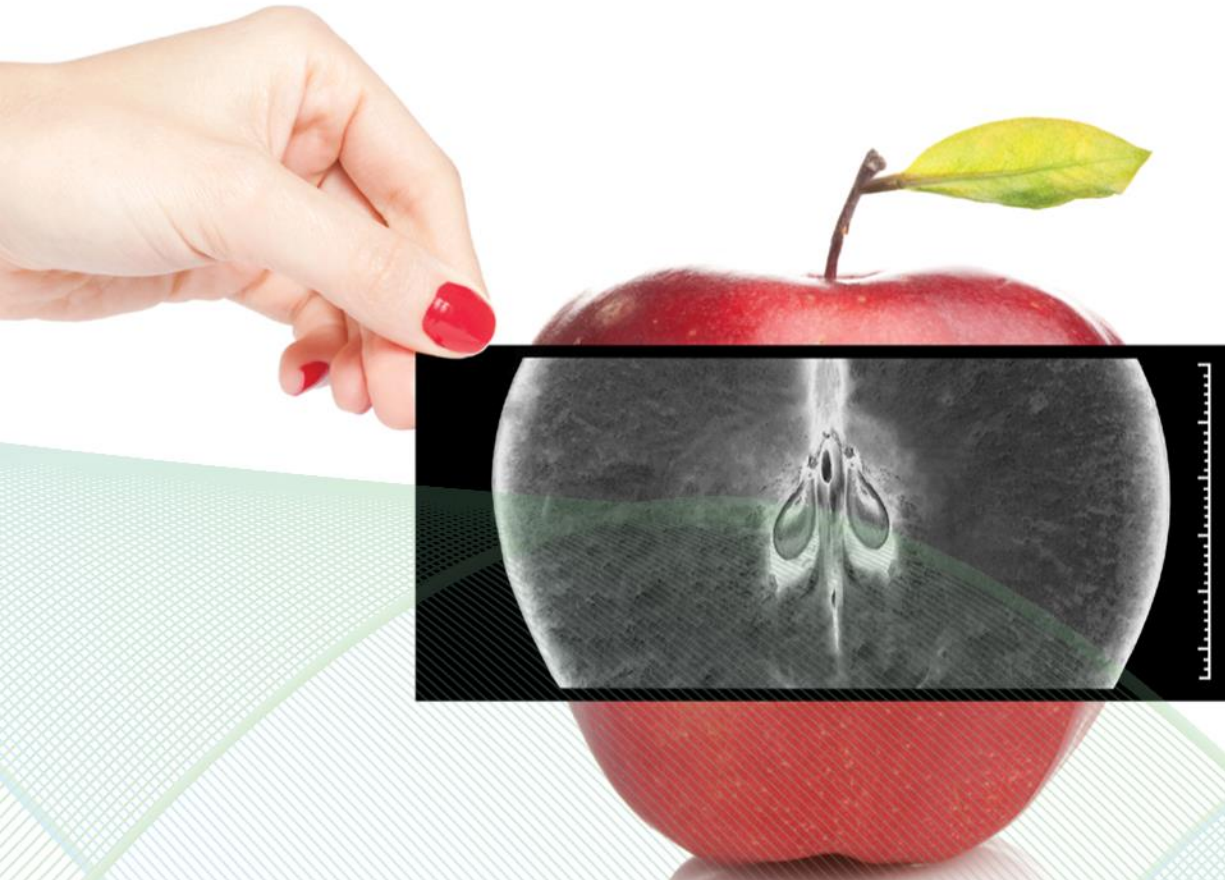


X-ray Safety in the Workplace

for BC Manufacturers & Food Processors



Acknowledgements

This guide was developed as part of a collaborative effort between Radiation Safety Institute of Canada and the Manufacturing Safety Alliance of BC, and with the support of WorkSafeBC, to bring increased attention and awareness of the risks associated with X-ray equipment in the manufacturing sector.

Disclaimer

This template is intended to support the development of a site-specific X-ray radiation exposure safety program. This template is not intended as a statement of the standards required in any specific situation, nor is it intended that this material should in any way advise anyone concerning legal authority to perform any activities or procedures.

In the Province of British Columbia industrial X-ray equipment in manufacturing and food processing are governed by Division 3, section 7 of the Occupational Health and Safety Regulation ("Regulation"). These regulations specify that employers have certain obligations to ensure the health and safety of themselves, their workers, and the public.

Nothing in this document is intended to supersede WorkSafeBC regulations or absolves the client from using sound judgment in the appropriate application of this template. No reference to other OHS issues should be implied. The user is responsible to use the documents and any other relevant information to ensure hazards are eliminated or controlled in accordance with BC OHS regulations and utilizing the hierarchy of control for hazards.

Prepared by the Manufacturing Safety Alliance of BC.

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Introduction

[Company name] is committed to providing a safe working environment for all its employees. The company recognizes that it has a responsibility to establish and uphold standards for the maintenance of its facilities and equipment. It accepts responsibility for providing protection, training, and other resources to promote employee safety on the job.

In support of these objectives, employees are expected to follow established work procedures and are encouraged to actively participate in making their own work environment safe and productive.

The management is committed to ensuring that ionizing radiation doses to all staff and the public during routine use of the X-ray equipment, and in the event of an emergency, remain **As Low As Reasonably Achievable (ALARA)** and that a high standard of X-ray safety is maintained at all times in the work environment.

This safety program for X-ray radiation has been established by [Company name] in order to ensure compliance with the relevant legislation (Health Canada's Radiation Emitting Devices Act and Regulations, and WorkSafeBC's Occupational Health and Safety Regulation respecting X-ray Safety (Sec. 7)), and the radiological safety of both its personnel and members of the general public.

Any concerns or issues regarding radiation safety should immediately be directed to the X-ray Safety Officer.

Equipment Identification and Installation Acceptance

This document for [Company name] covers the possession, use, storage, and transfer of the X-ray source [Make, Model and Serial #]. A package including forms, a floor plan drawing (see Appendix H), a technical manual, a copy of the CNSC letter of registration acknowledgement and installation acceptance, along with the initial submission documents and a copy of this X-ray Safety Program, is kept in the office of the X-ray Safety Officer, at [Location].

Roles and Responsibilities

[Company name] realizes that an effective X-ray Safety Program must have the support, commitment, and participation of management and workers. Accordingly, management at all levels will strive to provide a positive safety culture in the workplace. To this end, management will provide any essential human, physical and financial resources needed to support the X-ray Safety Program.

Employer

In the Province of British Columbia industrial X-ray equipment in manufacturing and food processing, as well as industrial lasers are governed by Division 3, section 7 of the Occupational Health and Safety Regulation (“Regulation”). These documents specify that employers have certain obligations to ensure the health and safety of themselves, their workers, and the public.

