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CODE OF SAFE PRACTICE FOR THE USE OF X-RAY ANALYTICAL EQUIPMENT

**National Radiation Laboratory
Ministry of Health
PO Box 25-099
Christchurch
New Zealand**

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1 INTRODUCTION

- 1.1 This *Code of safe practice* covers the use of x-ray analytical equipment. Such equipment includes both diffraction equipment used for analysis of crystal structures, and x-ray fluorescence equipment used for the identification and quantification of elements in materials.
- 1.2 The ownership and use of irradiating apparatus is controlled by the *Radiation Protection Act 1965* and *Radiation Protection Regulations 1982*. As well as mandatory compliance with the *Act* and *Regulations*, anyone licensed to use x-ray analytical equipment will be required by a condition on the licence to comply with this *Code*.
- 1.3 This *Code* stipulates the specific way in which some parts of the *Act* and *Regulations* must be satisfied with respect to x-ray analytical equipment. As well, there are further requirements that are recognised as good practice necessary for safety. All of these requirements are indicated by the word “**shall**”. They are binding on **all** people licensed to use x-ray analytical equipment. Whenever a responsibility is shared by more than one licensee, to avoid ambiguity, one person must take the role of ensuring the responsibility is carried out. This licensee is referred to in this *Code* as the **principal licensee**.
- 1.4 General advice on the safe use of x-ray analytical equipment and compliance with the radiation protection legislation and this *Code* is given in *Guidance notes: safe practice for the use of x-ray analytical equipment*.
- 1.5 This *Code* deals with radiation safety only. Other legislation covering occupational safety, local body planning and other issues may overlap with the radiation protection legislation. Compliance with this *Code* in no way implies that all or any of these other requirements have been satisfied.
- 1.6 If for purely technical reasons relating to a particular piece of equipment or procedure it is either not possible or deemed unnecessary to comply with any requirement or requirements in this *Code* then an exemption from the specific requirement or requirements for that piece of equipment or procedure may be

granted on application to NRL. An application for exemption will need to demonstrate that the proposed alternative to the requirement does not compromise the intent of the relevant section of the *Code*. Written evidence of this exemption must be retained for audit purposes.

2 RADIATION SAFETY MANAGEMENT

2.1 Radiation safety plan

2.1.1 The principal licensee **shall** ensure that full and up-to-date records and documented procedures are kept in relation to every x-ray system for which they are responsible. This documentation shall be known collectively as the radiation safety plan and for each facility **shall** include the following:

- a) details of radiation safety policy, responsibilities and names of persons authorised to operate the x-ray equipment;
- b) radiation protection induction and training requirements for staff, and associated records;
- c) a register of all x-ray analytical equipment at the facility;
- d) procedures for radiation safety audits as specified in Section 2.2 of this *Code*, and associated records;
- e) records of maintenance and repair work on x-ray analytical equipment;
- f) incident and accident investigation records;
- g) written local rules for the safe operation of x-ray analytical equipment;
- h) written emergency procedures.

2.1.2 Records as required in paragraph 2.1.1 (b)-(f) **shall** be kept for 5 years.

2.1.3 The principal licensee **shall** be responsible for ensuring that all persons involved in the use of the x-ray equipment at the facility are familiar with the radiation safety plan.

2.2 Radiation safety audits

2.2.1 The principal licensee **shall** cause to be carried out, on installation or significant modification and at least annually, a radiation safety audit that verifies compliance with this *Code*.

2.3 Storage of x-ray equipment

- 2.3.1 The principal licensee **shall** ensure that any x-ray equipment not in current use **shall** be stored with the mains supply disconnected from the generator in such a way that an unauthorised person cannot readily re-energise the unit.

2.4 Maintenance and servicing

- 2.4.1 Any maintenance or servicing of x-ray analytical equipment that involves the x-ray generator or tube, or production of x-radiation, **shall** be carried out only by a person appropriately trained and licensed under the *Radiation Protection Act 1965* to carry out such servicing.
- 2.4.2 The principal licensee **shall** ensure that all information necessary for the radiation safety of a contractor is fully disclosed and effectively communicated to the contractor prior to the commencement of any work.

