

Part 20 Radiation Exposure

Highlights

Requirements involving exposure to ionizing radiation have been, and continue to be, part of Alberta's *Radiation Protection Regulation*.

- Section 291 complements the *Radiation Protection Regulation* and brings the employer's responsibilities to the attention of employers and workers.

Requirements

Section 291 Prevention and protection

This section applies only to workers who may be exposed to ionizing radiation. No requirements are specified for exposure to non-ionizing radiation.

Employers are required to develop and implement safe work practices and procedures that are to be used when workers deal with or approach a radiation source. If practicable, workers are to be involved in developing and implementing the safe work practices and procedures. As required by section 8 of the *Occupational Health and Safety Regulation*, the procedures must be in writing. The employer must inform the workers of the potential hazards of ionizing radiation and the radiation source.

The remainder of the explanation to this Part presents information about both ionizing and non-ionizing radiation.

Overview

The term "radiation" includes many different types of electromagnetic radiation, both ionizing and non-ionizing. It can range from extremely high frequency/short wavelength radiation such as cosmic rays, through the visible light spectrum and on to extremely low frequency/long wavelength radiation such as electrical power.

Ionizing radiation

What is it?

Ionizing radiation is high-energy electromagnetic radiation that is capable of disrupting the structure of atoms or molecules. When ionizing radiation penetrates living tissues, the chemical structure of living cells may be changed. If enough radiation is absorbed, cells may be altered or destroyed. In some cases, these cellular changes could develop into cancer, or cause genetic damage or birth defects. Sources of ionizing radiation encountered at the workplace may include x-ray and radioactive material.

Federal regulations

In Canada, ionizing radiation is regulated both federally and provincially. At the federal level, the Canadian Nuclear Safety Commission (CNSC), formerly known as the Atomic Energy Control Board of Canada, focuses primarily on the control of nuclear activities. *The Nuclear Safety and Control Act (Canada)* limits the health and safety risks to persons and the environment that are associated with the development, production and use of nuclear energy, and the production, possession and use of nuclear substances that are products of the nuclear fuel cycle. Regulations under that *Act* deal with general nuclear safety and control, radiation protection, nuclear substances and radiation devices, and the packaging and transport of nuclear substances.

Provincial regulations

At the provincial level, the *Radiation Protection Act* and the *Radiation Protection Regulation* deal with radiation equipment and sources other than man-made radioactive sources, mainly ionizing radiation from x-ray equipment.

According to the *Radiation Protection Act*,

- (a) persons responsible for a radiation facility, radiation equipment or radiation source must take all reasonable precautions to protect persons from radiation injury,
- (b) employers must ensure that workers are informed of the potential hazards of the radiation and of the precautions to be taken to protect workers and other persons from those hazards, and
- (c) employers must ensure that the installation, maintenance, repair, testing, use or operation of radiation equipment is done by a competent worker.

The *Radiation Protection Regulation* designates certain radiation equipment as requiring registration certificates, describes protective measures for the use of ionizing radiation equipment, and specifies maximum exposure limits for ionizing radiation. Protective measures for the use of ionizing radiation are addressed by referencing existing Health Canada Safety Codes for x-ray equipment used in medical, dental and veterinary facilities, as well as analytical, industrial and baggage inspection x-ray equipment.

Exposure limits

One of the guiding principles of radiation protection is the ALARA principle. According to the principle, exposure of radiation workers and other persons to ionizing radiation is kept “As Low As Reasonably Achievable — economic and social factors being taken into consideration.”

The *Radiation Protection Regulation* specifies maximum exposure limits for ionizing radiation. The exposure limits represent international consensus on radiation protection standards. The maximum exposure limits include exposure from all sources of ionizing radiation except medical or dental radiation when the person is a patient, or natural background radiation. Radiation workers who use or are exposed to the operation of certain types of ionizing radiation equipment require personal exposure monitoring. Also, specific maximum exposure limits are applicable to pregnant radiation workers.

For more information



www.qp.alberta.ca

Radiation Protection Act (Alberta) and Radiation Protection Regulation



www.nuclearsafety.gc.ca

Canadian Nuclear Safety Commission



<http://laws.justice.gc.ca/en/N-28.3/>

Nuclear Safety and Control Act (Canada)



www.hc-sc.gc.ca/weh-semt/pubs/radiation/index-eng.php

Health Canada Safety Codes

Naturally Occurring Radioactive Materials

In addition to radioactive sources and x-ray equipment, another source of ionizing radiation is naturally occurring radioactive materials (NORM). These are radioactive materials that have always been present in various concentrations in the environment and in the tissues of every living animal, including people. Such materials have the potential to cause cancer in persons exposed to them.

