Radiation protection guidelines on mining in South Australia: Mineral exploration

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Author: Radiation Protection Division

For further information please contact:

Information Officer
Environment Protection Authority
GPO Box 2607
Adelaide SA 5001

Telephone: (08) 8204 2004
Facsimile: (08) 8124 4670
Free call (country): 1800 623 445

Website: <www.epa.sa.gov.au>

Email: <epainfo@epa.sa.gov.au>

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Disclaimer

This publication is a guide only and does not necessarily provide adequate information in relation to every situation. This publication seeks to explain your possible obligations in a helpful and accessible way. In doing so, however, some detail may not be captured. It is important, therefore, that you seek information from the EPA itself regarding your possible obligations and, where appropriate, that you seek your own legal advice.

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Abbreviations

DEF	Declaration of Environmental Factors
EL	Exploration Licence
EWA	Exploration Works Approval
EPA	South Australian Environment Protection Authority
LSA	Low Specific Activity
PPE	personal protection equipment
PIRSA	Department of Primary Industries and Resources South Australia
RMP	Radiation Management Plan
RPC Act	Radiation Protection and Control Act 1982

Summary

The following occupational radiation protection and waste management guidance is provided to assist explorers planning to undertake drilling operations conducted in areas of known radioactive mineralisation, and when exploring for new uranium/thorium deposits in South Australia.

Companies undertaking exploratory drilling operations for uranium/thorium should have an awareness and understanding of the information contained in this guideline so that, in the event radioactive mineralisation is encountered, appropriate occupational radiation protection and waste management procedures can be implemented.

This guideline provides a systematic approach to managing the radiation hazards to people and the environment associated with mineral exploration in areas of known uranium or thorium deposits, and will ensure compliance with current standards and regulatory requirements of the *Radiation Protection and Control Act 2000* (RPC Act).

This guideline details the following:

- The legislative framework that supports the requirement to manage radiation risks during exploration (Section 2)
- The need to devise and implement a Radiation Management Plan and the activities that should be included in the plan (Section 3)
- Management requirements during the transport of radioactive materials off site (Section 4 and Appendices 1 & 2)
- Management requirements during off-site storage of radioactive materials (Section 5)

1 Introduction

1.1 Purpose

The purpose of this guideline is to provide a basic understanding of the nature of radiation hazards associated with exploration for radioactive minerals and provide a systematic approach to managing those hazards to ensure compliance with current standards and regulatory requirements.

1.2 Scope

The guideline covers radiation protection and radioactive waste management issues arising from exploration drilling, sample handling, analysis, transport, storage and site rehabilitation in areas of known radioactive mineralisation.

This guideline does not cover the use or storage of instruments that emit gamma or neutron sources, Prompt Fission Neutron (PFN) logging tools or other devices that emit ionising radiation. These sources or devices must be registered and the operators licensed in accordance with the *Radiation Protection and Control Act 1982* (RPC Act).

2 Applicable legislation, codes and standards

Radiation exposures may arise where an exploration program involves contact with radioactive ores through drilling, sample handling, analysis, transport, storage and associated waste disposal practices. The radiation hazards associated with the handling, transport or storage of significant quantities of radioactive samples (including cores) are regulated under the RPC Act.

Under the conditions of an Exploration Licence (EL) according to the *Mining Act 1971*, Primary Industries and Resources South Australia (PIRSA) requires the proponent to submit an Exploration Work Approval (EWA) or Declaration of Environmental Factors (DEF) for authorisation by the Director of Mines before commencement of an exploration program involving the use of drilling or earthmoving equipment. The Mining Act provides PIRSA with the legislative powers to regulate these operations and ensure appropriate site rehabilitation is completed.

Radioactive mineralisation and samples (including cores and chip samples) are considered to be 'radioactive ore' if the uranium or thorium concentrations exceed the concentrations in Regulation 7 and total activities in Regulation 8 of the *Radiation Protection and Control (Ionising Radiation) Regulations 2000*[1]. The waste muds, sludges and groundwater associated with drilling and sample preparation, are also considered to be potentially radioactive materials and are to be treated as such.

To avoid unnecessary regulation of the low radiation risk activities arising from exploration, this guideline describes what radiation safety measures **should** be applied to activities currently managed on an Exploration Lease which includes areas of known radioactive mineralisation.

