NRL
National Radiation Laboratory

Core of knowledge: Industrial Processing (Sealed Source Irradiators)

This core of knowledge is the basic level of training in radiation safety an applicant must demonstrate to be granted (additional conditions apply) a licence under the *Radiation Protection Act 1965* to use:

Radioactive materials

for the purpose of

industrial processing

Continuing education

Once every year, a licensee will be required to demonstrate evidence of continuing education. Guidance on continuing education is available from the National Radiation Laboratory (NRL).

Training courses based on this core of knowledge

Practical component

Practical experience with radiation measuring instrumentation and industrial processing plant (sealed source irradiator) is expected.

Assessment

Following completion of a training course (candidates who wish to complete the written assessment without having first attended a core of knowledge training course should contact NRL) each participant who intends to apply for a licence is required to complete a written open book assessment, set and assessed by NRL, to confirm that the core of knowledge has been understood to the required level. The assessment will be **two hours** in duration and will be completed under supervised conditions specified by NRL. Descriptions of the assessment paper and example assessment questions are included at the end of this core of knowledge.

Duration

It is expected that a training course will be approximately 16 hours in duration.

Modules

Each core of knowledge is made up of standard-modules, and where applicable, one or more specific-modules. A standard-module (small variations can be expected between individual cores of knowledge) is common to all cores of knowledge.

Guide to depth of knowledge required

The depth of knowledge required for each topic is indicated using the following scale:

(1) **Introductory.** Overview and familiarity only.

(2) **Working.** Knowledge gained should be able to be used in problem solving and practical situations.

(3) **In depth.** In addition to a working knowledge there should be a thorough understanding of the underlying basis or theory.

Core of knowledge

Modules

Standard 1 Nature and sources of ionising radiation

- Radiation, radioactivity and half-life (2).
- Types and characteristics of radiation (*to include alpha, beta, X-ray, gamma)* and its interaction with matter (2).
- Quantities and units (activity, absorbed dose and effective dose) (2).
- Sources of ionising radiation (natural and artificial) (2).

Standard 2 Biological effects of ionising radiation and associated risks

- Damage mechanisms (2).
- Whole body and extremity exposures (2).
- Deterministic effects; skin erythema, cataracts, LD_{50}, acute radiation syndrome (haematopoietic, gastrointestinal and neurovascular) (2).
- Stochastic effects; cancer and hereditary (2).
- International Commission on Radiological Protection's risk factors and radiation risks in perspective (2).
- Public perception and communication of radiation risk (2).

Standard 3 International Commission on Radiological Protection's principles of radiation protection

- Justification (2).
- Optimisation ('as low as reasonably achievable ') (2).
- Individual dose limits (occupational and public dose limits, extremity dose limits and pregnant workers) (2).

Standard 4 Legal framework and regulatory authority

- The *Radiation Protection Act 1965* and amendments and the *Radiation Protection Regulations 1982* (2). Particular emphasis should be placed on owner and licensee obligations.
- Role of the National Radiation Laboratory (NRL) and compliance monitoring (2).
- The reporting of incidents to NRL (to include NRL's incident report form) (2).

Standard 5 Transport of radioactive material

- Regulations for the Safe Transport of Radioactive Material. 1996 Edition (Revised'. International Atomic Energy Agency (IAEA), Vienna, 2000. IAEA safety standards series no. TS-R-1 (ST-1, Revised) (2).

Standard 6 Unsealed radioactive materials

- Internal (including the behaviour of radionuclides in the human body) and external radiation hazards (1).
- Committed effective dose (1).
- Types, characteristics and hazards associated with commonly used unsealed radioactive material (1).

Standard 7 Sealed sources

- Sealed source manufacture (to include how radionuclides are produced and encapsulated) (1).
- The meaning and use of Special Form Certificates (1).

Standard 9 Practical issues associated with the security and disposal of sealed sources

- Options for disposal of sealed sources (2).

Modules

Specific 1 **Incidents**

- Review of incidents reported worldwide (3).
- Practical exercises based on plausible scenarios (2).

Specific 2 **Practical radiation protection**

- *'Code of practice for the design and safe operation of non-medical irradiation facilities (1988). Australian National Health and Medical Research Council, June 1988* (2).[1]
- Radiation safety plans (to include security) (2).
- Radiation measurement instrumentation likely to be encountered (2).
- Performance of radiation measurements (2).

Specific 10 **Sealed Source Irradiators**

- Review of manufacturer's design manual and operating instructions highlighting issues associated with radiation safety (2).
- Plant safety features (2).
- Routine radiation and contamination surveys (2).
- Personal dose monitoring, action levels and record keeping (2).
- Radiation safety considerations for maintenance and source replenishment (2).
- Emergency procedures (including initial management of irradiated casualties) (2).
- Access control procedures for staff, visitors and contractors (2).
- Production and physical characteristics of Co-60 (2).
- Awareness of security issues (terrorism (radiological dispersion devices); transport) (2).

[1] NRL have not made compliance with this Code of Safe Practice a licence condition. However, NRL considers that this code is a guide to good practice and it is used by NRL as a guide during compliance monitoring.

Open book written assessment

Description:	The assessment paper consists of two sections: general and specific. The assessment is open book e.g. the candidate may take any course notes or textbooks into the assessment. Past assessment papers are not available. To arrange for an open book written assessment a course organiser or a candidate should contact NRL.
Supervision:	Candidates will usually be asked to complete the assessment at a Public Health Office in a main town or city of their own choice.
Duration:	2 hours under supervision.
Pass mark:	75 %
Requirements if a pass mark is not achieved:	A candidate may re-sit an assessment paper, depending on availability, as many as three times. However, after any failure there is a minimum two-week stand-down period. If a candidate after three unsuccessful attempts wishes to re-sit the assessment paper additional conditions may be imposed by NRL.

Example questions:

The exam paper will consist of approximately 30 short-answer-type questions, for example:

1. State the 3 fundamental principles of the ICRP system of radiological protection. (3 marks).

2. The nuclide cobalt-60 has a mass number of 60 and an atomic number of 27. How many protons, electrons and neutrons are there in an atom of cobalt-60? (3 marks).

3. At a distance of 12 m from a radiation source your survey meter reads 100 μSv/h. What will be the reading at 1 m from the source? (2 marks).

4. What is the annual individual whole body dose limit for:
   a) an occupationally-exposed person
   b) a member of the public (2 marks).

5. Give two symptoms a person would experience soon after (within an hour or so) being exposed to an acute whole body dose of 3 Sv (2 marks).

6. List and briefly describe three lessons learned from reported incidents involving the use of radioactive material in industrial processing (6 marks).