Although the concentration of NORM in most natural substances is so low that this risk is generally regarded as negligible, higher concentrations may arise as the result of industrial operations such as:

- *mineral extraction and processing* — NORM may be released or concentrated in a process stream during the processing of ore, such as in the phosphate fertilizer industry and the abrasives and refractory industries;
- *oil and gas production* — NORM may be found in the fluids and gases from hydrocarbon-bearing geological formations;
- *metal recycling* — NORM-contaminated materials are redistributed to other industries resulting in the formation of new NORM-contaminated products;
- *forest products and thermal-electric production* — mineral ashes left from combustion may concentrate small amounts of NORM naturally present in plant material and coal;
- *water treatment facilities* — fresh or waste water is treated through sorptive media or ion-exchange resins to remove minerals and other impurities from the water being treated and may release radon (geothermal sources, fish hatcheries);
- *tunneling and underground working* — in areas where small amounts of indigenous radioactive minerals or gases may be present, such as underground caverns, electrical vaults, tunnels or sewer systems.

The concentration of radioactive substances in these materials may increase to levels at which special precautions are needed for handling, storing, transporting, and disposing of material, by-products, end-products or process equipment.

NORM is not regulated in Canada because its source is natural background radiation. However, guidelines describing safe work practices and procedures to be followed when dealing with NORM are available. The maximum exposure limits to NORM are the same as the exposure limits for all sources of ionizing radiation

For more information



www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/norm-mrn/index-eng.php

Canadian Guidelines for Management of Naturally Occurring Radioactive Materials (NORM) published by Health Canada



www.ogp.org.uk/pubs/412.pdf

Guidelines for the Management of Naturally Occurring Radioactive Material (NORM) in the Oil and Gas Industry



Guidelines for the Handling of Naturally Occurring Radioactive Materials (NORM) in Western Canada, available from the Workplace Health and Safety Contact Centre at 1-866-415-8690

Non-ionizing radiation

General

Non-ionizing radiation does not have enough energy to disrupt the structure of atoms or molecules. However, it may have biological effects such as heating or initiating photochemical reactions. Non-ionizing radiation includes ultraviolet light, visible light, infrared light, microwaves, radiowaves and electricity. Some of the most common sources of non-ionizing radiation encountered at the workplace are listed in Table 20.1

Except for lasers, there are no provincial regulations for specific types of non-ionizing radiation. However, under the *Occupational Health and Safety Act*, if an Occupational Health and Safety Officer believes that radiation is creating unhealthy or unsafe conditions for workers, the officer may issue an order prohibiting use of the equipment or requiring remedial action. Also, Part 2 of the OHS Code requires employers to conduct written hazard assessments of work sites to identify existing or potential hazards.

In the absence of specific rules, maximum exposure limits for non-ionizing radiation, other than for lasers or radiofrequency and microwave radiation, should be taken from levels published in the book *“Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents & Biological Exposure Indices (BEIs)”*, published annually by the American Conference of Government Industrial Hygienists (ACGIH).

Table 20.1 Common sources of non-ionizing radiation at the workplace

Type of radiation	Source/uses	Workers exposed
Ultraviolet light	<ul style="list-style-type: none"> ▪ welding ▪ sunlight ▪ fluorescent lamps ▪ mercury & xenon lamps 	<ul style="list-style-type: none"> ▪ welders ▪ outdoor workers ▪ lighting technicians ▪ laboratory personnel
Infrared light	<ul style="list-style-type: none"> ▪ industrial heaters & dryers ▪ sunlight ▪ welding ▪ lasers 	<ul style="list-style-type: none"> ▪ welders ▪ glass factory workers
Microwaves	<ul style="list-style-type: none"> ▪ radar ▪ cooking ▪ communication ¹ ▪ microwave diathermy ▪ telemetry 	<ul style="list-style-type: none"> ▪ broadcasting and communication workers ▪ medical personnel ▪ physiotherapists ▪ marine personnel
Radiofrequency	<ul style="list-style-type: none"> ▪ industrial heating (induction & dielectric), sealing, glueing, melting, tempering, welding, polymerization and sterilization ▪ communication ² ▪ metallurgy ▪ medical and short wave diathermy ▪ cellular telephones 	<ul style="list-style-type: none"> ▪ broadcasting and communication workers ▪ factory workers ▪ plastic sealer operators ▪ medical personnel ▪ air crews ▪ engineers/mechanics/technicians/maintenance workers
Extremely low frequency (ELF)	<ul style="list-style-type: none"> ▪ electricity transmission ▪ induction heaters ▪ steel and aluminum industry 	<ul style="list-style-type: none"> ▪ electrical utility workers ▪ factory workers
Static magnetic fields	<ul style="list-style-type: none"> ▪ magnetic resonance imaging ▪ nuclear magnetic resonance 	<ul style="list-style-type: none"> ▪ medical personnel ▪ laboratory personnel