The guideline also describes what measures **must** be applied regarding those exploration related activities conducted outside of an EL.

Complying with this guideline will demonstrate sufficient and effective procedures are in place to:

- minimise radiation exposures associated with an exploration program on an EL
- meet the objectives of the RPC Act for the management of radioactive samples and wastes associated with exploration on an EL
- meet the requirements of the *Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003* in relation to the transport of radioactive samples from an EL, and meet the objectives of the RPC Act in relation to off-site storage.

The guidance is based on relevant requirements of the RPC Act, associated Regulations, and incorporates the approach to radiation safety in the following Commonwealth documents:

- *Code of practice on radiation protection and radioactive waste management in nning and mineral processing* (2005)
- *Code of practice for the transport of radioactive material* (2008)
- *Code of practice for the near surface disposal of radioactive waste in Australia* (1992).

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[1] Regulation 7 defines a radioactive ore to be ore containing >200 ppm uranium by weight or, >500 ppm thorium by weight. (If both uranium and thorium are present, the sum of the fractions must exceed 1 to be defined radioactive ore).
Note: This definition will change with the adoption in South Australia of the Commonwealth's *National Directory for Radiation Protection* in 2010/2011. The definitions will effectively change to 80 ppm uranium and 140 ppm thorium respectively.

3 Radiation management plan

Exposure to radioactive samples and wastes during exploration activities in areas of known radioactive mineralisation is generally small and the radiation doses are low. However, a Radiation Management Plan (RMP) should be developed to ensure that these radioactive materials are recognised and controlled during exploration activities. Implementation of the RMP will ensure that radiation doses to workers are as low as reasonably achievable.

The purpose of the RMP is to:

- identify all radiation risks associated with the exploration program
- outline procedures to control the risks to people and the environment
- outline methods of monitoring and recording of doses to workers
- outline procedures for managing incidents and spills involving radioactive samples, waste or drilling fluids
- outline the program of disposal of radioactive waste generated on site or returned to site from laboratory testing
- outline the processes to ensure all contaminated equipment is cleaned before leaving site
- outline procedures to suitably record and report information as necessary
- outline procedures to ensure compliance with any transport or storage requirements under the RPC Act
- outline the roles of the Radiation Safety Officer[2] and the availability of resources to implement the RMP
- document the induction and training programme for all workers and contractors on site.

Advice on the development and content of the RMP can be sought from the Radiation Protection Division. When completed, the RMP must be submitted and endorsed by the EPA

Note: A copy of the endorsed RMP should be included in any EWA or DEF submitted to PIRSA for approval. Approval will not be granted for conducting drilling within a known uranium/thorium deposit without an accompanying RMP. Companies should therefore develop a RMP prior to undertaking uranium/thorium exploration drilling activities so radiation protection measures can be implemented as soon as mineralisation is encountered.

3.1 Sources of radiation exposure

Pathways

The RMP should describe the significant radiation exposure sources and exposure pathways as well as the form, quantity and concentration of radioactive samples and wastes that may be encountered during exploration activities.

External exposure of workers (or members of the public) to radiation during exploration activities can occur by being close to radioactive samples. For example:

- sampling of surface mineralisation
- handling of large quantities of radioactive core samples and drill cuttings
- working or residing near stored samples
- transporting large quantities of radioactive samples for storage or analysis off-site.

[2] A person should be identified as the Radiation Safety Officer (RSO) to implement the RMP and advise on radiation safety matters.

Internal exposure to radiation can arise from radioactive materials entering the body via inhalation or ingestion. This can include:

- inhalation of dust created from drilling through radioactive ore zones or cutting of cores
- ingestion of radioactive materials or inhalation of dust through handling core samples and drill cuttings
- ingestion of radioactive materials through poor personal hygiene (not washing hands after handling radioactive samples)
- Inhalation of radon decay products where large quantities of samples are kept in enclosed and poorly ventilated storage areas.

3.2 Control of radiation exposures

The RMP should describe the measures and procedures that will be implemented to control the sources of radiation exposures identified above.

External gamma radiation exposure

A portable gamma survey meter should be used to identify any radioactive samples. An ore grade scintillometer would be suitable for this purpose.

A gamma dose rate meter is required to determine the radiation dose from exposure to any radioactive samples. It is important that the meter used is properly calibrated.