The obligations include:

- Keeping equipment specification, maintenance and calibration information and all training, inspection, survey, and exposure records
- Developing an X-ray Safety Program and policies, including an Exposure Control Plan where required
- Ensuring the safe installation and operation of equipment
- Complying with specific exposure control standards, and “As Low as Reasonably Achievable” principles
- Conducting preventative maintenance and dosimetry monitoring as required.

[Company name] management is responsible for designating the X-ray Safety Officer and advising, where relevant, the appropriate regulator in writing of the name of the person designated.

General Safety and Responsibility

- Assure that all X-rays and X-ray systems have been labeled by the manufacturer to indicate the appropriate hazard classification
- Ensure that the product is properly classified and that the correct classification label is affixed (if this classification or label is not available or the system has been modified)
- Ensure that a hazard evaluation of the X-ray control area has been performed prior to X-ray operation
- Immediately inform the user of imminent danger from an X-ray hazard
- Ensure that control measures are in effect; and periodically evaluate the effectiveness of the selected controls
- Establish and enforce standard operating procedures
- Ensure that protective equipment is available, in good working order and is used correctly
- Ensure that the wording on area signs and equipment labels are accurate and appropriate
- Conduct hazard evaluations of modifications to existing facilities or X-ray equipment

- Ensure that maintenance and service is carried out by qualified personnel
- Ensure that appropriate safety education and training is provided to all personnel associated with X-rays
- Provide safety instructions, which shall be incorporated into the standard operating procedure for the X-ray (if manufacturer's labeling safety information does not exist and cannot be obtained from the manufacturer or the distributor of the X-ray system)
- Maintain necessary records

X-ray Safety Officer (XSO)

The XSO is the person responsible for the management, coordination, effectiveness, and control of an employer's X-ray Safety Program.

The XSO provides the expertise to prepare and implement all aspects of the X-ray safety program. The XSO may also contract parts of the X-ray safety program to qualified persons, such as for training or the writing of policies. However, the XSO remains the person ultimately responsible for the effectiveness and management of the X-ray safety program.

Duties of the XSO include responsibility for the following:

- Monitor, advise and consult regarding issues related to the use of an X-ray source or machine in accordance with all regulations and guidelines. Communicate with all workers and management
- Review requests for authorization to purchase or use an X-ray source/machine in order to ensure that the X-ray source/machine, the proposed use, and the location of installation are acceptable and comply with all the regulations, guidelines and company safety policies
- Assess the qualifications and competence of workers who will use the X-ray source/machine to determine whether they can do so safely and in compliance with regulations and guidelines
 - Ensure that workers who are required to operate an X-ray source/machine are adequately trained in X-ray safety and radiation protection procedures
 - Authorize qualified workers to operate an X-ray source/machine
 - Ensure that workers in proximity to an X-ray source/machine receive appropriate training in radiation safety
- Develop and implement programs to inspect and review registration and the installation acceptance of an X-ray source/machine
- Develop and implement programs to inspect and review the adequacy of worker training, safety procedures and/or the work environment
- Implement remedial actions to correct any deficiencies identified
- Initiate any revisions to procedures, changes to equipment/facilities registration/installation acceptance amendments required to ensure, on an ongoing basis, that the employer's operations, equipment, and facilities comply with WorkSafeBC's regulatory requirements

- Investigate all reports of overexposures to ionizing radiation and of accidents and losses involving an X-ray source/machine, determine pertinent facts or confirm events, and recommend appropriate actions to mitigate the consequences or to prevent recurrences. Ensure that the incidents and the results of related investigations are reported to WorkSafeBC
- Ensure that the X-ray equipment complies with Health Canada Safety Codes by occasionally measuring (or hiring a consultant to measure) the air kerma rate at 5 cm from any external surface by an appropriate annually calibrated survey meter. Note that such measurements are required if the equipment is moved or damaged
- Coordinate or participate in emergency responses to accidents and incidents involving the X-ray source/machine
- Ensure that all records and reports that are required by the Regulation respecting X-ray Safety Section 7 are prepared, maintained, and submitted as required

Designation of the XSO

The XSO for [Company name] is [full name of XSO] and reports to the [Name and Title of the XSO reporting manager].

The XSO should be trained through a course designed to meet the expectations of a qualified person with regards to XSO training.

[Company name] will maintain an up-to-date contact listing for staff, including a contact number for the XSO.

Authorized Operators

Authorized operators are those employees who are required to perform work using the X-ray source/machine. These workers will have the following duties over and above their regular duties:

- Use an X-ray source/machine in a safe manner
- Ensure access to the X-ray source/machine is restricted when not in use
- Perform maintenance as per manufacturer's instructions
- Undergo all required safety training

Joint Health and Safety Committee (JHSC)

Roles and Responsibilities of the JHSC include:

- Receive appropriate X-ray safety training
- Conduct monthly inspections of all X-ray source equipment
- Investigate all complaints regarding the exposure control program, equipment malfunctions that may have resulted in increased radiation levels or overexposure or safety procedure non-compliance
- Incident investigations and reporting regarding exposure to X-ray radiation and safety and security policy breaches
- Oversight of all X-ray level surveys of equipment or facilities and exposure monitoring of personnel
- Receive exposure, survey, and incident reports regarding X-ray equipment
- Review training and exposure records to ensure they are adequate and up-to-date
- Follow-up on all action items regarding the X-ray exposure program

Dose Limits and Monitoring

The dose limits for these workers, from the Regulations are shown in Appendix B.

** The annual limits do include any dose equivalent received by a worker, because of their occupation, from all sources of ionizing radiation.*

** The annual limits do not include any dose equivalent received by a worker from background sources or received as a patient undergoing diagnostic or therapeutic procedures.*

Personal Dose Monitoring

BC's Regulation in respect to X-ray Safety (Sec. 7) specify that personal monitoring is required for each X-ray worker who has a reasonable probability of receiving a radiation dose of 1 mSv/year (whole body) or greater.

When proper procedures are followed, X-ray equipment operators do not require dosimetry, as doses are not expected to approach 1 mSv per year. Moreover, in most emergencies, the X-ray source is shut off (not energized) so X-ray exposure is not possible.

Classification of Workers

General Facility Personnel

Typically, general facility personnel includes employees whose assigned duties do not include the use of an X-ray source/machine, but who work in the vicinity.

In general, X-ray sources/machines should be located as far away as possible from areas occupied by general facility personnel. Employers must ensure not only that the radiation levels in areas adjacent to X-ray source/machine locations do not lead to dose limits for general facility personnel being exceeded, but that doses remain As Low As Reasonably Achievable. This can be done by calculation, measurement, or both.

Authorized Operators

Only workers who have been authorized by the employer (via the XSO) will be allowed to operate the X-ray source/machine. Records of each authorized operator, including his/her up-to-date training record will be provided to WorkSafeBC upon request.

[quantity] workers will be designated as authorized operators. A list of authorized operators will be updated regularly, as required. Before becoming an authorized operator, the worker must undergo training.