3 FACILITIES AND EQUIPMENT

3.1 The principal licensee **shall** ensure that rooms in which x-ray analytical equipment is housed are either secure, or that the equipment cannot be operated without the insertion of a key (or equivalent device) which is kept secure, so that unauthorised use of the equipment is prevented.

3.2 The principal licensee **shall** ensure that:

- (a) no x-ray analytical equipment is put into routine operation until after an initial radiation safety audit has been carried out and compliance with the *Code* established;
- (b) a durable label showing the instrument model and serial number is displayed in an accessible position on the x-ray equipment and maintained in a clean and legible condition;
- (c) a radiation warning, either a radiation warning symbol as described in Part 1 of the Second Schedule of the *Regulations*, or suitable cautionary wording, is affixed in a readily visible position to the exterior of the equipment;
- (d) the dose rate due to stray radiation (leakage and scatter) at 5 cm from any accessible external surface does not exceed an instantaneous dose rate of 25 $\mu\text{Gy/h}$ when the x-ray tube is operated at any of the permissible ratings specified by the manufacturer of the equipment;
- (e) it is not possible to remove shutters and their operating mechanisms without the use of tools;
- (f) in the case of x-ray diffraction equipment:
 - i a distinctive warning light associated with each independently operated port shutter is prominently located, and maintained in an operating condition, so that when activated by the high tension or shutter circuit it will always indicate when an x-ray beam is emerging from that port. Each warning light shall be interlocked with the x-ray generator so that in the event of bulb failure x-rays will not be produced;
 - ii each shutter is mechanically or electrically interlocked so that it cannot open unless diffraction

equipment, which will completely intercept the primary beam, is in position at the beam port;

iii in all equipment which allows routine changing of samples in the path of the primary x-ray beam, the sample position is not accessible when the beam is on, ie, the sample changing port has a cover interlocked with the shutter or high tension circuit.

(g) in the case of x-ray fluorescence apparatus access to the primary x-ray beam is prevented by effective safety locks and a warning light is illuminated when x-rays are being produced.

3.3 All operators **shall** ensure that:

- (a) when unattended the equipment is not accessible to unauthorised persons;
- (b) all shielding is in place and no interlocks are disabled during operation.

4 OCCUPATIONAL SAFETY

4.1 General requirements

4.1.1 The principal licensee **shall** ensure that the use of x-rays for x-ray analysis takes place only if the facility has written local rules to ensure user radiation safety (as required in paragraph 2.1.1g).

4.2 Use by an unlicensed person

4.2.1 In addition to the requirements of Section 2.1.3 of this *Code* the principal licensee **shall** ensure that any unlicensed user is familiar with the component of the written safety procedures (as required in paragraph 2.1.1g) detailing instructions for contacting a licensee in case of an accident or emergency. (See also Section 15 of the *Act*.)

5 PUBLIC SAFETY

5.1 Control of visitors

- 5.1.1 The principal licensee **shall** ensure that the written local rules as required in paragraph 2.1.1g of this *Code* and/or security arrangements control access by visitors or members of the public to areas where radiation is used.

6 INCIDENTS, ACCIDENTS AND EMERGENCIES

- 6.1 The principal licensee **shall** be responsible for investigating any x-ray equipment damage or malfunction, or departure from local rules, to ascertain whether persons may have been exposed to abnormal levels of radiation.
- 6.2 In the event of a suspected or actual exposure to primary beam radiation the principal licensee **shall**:
- (a) immediately advise the National Radiation Laboratory of the circumstances;
 - (b) make available to the person exposed such medical examinations as may be appropriate to manage any injury.
- 6.3 There **shall** be written procedures for fire and civil defence emergencies, including who is responsible for the shut-down of the equipment in the event of building evacuation (as required in paragraph 2.1.1h).

CROSS-REFERENCE INDEX

The regulatory framework for this *Code* is provided by the radiation protection legislation.

This index provides references to specific parts of the legislation, some of which, while not directly cited in the *Code*, do provide the regulatory authority for its requirements. It also indicates where practical compliance information can be found in the *Guidance notes*.

The references are from this *Code of safe practice for the use of x-ray analytical equipment, NRL C17* to:

- *Radiation Protection Act 1965*;
- *Radiation Protection Regulations 1982*;
- *Guidance notes: safe practice for the use of x-ray analytical equipment* (NRL, August 2001).

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