Basic principles for radiation protection from external sources should be applied to minimise worker exposure:;

- minimising the time spent working with radioactive samples
- locating radioactive samples away from occupied areas
- use non-active samples or other materials as shielding for radioactive samples if necessary.

Internal exposures

The use of appropriate personal protective equipment (PPE) and hygiene procedures are an important part of radiation management and procedures should be developed to minimise the spread of radioactive material when handling core samples and drill cuttings. Procedures include the following:

- dust masks should be used if there is potential for exposure to dust when intersecting radioactive ores or cutting core samples.
- gloves and appropriate work clothing should be worn when using drilling equipment and handling radioactive samples to minimise any transfer of contamination.
- hands should be washed before eating or smoking
- regular cleaning of work areas where there is significant build up of dust or mud
- workers should shower and change out of work clothing at end of shift or before leaving the site. Clothing should be laundered regularly.

On-site sample storage

Radioactive samples should be stored away from normally occupied areas, and well ventilated if held in an enclosed space. Particularly active samples should be placed in a sign-posted designated area. All radioactive samples must be clearly labelled, and radioactive sample bags should be sealed and in good condition to prevent release of radioactive dust.

3.3 Monitoring

Summary details of the plan to conduct personnel and area radiation monitoring need to be provided in the RMP. The reasons for monitoring radiation levels in the workplace and in the environment are to:

- identify the presence and activity levels of radioactive material
- provide information on the effectiveness of the control measures at the site
- determine the radiation exposure of workers and demonstrate compliance with regulatory radiation dose limits
- assess the impact of the project on the local environment and confirm that rehabilitation of the site has been successful.

3.3.1 Monitoring for site controls

A gamma survey should be conducted of cores, samples and drill cuttings to determine the presence of radioactive material and any controls necessary to minimise exposures to workers. The RMP should specify the instrument to be used for monitoring, and relevant calibration information.

3.3.2 Monitoring of workers

Average radiation doses received by workers during exploration activities are typically well below the recommended annual limit for members of the public (1 mSv/a). However, it is recommended that doses be assessed for those work groups most exposed to gamma radiation through routine contact with radioactive samples. This is best achieved by issuing a personal dosimeter [eg thermoluminescent dosemeter (TLD) badge] to those workers with routine exposure to radioactive samples[3].

The dose results should be recorded and reported to the relevant workers on a regular basis (eg quarterly) and at the end of the exploration program.

Monitoring for airborne radioactive dusts should be considered if workers are exposed to significant levels of dusts involving radioactive ores. In this case, monitoring should be undertaken in accordance with the appropriate Australian Standards and advice on equipment choice can be sought from the EPA.

3.3.3 Monitoring of the environment

For rehabilitation purposes, the area of the drill hole, mud pit and bulk disposal pit should be surveyed to determine background gamma dose rates (or scintillometer count rate) before drilling commencement and after site rehabilitation. Before leaving the site, background gamma dose rates must be similar to initial background levels. The measurement method should be defined in the RMP and records kept of the results.

3.4 Incidents

The RMP should describe procedures to manage and report incidents involving radioactive samples or wastes on site, or samples during transport or located in off-site storage. Licensed users of radioactive sources will have incident procedures in place to ensure reporting of damaged, stuck or lost logging sources.

[3] The Radiation Protection Division can provide advice on approved suppliers of personal dosimeters.

3.5 Disposal of radioactive waste materials

The RMP should detail the methods that will be implemented to safely dispose radioactive liquid and solid wastes[4] generated during exploration. None of these wastes should be disposed off-site or near permanently occupied areas.

Liquid wastes

Liquid wastes can include:

- drilling muds
- slurry from core cutting
- vehicle and equipment wash-down water
- groundwater containing elevated natural levels of radionuclides (such as radium).

Where radioactive mud, cuttings or samples are present in mud pits, the pits should be allowed to dry, and be covered by a minimum of 1 m of compacted clean soil. If core cutting of radioactive samples is conducted on-site, the waste slurry should be directed to a mud pit for disposal as above.

Vehicle or equipment wash-down should be conducted on site and wastewater should be directed to a mud pit or similar, allowed to dry, and be covered by a minimum of 1 m of compacted clean soil.

Care should be taken to minimise the surface spread of groundwater. Groundwater should be directed to a mud pit or similar, allowed to dry, and be covered by a minimum of 1.0 m of compacted clean soil.