X-ray Workers

A type of Authorized user, an “X-ray Worker” is a worker who, as a necessary part of their employment, has a reasonable probability of receiving a radiation dose greater than 1 mSv (whole body) per calendar year in the course of their work.

As a best practice, X-ray Workers should be notified, in writing, of their status as X-ray Workers, as well as all associated implications (dose limits). These include the risks associated with radiation to which they may be exposed (see Appendix A: Information on Health Effects from Exposure to Ionizing Radiation, and Appendix B – Exposure Limits).

Note: A pregnant X-ray worker should inform the XSO immediately, in writing, when she becomes aware of the pregnancy. Upon being informed that an X-ray equipment operator has become pregnant, [Company name] will evaluate the risk and may reassign that worker to other tasks and duties that will not lead to increasing the worker’s radiation dose. **Note: There should be no increased risk related to the operation of a properly functioning X-ray equipment system.**

A written acknowledgement from each X-ray worker that this information has been received will be kept in the records. An example of this form is attached as Appendix B –BC worker X-ray exposure limit table

Typically, an authorized worker operating a food X-ray inspection machine or an X-ray cabinet in a manufacturing operation is not expected to receive exposures above 1mSv per year. This is below normal background levels of approximately 2 – 4 mSv per year (ref. CNSC website).

If a worker has the potential to exceed the 1mSv action limit, the employer is required to have an “Exposure Control Program” (sec. 7.20 (1)) and personal monitoring (sec. 7.22).

| PART OF BODY IRRADIATED | EXPOSURE CONDITIONS AND COMMENTS | EXPOSURE LIMIT (mSv) |
|--|---|----------------------|
| Whole body or trunk of body | Uniform irradiation | 20 |
| Lens of eye | Irradiated alone or with other organs or tissues | 150 |
| Skin | The limit applies to the mean dose equivalent averaged over any area of skin of 1 cm ² , at a nominal depth of 7mg/cm ² | 500 |
| Individual organs or tissues other than lens of eye or skin (eg. Hands and feet) | The limit on effective dose equivalent applies, with an overriding limit on the dose equivalent to the individual organ or tissue | 500 |

If a worker declares her pregnancy to the employer, her effective dose limit for the duration of the pregnancy is 4mSv.

Appendix C – Notification of X-ray Worker Status.

Workers who are authorized to operate an X-ray source/machine as a regular part of their job will be required to be X-ray Workers only when their annual dose equivalent is reasonably likely to exceed 1 mSv (whole body).

Training Requirements

X-ray Safety Officer

The X-ray Safety Officer (XSO) should have sufficient training and qualifications to allow him/her to effectively manage the radiation safety program of [Company name], including the components of training and oversight of authorized users.

Training materials for the XSO must include the following topics:

- Structure of matter
- Radiation
- Radiation quantities and units
- Radiation detection instrumentation, and dosimetry
- Biological and health effects of radiation exposure
- Radiation protection principles and practices
- X-ray sources and their applications
- Workplace radiation safety program: organization and administration
- Emergency procedures
- Employee training
- Workplace inspections and audits
- Regulatory agencies and standard-setting organizations
- Registration, installation, and approval of X-ray sources/machines
- Key sections of the OHS Regulation respecting X-ray safety (Section 7, Div 3), Part XIV (Analytical X-ray Equipment) of the Radiation Emitting Devices Regulations and Safety Code 32 (Safety Requirements and Guidance for Analytical X-ray Equipment).

The XSO should have appropriate X-ray Safety Officer training, experience with X-ray equipment operation and will be familiar with all X-ray sources/machines in the company's possession.

Authorized Operators

[Company name] workers who will be using the X-ray equipment are designated as authorized users. Authorized users must be sufficiently trained in the safe use of the X-ray equipment, to ensure that doses to the workers and the public are kept ALARA.

Prior to being authorized to directly operate the X-ray equipment, all workers should successfully complete training as described below. The training will be given by the XSO, or another qualified worker or consultant.

The training for authorized operators typically includes the following topics:

- Properties of radiation (transmission, attenuation)
- Interactions of radiation
- Biological effects of radiation (health effects)
- Background radiation
- Measurement of radiation (survey meters, dosimetry)
- Production and characteristics of X-rays
- Radiation protection legislation
- Control of radiation hazards (customized overview of the warning labels, safety devices, and shielding, which are particular to the X-ray machine being used)
- Controlling radiation exposures
- Security
- Safety features of the X-ray equipment
- Procedures for the safe operation, inspection, and maintenance of the X-ray equipment, per the manufacturer's manual
- Procedures for the use and maintenance of a survey meter
- How to diagnose a problem with the X-ray equipment and/or survey meter
- Emergency procedures

A test may be administered following the training. Once the course and the test have been successfully completed, a record of the worker's training will be produced and kept by the XSO.

Workers who are required to operate the X-ray equipment must also read this Safety Manual.

Once the above training is completed, the XSO will ensure that the X-ray equipment operator receives hands-on training on the safe use of the equipment. The XSO will review, with the worker:

- The safety features of the X-ray equipment
- The procedures for the safe use and maintenance of the X-ray equipment as per the manufacturer's manuals
- How to determine a problem with the X-ray equipment and/or survey meter (if present) when conducting leakage measurements
- All emergency procedures.

The XSO will then determine, based on the training and the prior experience of the worker, whether the worker should be supervised by a more experienced worker before independently using the X-ray equipment.

Records of the hands-on training, as well as the XSO's decision on the autonomy of the workers, will be kept on file by the XSO, along with all other training records.

Only trained and authorized individuals can use the X-ray equipment.

[Company Logo]

[Company Name]
X-ray Safety Program
[Date]

General Facility Personnel

Due to the presence of an X-ray source/machine in the facility, general facility personnel working in the immediate vicinity of the X-ray equipment require some awareness training, even though they do not operate the device themselves. Their training should include the following topics:

- What is radiation
- Biological and health effects of exposure to radiation
- Controlling radiation exposure
- Facility operating and emergency procedures, for the X-ray equipment, as they relate to the general facility personnel
- Key points of the Regulation respecting X-ray Safety (Sec. 7)

Refresher Training Requirements

As a best practice, personnel should receive regular refresher training, according to the following frequency:

- XSO: every 3 years
- Authorized Operators: every 3 years
- General Facility Personnel (awareness training): every 3 years

Refresher training can be given more frequently than what is listed above. The XSO will keep records of all refresher training.

Training Records

The training records are to include:

- Course dates, including hands-on training dates
- Course duration
- Names of the workers who attend each course
- The content of each course or level of training
- The name of the instructor of each course

If a worker has the potential to exceed the 1mSv exposure limit, they would be designated as an “X-ray Worker”, and a notification form, signed by the worker indicating that he/she read the Radiation Safety Manual, will also be kept. See Appendix B –BC worker X-ray exposure limit table. Typically, an authorized worker operating a food X-ray inspection machine or an X-ray cabinet in a manufacturing operation is not expected to receive exposures above 1mSv per year. This is below normal background levels of approximately 2 – 4 mSv per year (ref. CNSC website).