Notes:

¹ Microwave communication — television, weather radar, satellite communication, marine navigation, taxi, police/fire/ambulance, CB radios, microwave relay towers, radio navigation

² Radiofrequency (RF) communications — radio navigation, AM/FM radio, marine broadcasting, CB radios, television, air traffic control, police/fire/ambulance

Ultraviolet radiation

The most common and well-known hazards of ultraviolet light are

- (a) sunburn, which can lead to premature skin aging and skin cancer,
- (b) kerato-conjunctivitis, commonly known as welder's flash,
- (c) macular degeneration of the eye, and
- (d) possible cataract formation.

For more information



www.labour.gov.on.ca/english/hs/guidelines/uvradiation/

Ultraviolet Radiation in the Workplace

Lasers

The most common and well-known hazards of lasers are eye injuries and skin burns. The *Radiation Protection Regulation* designates Class 3b and 4 lasers as requiring registration certificates. The *Regulation* further describes protective measures for the use of all classes of lasers by referencing CSA Standard CAN/CSA-Z386-01, *Laser Safety in Health Care Facilities*, and ANSI Standard ANSI-Z136.1-2000, *American National Standard for the Safe Use of Lasers*.

Maximum exposure limits for non-ionizing radiation from lasers are also specified in the *Regulation* by reference to ANSI Standard Z136.1. These exposure limits do not include exposure from non-ionizing medical or dental radiation when the person is a patient.

Information specific to laser pointers can be found at the following Web sites:



www.bccdc.org/content.php?item=54

Health Concerns of Hand Held Laser Pointers



www.hc-sc.gc.ca/iyh-vsv/prod/laser_e.html

Laser Pointers

Radiofrequency and microwave radiation

Radiofrequency and microwave radiation span the frequency range from 3 kHz to 300 GHz, which includes wireless telecommunications devices such as cellular telephones. The main health concern with this type of radiation is its thermal effects i.e. induced tissue heating.

In Canada, Health Canada publishes Safety Code 6, *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz*. Industry Canada requires all operators of radio and television broadcast stations, cellular, land, mobile, amateur radio and other radiofrequency emitters to adhere to Safety Code 6. Operators must ensure that the radiofrequency fields produced by their installations do not exceed the maximum levels listed in the Safety Code. Industry Canada licenses this radiocommunication equipment, approves where cellular telephone base stations are located, and conducts compliance assessments of both cellular telephones and base stations.

Many studies into the relationship between radiofrequency electromagnetic fields and cancer have been completed. The results have been both contradictory and inconclusive. Research in this subject areas continues.

For more information



www.labour.gov.on.ca/english/hs/guidelines/radiation/index.html

Radiofrequency and Microwave Radiation in the Workplace



www.osha-slc.gov/SLTC/radiofrequencyradiation/index.html

Radiofrequency/Microwave Radiation



www.rsc.ca/index.php?page=expert_panels_rf&lang_id=1&page_id=120

Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices – Report of the Expert Panel



www.bccdc.org/contnet.php?item=55

Health Concerns of Cellular and PCS Telephones



www.hc-sc.gc.ca/ewh-semt/radiation/comns/radiofreq/index-eng.php

Radiofrequency Fields

Extremely low frequency (ELF) radiation

Alternating current (a.c.) electricity in Canada operates at a power line frequency of 60 Hz. As electrical current flows through wires, electric and magnetic fields are created that fluctuate at this frequency. The electric and magnetic fields produced are referred to as extra low frequency (ELF) radiation.

The most common hazards of ELF radiation are contact electrical shock and the induction of weak electrical currents in the body. Many studies into the relationship between ELF magnetic fields and cancer have been completed. The results have been both contradictory and inconclusive. Research in this subject area continues.

For more information



www.who.int/topics/electromagnetic_fields/en/index.html

Electromagnetic Fields



www.bccdc.org/download.php?item=1812

Health Effects and Exposure Guidelines Related to Extremely Low Frequency Electric and Magnetic Fields – An Overview



www.osha.gov/SLTC/elfradiation/index.html

Extremely Low Frequency (ELF) Radiation



www.bccdc.org/contnt.php?item=57

Health Concerns of Power Frequency Electric and Magnetic Fields



www.cdc.gov/niosh/topics/emf

EMF (Electric and Magnetic Fields)