Solid wastes

- Solid waste material generated during exploration activities can include surplus radioactive samples and returned analytical samples as well as contaminated PPE, equipment and containers.

Samples

All samples should be removed from sample bags for disposal.

Radioactive samples should be preferentially returned to the drill hole (ie before other cuttings). The drill hole should then be rehabilitated in accordance with procedures approved by PIRSA.

Where this is not possible, radioactive samples from individual drill holes should be buried in adjacent mud pits if available with at least 1m of compacted clean soil cover.

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[4] Radioactive Waste is defined as any radioactive substance in the form of a solid, liquid or gas (or combination thereof) that is left over, surplus or an unwanted byproduct of any business or domestic activity, whether of value or not, but excluding the following:

a) Substances to which the regulations under the Radiation Protection and Control Act 1982 do not apply

b) Substances that have been exempted from regulatory control under provisions of the Radiation Protection and Control Act 1982

c) Material containing activities or activity concentrations of radioactive elements below the exemption levels specified in the National Directory of Radiation Protection published by the Australian Radiation Protection and Nuclear Safety Agency.

Bulk samples

In the situation where radioactive samples cannot be backfilled down the hole and no mud pit is available, the samples should be removed from their sample bags, mixed with barren cuttings or clean soil to reduce any artificial concentration of the material, and be buried in a purpose-built disposal pit as outlined below.

Disposal pit

The disposal pit for bulk samples should:

- only hold samples removed from their sample bags and containers, and should not be used to dispose of other wastes generated on site
- be located in a stable area that does not compromise its future use, and on ground not subject to flooding or erosion which may re-expose the material
- be constructed so as to ensure the material has at least 2 m of clean and compacted soil cover
- be located within exploration licences associated with the authorised exploration program

Where companies require a bulk disposal pit, the location, dimensions and construction requirements must be included within the EWA or DEF submitted to PIRSA for approval. If a bulk sample pit has not been included within the EWA, the company must supply an addendum to the authorised program for approval. The application must also clearly demonstrate why a specific location has been proposed, taking into account all potential stakeholder and environmental issues including topography, social, biological and radiological aspects.

Disposal pit closure report

A ‘closure report’ must be completed for each pit providing:

- the location (GPS coordinates) and dimensions of the pit
- a list of contents
- photographic confirmation of the construction of the pit
- photographic confirmation of the pre-closure waste location within the pit indicating depth
- measured gamma dose rates (or scintillometer rates) before construction and after closure (see Section 3.3.3) .

The pit closure report must be forwarded to PIRSA within one month of pit closure.

Analytical sample returns

It is common practice for off-site analytical laboratories to return samples to the owner once analysis is completed. The analytical laboratory may also send other materials from the analytical process to the owner for disposal. Any radioactive sample returns should be disposed of in the same manner as surplus samples.

Other wastes (empty bags, PPE, etc), should be drummed and sent to a licensed landfill as uncontaminated waste (in respect to radioactivity) provided they are not radioactively contaminated. Radioactive waste is not permitted for disposal to general landfill.

Sample returns from barren intervals (ie not radioactive samples) can also be disposed of in a licensed landfill.

Potentially contaminated waste materials

Empty sample bags, used PPE, and other miscellaneous waste are unlikely to be contaminated to the extent that they are considered a ‘radioactive waste’ material requiring special disposal arrangements. These wastes should be disposed of in a licensed landfill.

In the unlikely event items are suspected of being contaminated to the extent they are considered ‘radioactive waste’; the waste items should be drummed, labelled and stored securely on site for further assessment. The EPA should be contacted for advice on the assessment required.

3.6 Decontamination of machinery and equipment

It is possible that some machinery and other equipment items may become contaminated through significant or prolonged contact with radioactive material. Operators should ensure all equipment have been thoroughly cleaned to remove loose material before leaving the site. Fixed surface contamination not removed by washing may need abrasive cleaning methods such as abrasive blasting. Any radioactive waste material removed during this process should be disposed of as outlined earlier.

3.7 Spills management

Spills of drilling or cuttings fluids, and any groundwater returns must be contained, eg through the use of earth bunds or by directing fluids into mud pits. If there is obvious soil contamination resulting from these spills, the soil should be removed for burial in a mud pit or bulk sample disposal pit.

Where mud pits have been used for this purpose these should be allowed to dry out before covering with at least 1m of compacted clean soil.