If a worker has the potential to exceed the 1mSv action limit, the employer is required to have an “Exposure Control Program” (sec. 7.20 (1)) and personal monitoring (sec. 7.22).

| PART OF BODY IRRADIATED | EXPOSURE CONDITIONS AND COMMENTS | EXPOSURE LIMIT (mSv) |
|-------------------------|----------------------------------|----------------------|
|-------------------------|----------------------------------|----------------------|

| | | |
|---|---|-----|
| Whole body or trunk of body | Uniform irradiation | 20 |
| Lens of eye | Irradiated alone or with other organs or tissues | 150 |
| Skin | The limit applies to the mean dose equivalent averaged over any area of skin of 1 cm ² , at a nominal depth of 7mg/cm ² | 500 |
| Individual organs or tissues other than lens of eye or skin (eg. Hands and feet) | The limit on effective dose equivalent applies, with an overriding limit on the dose equivalent to the individual organ or tissue | 500 |

If a worker declares her pregnancy to the employer, her effective dose limit for the duration of the pregnancy is 4mSv.

[Company Logo]

[Company Name]
X-ray Safety Program
[Date]

Appendix C – Notification of X-ray Worker Status.

All training information will be kept by the XSO. An updated list of trained workers will be maintained and supplied to WorkSafeBC upon request.

Procedures and Requirements for the Safe Use of X-ray Sources/Machines

The ALARA Principle

The **ALARA** principle requires that radiation exposures be kept ***As Low As Reasonably Achievable***, taking social and economic factors into consideration.

All work associated with X-ray sources will be governed by considerations for potential radiation hazards. As stated in Regulation section 7.19, exposures must be kept ALARA to ensure that occupational doses to individuals who are not X-ray workers shall not exceed the annual dose limits.

As a best practice and recommendation of the International Commission for Radiological Protection, an annual dose to members of the public should not exceed 1mSv.

Storage and Access Control of the X-ray equipment

The main location for the X-ray equipment will be [address location].

The X-ray equipment will only be located according to the floor plan diagram provided in the appendices section. The only workers permitted access to the room containing the X-ray equipment include the XSO, authorized operators, and workers who have undergone the X-ray radiation safety awareness training. If anyone discovers that the X-ray equipment is missing, they must immediately contact the XSO and follow the emergency procedures, outlined in this manual.

Only authorized operators can use the X-ray equipment, and access to the X-ray equipment must be restricted when not in use in order to limit exposure to workers.

When not in use, access to the X-ray equipment must be restricted by storing the key or password required to energize the X-ray source from unauthorised users. Furthermore, the appropriate signage will be posted.

All procedures are developed in accordance with the X-ray equipment manufacturer's specifications and instructions as well as the regulatory requirements. All operation, inspection, and maintenance of the X-ray equipment will be performed according to the X-ray equipment manufacturer's specifications and instructions. All workers working with the X-ray equipment are trained with the corresponding manual to ensure they understand the procedures outlined by the manufacturer.

It is the policy of [Company name] to control and have records of the inventory of each X-ray source/machine from the time it is acquired until it is disposed of. These records will be available for WorkSafeBC inspection.

Use

Only authorized workers have access to the X-ray equipment. Furthermore, only authorized workers are permitted to operate the X-ray equipment.

All procedures are developed in accordance with the X-ray equipment manufacturer's specifications and instructions as well as the regulatory requirements. All operation, inspection, and maintenance of the X-ray equipment will be performed according to the X-ray equipment manufacturer's specifications and instructions. All workers working with the X-ray equipment are trained with the corresponding manual to ensure they understand the procedures outlined by the manufacturer.

The following procedures must be followed when using the X-ray equipment.

1. Use the X-ray equipment according to the manufacturer's instructions and recommendations.
2. Always keep unauthorized persons away from the immediate vicinity of the X-ray equipment.
3. Perform routine cleaning and maintenance according to the manufacturer's instructions and recommendations.
4. The authorized operator must contact the XSO immediately if
 - a. The X-ray equipment is missing, damaged, not functioning as normal or any other safety concerns
 - b. He/she suspects theft, tampering, or unauthorized use
 - c. An event occurs which may have resulted in a worker receiving a dose equivalent in excess of the annual limits set out in Appendix B.
5. In the case of a potential exposure over the annual limit, in accordance with section 7.19 of the Regulation respecting X-ray Safety, the XSO will immediately make a verbal report of the incident to both WorkSafeBC and the [Company name] Joint Health and Safety Committee. A full written report will be provided within 48 hours, to WorkSafeBC, detailing the circumstances of the accident or failure of equipment.

Purchase and Receipt of X-ray Sources/Machines

Only X-ray sources/machines registered with and having the installation location accepted by the Health & Safety Manager and XSO may be purchased, installed, and used. Furthermore, [Company name] will only purchase X-ray sources/machines whose manufacturers can confirm that their product is compliant with Health Canada's Radiation Emitting Devices Act and Regulations.

The XSO is responsible for the receipt of X-ray sources/machines, but this task may be delegated to a qualified person, if required. Upon receipt of an X-ray source/machine, either new or returning from servicing and/or calibration, the receiver will:

1. Review the shipping documents to ensure compliance with the terms of the agreement/invoice.
2. Inspect the package visually to determine if it has been damaged or tampered with.

3. Open the package and ensure that the contents of the package match the information on the shipping documents.
4. Record the receipt of the package and alter the inventory information to account for the new X-ray source/machine.

If a problem occurs at any point in the receipt of the package, the receiver will notify the XSO. The XSO will immediately contact the necessary bodies (carrier, consignor, etc).

Transfer or Disposal of An X-ray Source/Machine

XSO authorization is required to either transfer an X-ray source/machine to another location (for example, for servicing or calibration of the X-ray source/machine), or to dispose of the X-ray source/machine.

Transfer of an X-ray source with the intent of having it returned after calibration or servicing does not require WorkSafeBC notification. When an X-ray source/machine is transferred or disposed of, the XSO will adjust the inventory accordingly.

From a radiation safety perspective, transportation of an X-ray source is unrestricted but would be governed by provincial/territorial/federal legislation involving the importation/registration/installation of such a device. The respective authority should be informed of the employer no longer having possession of a registered X-ray source.

Non-Possession of any X-ray Source/Machine

When [Company name] no longer possesses any X-ray source/machine, [Company name]'s X-ray registration and program will terminate upon notification (excepting all required records retention).

The X-ray source/machine will be disposed of according to jurisdictional requirements for disposal of hazardous materials.

Maintenance

[Company name] will use qualified contractors to maintain and conduct leakage radiation surveys (using a properly functioning and calibrated survey meter).

Leakage radiation surveys of the X-ray equipment and calibration of any survey meter will be done on an annual basis. A copy of the leakage radiation survey report and calibration certificates will be kept on file, as described in the records management section.

Routine maintenance of the X-ray equipment will be done in accordance with the manufacturer's manual. If problems with the X-ray stress measurement source or equipment are detected at this point, a representative of the manufacturer will be contacted, and arrangements will be made to send the source and/or equipment for servicing.

Radiation Detection Instruments

Health Canada's Safety Code 32 states that qualified personnel use a properly functioning radiation survey meter to identify and monitor radiation levels to ensure that the regulatory limit of 0.5 mR/h at 5 cm from any external surface is not exceeded. BC's regulations require X-ray equipment to be arranged and shielded to prevent the air kerma rate from exceeding 5 micrograys per hour at any accessible point 5 centimetres from the external surface. A radiation survey meter must have been calibrated within the preceding 12 months to be used for measuring a dose rate. Possession of a survey meter is not mandatory although it is recommended that a survey meter be readily available in case of an event that may result in exposure to a worker.

The XSO will therefore ensure that:

- [Company name] will have a survey meter readily available, preferably an ion chamber survey meter capable of detecting X-ray energies down to 5 keV
- Each year (every 12 months), [Company name] (or the owner of the survey meter) will send all radiation detection instruments to a competent calibration service provider, for calibration
- The calibration service provider will ensure that calibrations are performed in accordance with regulatory requirements. Ideally, such units will be calibrated for at least two X-ray energies
- Records of the calibration certification will be kept by the XSO and a copy of the most recent certificate will be kept with the survey meter
- Workers are trained in the use and maintenance of the survey meters

Before each use, workers will verify that the survey meter is properly functioning by performing inspections for:

- Physical Damage
- Battery power
- Calibration date

As the survey meters are sent for calibration once a year, the workers are not expected to do regular maintenance on the meters, aside from keeping them clean and in good working condition (e.g., careful handling and/or replacing batteries that are known to have expired). Should a worker have any reason to think a survey meter is not working properly, he/she will immediately contact the XSO, who will determine whether the survey meter needs to be sent for calibration/servicing before its next use.

Leakage Radiation Survey

Although BC legislation has no specific required frequency for leakage radiation survey, Safety Code 32 suggests that leakage measurements should be done upon initial installation, and when maintenance, modification, damage, or overexposure incidents have occurred. If the X-ray equipment's leakage measurement ever exceeds the legislated limit (which, according to regulations is 5 micrograys per hour at 5 centimetres from the external surface):

1. The X-ray equipment must not be used; and,
2. A competent service company will be contacted to investigate and repair the X-ray equipment.

Industry best practice is to perform leakage testing at a minimum of once per year, in addition to the testing performed upon initial installation, and after maintenance and/or modification, and whenever damage or overexposure incidents have occurred.

Records Management

Records will be kept both electronically and in hard copy and retained until all X-ray sources/machines are disposed of. The following records will be kept:

- Names of persons involved in the operation of an X-ray source/machine
- Names and job categories of persons designated as X-ray workers
- Training conducted for workers operating an X-ray source/machine
- List of locations of an X-ray source/machine in [Company name]'s possession
- Survey results, if applicable
- Inventory of an X-ray source/machine in possession
- Details of incidents involving an X-ray source/machine
- Purchases and transfers of an X-ray source/machine
- A copy of the registration package consisting of: the plan drawing, technical manual, operator/XSO training certificate, a copy of the letter of registration acknowledgement and installation acceptance
- List of radiation detection equipment and annual calibration data
- Leakage radiation survey monitoring results
- Disposal details and notification to the appropriate jurisdiction managing disposal of hazardous materials

All records pertaining to workers must be kept for a minimum of ten years after the termination of the employment of the worker with [Company name]. All other records will be retained for a period ending three years after the disposal of the X-ray source/machine.

Reporting

Reporting to the appropriate authorities is required upon becoming aware of any of the following occurrences (as required under section 7):

- Loss or theft of an X-ray source/machine
- Contravention of the Occupational Health and Safety Act or Regulations
- Possible exposure of persons to radiation exceeding dose limits
- A change in the possession of the X-ray source/machine (replacement, disposal)
- A change in the location of the X-ray source/machine
- A change in the designated competent person (XSO)
- A change in the employer
- A change in the shielding or safety devices of the X-ray source/machine which may increase a worker's radiation exposure

Reporting is normally done by the XSO. If such an event should occur, the XSO must immediately contact the appropriate authority.

Immediate Verbal Report

Immediately upon becoming aware of an over-exposure incident, the XSO is to make a verbal report to the WorkSafeBC. WorkSafeBC is to be told of the details of the situation, including location and circumstances, and any action that [Company name] has taken or proposes to take with respect to it. [Company name]'s Joint Health and Safety Committee or Health and Safety Representative must also be notified.

Full Written Report (within 48 hours)

Within 48 hours of the over-exposure incident, the XSO is to submit a full written report on the situation with the WorkSafeBC. The report must contain the following information:

- A description of the situation, the circumstance of the problem, if any, with the radiation device
- The probable cause of the situation
- The details of the X-ray source/machine, including, if applicable, the brand name, model number and serial number
- The date, time, and location where the situation occurred, or if unknown, the approximate date, time, and location, and the date and time of becoming aware of the situation
- The actions that the employer has taken to re-establish normal operations
- The actions that the employer has taken or proposes to take to prevent a recurrence of the situation
- The qualifications of the workers, including any trainee, who were involved
- The effective dose and the equivalent dose (may be an estimation) received by any person as a result of the situation
- The effects on the environment, the health and safety of persons, and the maintenance of security that have resulted or may result from the situation

Signage and Labelling

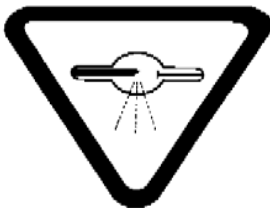
According to section 7 of the OHS Regulation, at a workplace where an X-ray source is used:

- 1) X-ray warning signs or warning devices shall be posted or installed in conspicuous locations.
- 2) Every X-ray source capable of producing an air kerma rate greater than 5 micrograys per hour at any accessible point shall be labelled at its operating controls as a source of X-rays.
- 3) A warning device that indicates when X-rays are being produced shall be mounted on or near the equipment in such a way as to be conspicuous from any position from which the equipment can be opened.

According to Health Canada's RED Act Part XIV section 4 requires that analytical X-ray equipment shall bear on the control panel, next to any one switch that turns on an X-ray tube, each of the following labels:

(a) a label bearing an X-radiation warning symbol that

- (i) is displayed in two contrasting colours,
- (ii) is clearly visible and readily discernible from a distance of 1 m,
- (iii) has no outer dimension that is less than 2 cm,
- (iv) bears the words "CAUTION: X-RADIATION--ATTENTION: RAYONNEMENTS X", and
- (v) conforms to the following diagram, namely,



(b) a label bearing the words

"CAUTION--X-RADIATION. This Equipment Produces High Intensity X-radiation When Energized. To be Operated Only by Qualified Personnel.