3.8 Personnel and resources

A person should be identified to act as Radiation Safety Officer. The RMP should outline their role and those of any other responsible persons, and also the resources available to properly implement the plan.

3.9 Induction and training of workers

All workers and contractors working with radioactive samples should be appropriately inducted and trained regarding the radiation aspects of their work and in the precautions necessary to control their exposure to radiation. The induction should cover all site safety and environmental issues associated with radiation and the management of radioactive samples and wastes.

The RMP should document the induction and training required.

3.10 Records

Records should be kept of the following information or events:

- details of radiation safety training provided to employees
- results of all employee radiation monitoring undertaken
- estimates of dose received by employees and members of the public
- incidents involving exposure to radiation and the corrective actions
- for rehabilitation purposes records should be kept of any measurements related to soil contamination caused by exploration activities.
- in particular, records should be kept in relation to bulk sample disposal pit closure reports as described earlier. The survey method used to establish gamma levels (or scintillometer count rates) before construction and after closure of the pit should be defined in the RMP and records kept of the results
- calibration of radiation monitoring equipment.

4 Transport

Radioactive materials transported within South Australia must be done so in according with the Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003. These Regulations are designed to follow and refer to the provisions of the *Code of Practice for the Safe Transport of Radioactive Material* (2008) [the Transport Code]. This may include radioactive samples collected during the course of uranium exploration programs. Transport of radioactive materials outside of South Australia may be subject to different regulatory requirements. The relevant authority within the receiving state or territory should be consulted prior to transportation.

The majority of exploration samples collected will be either non-radioactive or low-level radioactive. Radioactive samples can usually be transported as an 'Excepted Package'.

All shipments are to be packaged and labelled according to the Transport Code.

4.1 Sample packaging

The package must be such that it will keep the radioactive samples contained during routine conditions of transport. Packaging can range from a sturdy box for small packages to a sturdy plastic bucket or steel drum for larger samples. Multiple packages may be combined onto a pallet for transport together. The samples must be secured together onto the pallet. Sample packages grouped together in this way would be treated as if it was one package under the code.

4.2 Package classification

Classification for radioactive samples for transport can be determined by measurement of the gamma dose rate at the surface of the package. This gamma dose rate can be determined using a suitably calibrated portable gamma survey meter. Where packages are grouped together, for example on a pallet, it may be possible to rearrange the individual samples in the group to result in a lower surface dose rate. That is, samples with a low level of radioactivity can be used to shield higher-level samples. In such cases, care should be taken to ensure that movement during transport will not disturb the packed samples sufficiently to expose the higher activity samples.

4.2.1 Excepted packages

Significant quantities of radioactive samples can be transported as 'Excepted Packages' under the Transport Code. That is, the sample container can be transported as an excepted package provided that the gamma dose-rate measured on the surface is less than 5 uSv/h. In practice, if a package has an external dose rate greater 5 μSv/h in one area, it is permissible to repackage it to reduce the dose rate below 5 μSv/h (for example by placing high activity material in the centre of the package, shielded by lower activity samples.

The transport arrangements for excepted materials are described in Appendix 1.

4.2.2 Higher activity samples (LSA–1 Package)

Higher activity samples where the dose-rate > 5uSv/h, must be transported as Low Specific Activity (LSA) material.

The transport arrangements for LSA materials are described in Appendix 2.

4.3 Transport Incidents

The RMP should outline a contingency plan in the event of a vehicle accident or an emergency during transport.

Should there be an incident involving the loss or dispersal of radioactive samples (eg through a vehicle accident or failure of the packaging), the driver should as soon as practicable, contact;

1 The site manager (or sender)

2 The Director, Radiation Protection Division of the Environment Protection Authority, Tel (08) 84637826 or Fax (08) 8124 4671.

3 After-hours EPA contact: 8204 2004–state type of radiation incident.

5 Off-site storage of radioactive samples

5.1 Registration of premises

In accordance with Section 29 of the RPC Act, storage sheds/buildings holding radioactive samples must be registered in accordance with applicable requirements of Regulations 174 & 175 of the Radiation Protection and Control (Ionising Radiation) Regulations 2000.