ATTENTION--RAYONNEMENTS X. Cet appareil produit des rayonnements X haute intensité lorsqu'il est sous tension. Son utilisation est réservée au personnel compétent";

(c) a label setting out

- (i) the name and address of the manufacturer,
- (ii) the model designation,
- (iii) the serial number,
- (iv) the date of manufacture, and
- (v) the country of manufacture.

Health Canada's Safety Code 32 requires that the label on the control panel should have a warning sign that reads "Caution X-rays. This equipment produces high intensity X-rays when energized. To be used and serviced by qualified personnel only." and where appropriate, its French equivalent: "Attention Rayons X".

Internal Inspections/Audits

Radiation compliance inspections will be performed periodically by the XSO. The purpose of such inspections is to ensure that each worker is conducting their work in accordance with safe work practices, and in compliance to legislated and guideline requirements, and the procedures detailed in this Radiation Safety Manual as well as any further procedures instituted by [Company name].

If an employee is found, during the compliance inspection, to be operating incorrectly, not according to procedure, or unsafely, the employee will be coached during or immediately after the inspection, as to what was incorrect and the proper procedure that they should be following. Communication of inspection findings will be done during regular staff meetings and the inspection reports will be posted for all employees to view. The nature and findings of these inspections will be summarized and communicated to management, quarterly.

Once a year, the XSO is responsible for carrying out an internal audit of the facility containing the X-ray source/machine and reviewing the X-ray Safety Program. During the audit, the XSO will:

- Address any radiation concerns or recurring comments expressed by workers who have access to the X-ray source/machine
- Review all other records (shipping documents, training records, X-ray worker Status documents for all workers who use the X-ray equipment, servicing records, etc)
- Ensure that the appropriate radiation warning signs are posted, along with other required information
- Ensure that workers who use the X-ray equipment are knowledgeable about the procedures and safety precautions to take with regards to the equipment and X-ray source
- Ensure that all policies and procedures within this manual are followed and updated
- Verify that the necessary leakage tests have been done and the records are on file
- Verify that the survey instruments have been calibrated and the records are on file

If any adjustments to procedures and policies are needed to ensure the effectiveness of the Radiation Safety Program, the changes will be documented.

Emergency Procedures

The XSO is the person to contact in case of an emergency. [Company name] will maintain an up-to-date emergency contact listing, including the 24-hour telephone numbers to contact the XSO, the alternate for the XSO, WorkSafeBC, and any other required emergency contacts.

See Section *Reporting* for a list of occurrences requiring reporting as well as requirements for preliminary notification and report, and submission of follow-up report.

X-ray Equipment-Specific Emergency Procedures

In the event of an emergency affecting the X-ray equipment, such as the X-ray beam remaining on when the cover is opened, or if damage to the shielding occurs, the following steps are to be followed:

1. Turn off the X-ray source/machine and unplug it from the power source
2. Identify and isolate all workers and persons who may be exposed
3. Secure the incident site to prevent entry
4. The X-ray Safety Officer is to be informed **immediately** of the incident
5. The X-ray Safety Officer will **immediately** notify WorkSafeBC and make a preliminary verbal report of the incident. WorkSafeBC is to be told of the details of the situation (including location and circumstances of the situation), and any action that the employer has taken or proposes to take with respect to it
6. Get assistance from the manufacturer or a qualified radiation safety professional as required
7. Record all event details chronologically
8. Activate authorized follow-up procedures
9. The XSO is to submit a written report to WorkSafeBC within 48 hours with contents of the report describing the circumstances of the accident or failure of equipment that may have resulted in a worker receiving a dose in excess of the annual limits.

Notes:

If the shielding has been damaged, the equipment must be tagged out of service, repaired, and surveyed for leakage before it can be returned to service.

Loss or Theft of an X-ray Source/Machine

Loss or theft of an X-ray source/machine is rare; however the appropriate authorities should be notified if it does happen. The following steps must be followed in the case of the disappearance of an X-ray source/machine:

1. Immediately notify the XSO
2. XSO to immediately notify the police or other appropriate local authorities
3. Interview all personnel who may know the location of the X-ray source/machine
4. Identify and search all possible locations of the X-ray source/machine

Fire or Explosion

In the event of a fire or explosion involving the area where the X-ray source/machine is located the following procedures should be followed:

- Immediately sound the fire alarm by activating the alarm switch
- Shut off and de-energize the X-ray source/machine (if safe to do so)
- Call 911 and inform the XSO
- Follow company emergency procedures for fire

Overexposure

Although an overexposure is unlikely due to normal operation of an X-ray equipment, it is possible to have an overexposure, particularly in emergency situations when the shielding of the X-ray source has been compromised. In the event of a potential overexposure of a person, specific actions must be taken.

1. Upon recognizing that an overexposure situation may exist, authorized operators are to make the situation safe (shut off the X-ray equipment, and unplug it), and remove the exposed person (themselves included, if applicable) from the source
2. Authorized operators are to immediately notify the XSO of the overexposure situation. Such situations may include, but are not necessarily limited to, accidents with the X-ray equipment that compromised the shielding, or a situation where the interlock fails to shut off the X-ray beam when opening the cover of the equipment
3. The XSO is to immediately contact the WorkSafeBC and make an initial verbal preliminary report of the situation
4. The XSO will assess the situation, and if required, provide additional resources (such as a medical assessment and mitigation) to assist
5. The XSO will investigate the overexposure, and obtain all possible information, including personnel distances from the source, personnel time at the various distances, radiation field strength, etc. This information will be used to estimate the dose to personnel
6. The XSO will submit a formal written report on the incident to the WorkSafeBC within 48 hours of the incident

Appendix A: Information on Health Effects from Exposure to Ionizing Radiation

Radiation is one of the best-investigated hazardous agents. Because of the vast accumulation of quantitative dose-response data, scientists have been able to set environmental radiation levels so that applications of radiation and X-ray technologies may continue at a level of risk that is much less than with many other technologies. Consequently, machine operators of X-ray food inspection systems and cabinets can feel confident of working in a safe operating environment when standard exposure controls are followed because: 1) X-ray systems must meet rigorous safety standards before being sold and used in Canada; and 2), typical X-ray exposures to operators of X-ray machines in manufacturing and food processing are much less than the radiation exposure Canadians receive from naturally occurring background radiation.

According to the regulation, if a worker has the potential to receive more than 1mSv per year, additional monitoring and protocols are required as described in Regulation section 7.20 (1) "Exposure Control Plan" .

Health Canada estimates that Canadians receive on average **2-4 mSv** of radiation dose each year from *background radiation*. Background radiation is radiation which is always all around us. Most background radiation is from natural sources, such as the Sun (cosmic radiation), radioactive particles like uranium, radium, and radon, found in soil or emanating from the soil (terrestrial radiation), and radioactive particles, like potassium-40 and carbon-14, found in food (internal radiation). This type of radiation exposure has never been shown to lead to adverse health effects.

A single accidental exposure to a high dose of radiation during a short period of time is referred to as an acute exposure and may produce biological effects within a short period after exposure. These effects include:

- Skin damage
- Nausea and vomiting
- Malaise and fatigue
- Increased temperature
- Blood changes
- Bone marrow damage
- Damage to cells lining the small intestine
- Damage to blood vessels in the brain

The above list is given for information purposes only. The doses that can produce such effects are extremely unlikely even in the event of an accident at work.

The delayed effects of radiation are due to both acute exposure and continuous exposure (chronic exposure). In this case, the negative effects may not be apparent for years. Chronic exposure is likely to be the result of improper or inadequate protective measures.

The most common delayed effects are various forms of cancer (leukemia, bone cancer, thyroid cancer, lung cancer) and genetic defects (malformations in children born to parents exposed to radiation). In any radiological situation involving the induction of cancer, there is a certain period between the exposure to radiation and the onset of disease. This is known as the "latency period" and is an interval in which no symptoms of the disease are present. The minimum latency period for leukemia produced by radiation is 2 years and can be up to 10 years or more for other types of cancer.

The connection between the effects of exposure to radiation and dose (i.e., dose-response relationship) is classified into 2 categories, deterministic and stochastic.

The deterministic effects, also referred to as tissues and organs effects, are specific to each exposed individual. They are characterized by:

- A certain minimum dose must be exceeded before the effect is observed. Because of this minimum dose, the deterministic effects are also called Threshold Effects. The threshold may differ from individual to individual
- The magnitude of the effect increases with the size of the dose received by the individual
- There is a clear relationship between exposure to radiation and the observed effect on the individual

Stochastic effects are those that occur by chance. They are more difficult to identify since the same type of effects may appear among individuals not working with radioactive materials. The main stochastic effects are cancer and genetic defects. According to current knowledge of molecular biology, a cancer is initiated by damaging chromosomes in a somatic cell. Genetic defects are caused by damage to chromosomes in a germ cell (sperm or ovum). There is no known existing threshold for stochastic effects. One single photon or electron can produce the effect. For these reasons, a stochastic effect is called a Linear or Zero-Threshold Dose-Response Effect.

Stochastic effects can also be caused by many other factors, not only by radiation. Since everybody is exposed to natural radiation, and to other factors, stochastic effects can arise in all of us regardless of the type of work (working with radiation or not). Whether or not an individual develops the effect is simply a question of chance.

There is a stochastic correlation between the number of cases of cancers developed inside a population and the dose received by the population at relatively large levels of radiation. Attempts have been made to extrapolate the data from these levels of dose to low levels of dose (close to the levels received from background radiation). There is no scientific evidence to prove the results of these attempts.

Since there is no evidence of a lower threshold for the appearance of Stochastic Effects, the prudent course of action is to ensure that all radiation exposures follow a principle known as **ALARA (As Low As Reasonably Achievable)**.

The International Commission on Radiological Protection (ICRP, an independent organization of scientist) estimates that for every **1000 mSv** of radiation dose, accumulated over 50 years, the risk of getting a fatal cancer increases by **4%**. This number was used to create the dose limits for nuclear energy workers in Canada.

Finally, an acute exposure to a large amount of radiation can lead to immediate health effects, such as nausea, fatigue, and even death. A person would need to receive around **1000 mSv** of radiation dose within a short period of time to feel any such immediate effects. The severity of the effect would then increase with increasing dose. Between 1000 and 2000 mSv, a person would expect to have radiation sickness, characterized by fatigue, nausea, possible diarrhea, and general malaise. Receiving **3500 mSv** of radiation dose suddenly will be lethal for 50% of the people exposed, if untreated. Other effects, such as effects on embryos and specific organs in the body, also require doses far above the limits on radiation dose to nuclear energy workers. Typically, workers in a manufacturing setting are not expected to reach the 1 mSv action level.

Pregnant Workers

It is well known that the fetus is more sensitive to the effects of radiation than an adult human. If an irradiation occurs in the first 30 weeks of pregnancy, delayed effects may appear in the child. These include mental and behavioural development issues, with a delay period of approximately 4 years.

Because of these possible effects, dosimetry during pregnancy differs from the usual protocol. Special attention is paid to both external and internal irradiation. An X-ray Safety Officer must review exposure control and work procedures when working around an X-ray source when a pregnant worker performs such work.

It is not possible to accurately measure the dose to the fetus and so it must be inferred from the exposure to the mother. Radiation protection principles limit exposure to the mother to achieve the minimum risk to the fetus.

Appendix B –BC worker X-ray exposure limit table

Typically, an authorized worker operating a food X-ray inspection machine or an X-ray cabinet in a manufacturing operation is not expected to receive exposures above 1mSv per year. This is below normal background levels of approximately 2 – 4 mSv per year (ref. CNSC website).

If a worker has the potential to exceed the 1mSv action limit, the employer is required to have an “Exposure Control Program” (sec. 7.20 (1)) and personal monitoring (sec. 7.22).

| PART OF BODY IRRADIATED | EXPOSURE CONDITIONS AND COMMENTS | EXPOSURE LIMIT (mSv) |
|---|---|----------------------|
| Whole body or trunk of body | Uniform irradiation | 20 |
| Lens of eye | Irradiated alone or with other organs or tissues | 150 |
| Skin | The limit applies to the mean dose equivalent averaged over any area of skin of 1 cm ² , at a nominal depth of 7mg/cm ² | 500 |
| Individual organs or tissues other than lens of eye or skin (eg. Hands and feet) | The limit on effective dose equivalent applies, with an overriding limit on the dose equivalent to the individual organ or tissue | 500 |

If a worker declares her pregnancy to the employer, her effective dose limit for the duration of the pregnancy is 4mSv.

Appendix C – Notification of X-ray Worker Status

Following is an example letter to use for notification to an employee of their X-ray Worker status. The worker would be given this letter by the employer. It is suggested that the employer retain a copy of the letter for his/her files which has been signed by the worker. If this example is used, it should be printed with the Exposure Limit Table in Appendix B.

ABCD Manufacturing Canada Inc.
123 Any Street
City, Province, Canada
Postal Code

Dear _____ (worker name),

As required by the X-ray Regulations respecting X-ray Safety made under the Occupational Health and Safety Act, Division 3 section 7.19 , I hereby inform you that you are subject to the employer's Exposure Control Program under section 7.20 (1).