An up-to-date site-specific Radiation Management Plan (RMP) must be submitted. to address the requirements of the Regulations. This RMP is in addition to that developed for exploration operations and must include the following:

- working rules for the store should be posted in a prominent position including contingency plans, use of appropriate PPE, signs prohibiting eating, drinking or smoking in other than designated areas
- routine monitoring of the premises and people (as necessary), and recording the results of the measurements
- maintaining an inventory of radioactive samples held on site
- a waste management plan to be prepared for the management and disposal of radioactive waste at the premises or returned to site from laboratory testing
- signs[5] need to be placed at the entrances or approaches to clearly identify the area that contains radioactive samples [the signs should be as specified in Regulation 130(1) of the Ionising Radiation Regulations]
- procedures to keep the registered premises secure, clean and tidy, and free from radioactive contamination by ensuring:
  - floors are free from cracks (eg that could collect radioactive dust from friable samples)
  - adequate ventilation and management of any dust generated
  - sample cutting is carried out in an area with sealed floors and a sump or some other means for collecting the run-off and cuttings for later disposal
  - radioactive samples are stored away from occupied areas (and walls of adjoining properties) and shielded if necessary, by placement behind less active samples.

[5] The sign should comply with AS 1319-1994 *Signs for the Occupational Environment.*

Application forms for Registration of Premises can be obtained from the Radiation Protection Division, or by downloading the form:

Application to register premises in which unsealed radioactive substances are handled or kept (Section 29)

The completed form must include a copy of the working rules and preferably, photographs of the interior and exterior of the premises showing any signs associated with the storage area or other features (sumps, drainage). The photographs will assist in assessing the application.

Note:

Comments or suggestions on this Interim Guidance are welcome and should be sent to:

Andrew Johnston
Manager, Mining & Environment Group
Radiation Protection Division
Tel: 08 8463 7823
Email: <radiationprotection@epa.sa.gov.au>

6 Glossary

Most definitions have been taken from the *Code of Practice on Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005)

Accident an unintended event which causes, or has the potential to cause, employees or members of the public to be exposed to radiation from which the individual doses or collective doses received do not lie within the range of variation which is acceptable for normal operation. An accident may result from human error, equipment failure or other mishap; it may require emergency action to save life or to safeguard health, property or the environment. An accident requires investigation of its causes and consequences and, possibly, corrective action within the program for control of radiation, and it may require remedial action to mitigate the consequences

Activity the measure of quantity of radioactive materials, except when used in the term 'human activity'.

Approval a written agreement by the relevant regulatory authority that a plan or proposal meets the requirements of the Code.

Disposal the emplacement of waste in an approved, specified facility without intention of retrieval. Disposal may also include the approved direct discharge of effluent (eg liquid or gaseous waste) into the environment with subsequent dispersion.

Dose a generic term which may mean absorbed dose, equivalent dose or effective dose depending on context.

Employee a person who works for an employer within an operation including a contractor performing work on the project site on behalf of the owner/operator.

Employer an operator who, or which, engages people to work within an operation; the term employer includes a self-employed person.

Exemption a designation, by the relevant regulatory authority, for sources of radiation that are not subject to nuclear regulatory control because they present such a low radiological hazard; the deliberate omission of a practice from regulatory control, or from some aspects of regulatory control, by the relevant regulatory authority.

Exposure either:

- the circumstance of being exposed to radiation or,
- a defined dosimetric quantity now no longer used for radiation protection purposes.

(The context in which the word is used should avoid ambiguity.)

Incident	an event which causes, or has the potential to cause, abnormal exposure of employees or members of the public and which requires investigation of its causes and consequences. Such an event may require corrective action within the program for control of radiation, but is not of such scale as to be classified as an accident.
Licence	a written approval issued to an operator, which allows the operator to carry out an operation legally. This may be in the form of a licence or a registration, as required by the Radiation Protection and Control Act (1982), dependent on the activity being undertaken.
Mining and mineral processing	mining is all activities associated with the extraction of minerals from the ground. Mineral processing is all activities associated with the processing of minerals to produce a physical or chemical concentrate, including hydrometalurgical and pyrometalurgical processing, and physical ore beneficiation.
Occupational exposure	exposure of a person to radiation which occurs in the course of that person's work and which is not excluded exposure.
Operation	an instance of a practice; a particular human activity which may result in exposure to ionising radiation and to which a program of radiation protection applies.
Operator	any person or entity responsible for a mining or mineral processing operation which may lead to exposure to ionising radiation.
Public exposure	exposure incurred by members of the public from radiation sources, excluding any *occupational* or *medical exposure* and the normal local natural background radiation but including exposure from authorised *sources* and practices and from *intervention* situations.
Radiation	electromagnetic waves or quanta, and atomic or sub-atomic particles, propagated through space or through a material medium.
Radiation Safety Officer (RSO)	an individual technically competent in radiation protection matters relevant for a given type of practice who is designated by the operator or employer to oversee the application of the requirements of the code.
Radioactive waste	radioactive waste means material that contains or is contaminated with radionuclides at concentrations or activities greater than clearance levels as established by the relevant regulatory authority, and for which no use is foreseen.
System of radiation protection	a generic process of radiation risk management designed to limit the health risks arising from exposure to radiation to acceptable levels in a manner which takes economic and social considerations into account.
Waste management system	includes all the facilities and procedures involved in the handling, treatment, storage and disposal of radioactive wastes.