Section 7.19 of the regulation imposes limits as to the radiation exposure that you may receive as part of your employment. They are that doses are to be kept as low as reasonably achievable; in any case, you shall not receive a dose equivalent in excess of the annual limits.

If applicable, your employer shall take every precaution reasonable in the circumstances to ensure that the mean dose equivalent received by the abdomen of a pregnant X-ray worker does not exceed four millisieverts during the full term of the pregnancy.

Sincerely,

_____ dated _____
(Name of employer or employer's rep)

_____ dated _____
(worker signature)

Appendix D: Standard Preventative Maintenance on X-ray machines

This document lists standard items to be reviewed during preventative maintenance service. Often, this work would be conducted by a qualified contractor. This list is a reference for the employer and/or XSO for understanding what should be included in preventative maintenance work.

A standard Preventative Maintenance visit usually consists of the following:

- Clean, inspect X-ray Tubes, replace O-rings, and adjust to manufacturers specs.
- Clean, inspect, reapply dielectric grease to high voltage (HV) cables and set compression.
- Clean, inspect and lubricate manipulator.
- Clean cooler, test flow, and check temperature switches.
- Clean and verify adjustments on the HV generators to prolong tube filament life.
- Test and adjust Safety Interlocks and Safety Lamps.
- Test power supplies and adjust to factory specifications.
- Test and adjust shutter.
- Service vacuum system.
- Inspect for proper cable drape.
- Verify emergency stop operation.
- Perform a Radiation Safety Survey with documentation.

After going through these checkpoints, a service technician will typically go through potential wear on specific parts of the system and may make recommendations on repairing or replacing specific components. This may include parts that need to be replaced as soon as possible, or parts that are recommended to keep on hand to reduce total downtime. This helps ensure that the system is kept in working order and minimizes wear over the course of time

Appendix E: Radiation Protection Survey

This document lists the standard measurements taken during a Radiation Protection Survey. This work would be conducted by a qualified contractor or the XSO. This list is a reference for the employer and/or XSO for understanding what measurements could be included when conducting the survey.

Radiation Protection Survey of (Equipment Name), (Model #), (Serial number #)

kVp (typical/max): ____/____ mA (typical/max): ____/____

Scatter medium: _____

Survey meter used (make, model, serial number): _____

Calibration date of survey meter: _____

Measurement Results (expressed in micrograys per hour at 5 cm from the external surface at typical/maximum operating conditions, as stated above)

| Measurement Location | Result @ 5cm from surface For Typical / Maximum Operating Conditions | | | |
|----------------------|---|---------|--------------------------------|---------|
| | Instrument units Specify units: _____ | | Converted (if needed) μGy/h | |
| | Typical | Maximum | Typical | Maximum |
| Front | | | | |
| Back | | | | |
| Left Side | | | | |
| Right Side | | | | |
| Bottom | | | | |
| Top | | | | |

Verified that interlock is functional and can only be reset at control screen after tripped and closed: ____ (initial)

“X-ray on” warning device conspicuously placed on or near equipment so that it can be seen from any position: ____ (initial)

Date of Survey: _____ Operator: _____

Appendix F: X-ray Equipment-Specific Emergency Procedures

In the event of an emergency affecting the X-ray equipment, such as the X-ray beam remaining on when the cover is opened, or if damage to the shielding occurs, the following steps are to be followed:

1. Turn off the X-ray source/machine and unplug it from the power source.
2. Identify and isolate all workers and persons who may be exposed
3. Secure the incident site to prevent entry.
4. The X-ray Safety Officer is to be informed **immediately** of the incident.
5. The X-ray Safety Officer will **immediately** notify WorkSafeBC and make a preliminary verbal report of the incident. WorkSafeBC is to be told of the details of the situation (including location and circumstances of the situation), and any action that the employer has taken or proposes to take with respect to it.
6. Get assistance from the manufacturer or a qualified radiation safety professional as required.
7. Record all event details chronologically.
8. Activate authorized follow-up procedures.
9. The XSO is to submit a written report to WorkSafeBC within 48 hours with contents of the report describing the circumstances of the accident or failure of equipment that may have resulted in a worker receiving a dose in excess of the annual limits.

Notes:

If the shielding has been damaged, the equipment must be tagged out of service, repaired, and surveyed for leakage before it can be returned to service.

Appendix G: Hand-held X-ray devices

Technological innovations that barely existed about a decade ago resulted in the development of specific X-ray tube-based X-ray fluorescence (XRF) devices used for *in situ* elemental or chemical analyses of materials, components, or systems by industry. The defining characteristics of such devices typically include:

- An X-ray tube as the source of ionizing radiation, capable of operating up to ~50 kV and a few hundred microampere (μA);
- An open port from which a collimated primary beam of high intensity emerges (beam port);
- Inherent filter(s) for modifying the intensity or quality of primary or characteristic radiation;
- An internally positioned sensitive radiation detector that picks up, through the open port, fluorescent X-rays created by the irradiated materials;
- Appropriate internal electronics coupled with software that process the detected signals to yield real-time analytical data within short irradiation times (on the order of a few tens of seconds); and
- Portability and of low enough weight to be hand-held for use utilizing an X-ray on/off switch, which incorporates a failsafe feature in that positive pressure is applied via the operator's finger to generate and sustain X-ray generation for the duration of the test and removal of that pressure promptly stops X-ray generation.

Such devices are defined as portable, hand-held, X-ray tube based open-beam XRF devices and are limited to maximum designed operational ratings of 50 kV and 4 W.

Analyses are performed when the devices, hand-held by the operator, are taken to the location of the test material and activated to provide a high intensity primary beam that bombards the test material at close range. In the past several years, these devices have been particularly useful to industry while gaining acceptance in a wide array of industrial applications, such as alloy analysis, mining and exploration, lead (Pb) testing in toys, sorting and recycling of scrap metal, and identification of materials. These applications constitute an analytical technique or test method that is not only repetitive or automated, but also falls within the scope of limited industrial non-destructive testing (NDT).

XRF devices possessing the above characteristics that are not limited to the maximum operational ratings specified in this section must not be used in an open-beam or hand-held mode.

[Company Logo]

[Company Name]
X-ray Safety Program
[Date]

Appendix H: Facility Floor Plan

[insert floor plan showing the placement of the X-ray equipment]

About us

The Manufacturing Safety Alliance of BC is the industry-led, nonprofit health and safety association that helps BC manufacturers and food processors build and certify safety programs that protect workers and cut costs.

The Alliance is also the WorkSafeBC Certifying Partner for the Occupational Safety Standard of Excellence (OSSE), the health and safety Certificate of Recognition for BC manufacturers.

The Alliance offers safety certification, OHS consulting and advisory services, and broad selection of classroom and online training. Our vision is to partner with BC's industry leaders to achieve cultural change that ensures safe workplaces for all employees.

For more information please contact us:

T 1-804-795-5595 E manufacturing@safetyalliancebc.ca safetyalliancebc.ca