7 Further information

Legislation

Radiation Protection and Control Act (1982)

Radiation Protection and Control (Ionising Radiation) Regulations (2000)

Radiation Protection and Control (Transport of Radioactive Substance) Regulations (2003)[6]

Recommendations for Limiting Exposure to Ionizing Radiation (1995)

National Standard for Limiting Occupational Exposure to Ionizing Radiation (republished 2002)

References

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[6] The Transport Regulations refer to the 2001 Transport Code; however this has now been replaced by 2008 Transport Code.

Appendix 1 Transport arrangements for excepted packages

Package (container)

- The package must be such that it will retain its contents under routine transport conditions.
- The design should provide for strength of lifting attachments, ease of handling and securing, and ease of decontamination.
- The package should not have external surface alpha contamination above 0.4 Bq/cm^2. In practice this condition is met if there is no visible contamination or dust on the surface.

Documentation

The shipment must be accompanied by documentation, which includes (in the following order):

- 'Radioactive Material, Excepted Package – Limited Quantity of Material'
- 'UN Class Number 7, UN–2910'
- 'Uranium ore samples–solid'
- the maximum activity of the shipment. For material of 1,000 ppmU, this is 12 KB q/kg. As the activity (grade) will generally not be known, make a generous estimate based on this figure
- a signed and dated declaration in the form: 'I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packed, marked and labelled, and are in all respects in proper condition for transport by road according to the applicable international and national governmental regulations.'
- sender and receiver details
- instructions to the consignor
- emergency procedures.

Labels

- each Excepted Package should be labelled 'Radioactive' on an internal surface such that upon opening, the warning is clearly visible.
- the package is marked 'UN2910' on the outside surface
- sender and receiver details should be marked on the outside surface
- for packages exceeding 50 kg the mass to be marked on the outside.

Appendix 2 Transport arrangements for LSA material

LSA–1 Package

Higher activity samples where the dose-rate > 5 uSv/h, must be transported as Low Specific Activity (LSA) Material. The transport arrangements are described below assuming samples are packaged within a single vehicle.

Package (container)

Package requirements for transporting solid LSA material are similar to those for Excepted Packages, with the additional requirement that the smallest external dimension of the package must not be less than 10 cm. Contact the EPA for advice if there is a need to transport liquid LSA–1 material.

Transport Index–Package

- a Transport Index (TI) must be determined for the package. The TI reflects the external radiation hazard associated with the handling of the package
- the TI is determined by first measuring the dose rate at 1 metre from the package surface. For core samples, the dose rate is typically less than 1,000 uSv/hr
- the dose rate (measured in µSv/hr) is then divided by 10 to determine the TI
- the determined TI is to be rounded up to the first decimal place. However, a TI of 0.05 or less can be rounded to zero (0).

Transport Index–Vehicle

- a TI needs to be determined if shipping multiple packages together in a container or on a single vehicle. In this case the TI is either the sum of the TIs of all the contained packages or it can be determined by direct measurement of radiation level for the vehicle of container (as above)
- for tanks, freight containers and unpackaged LSA–1 material the TI is modified by a multiplication factor based on the size of the load.

Table 1 Multiplication factors for tanks, freight containers and unpackaged LSA–1 and SCO–1

Size of load[a]	Multiplication factor
size of load ≤ 1 m^2	1
1 m^2 < size of load ≤ 5 m^2	2
5 m^2 < size of load ≤ 20 m^2	3
20 m^2 < size of load	10

[a] Largest cross-sectional area of the load being measured.

Documentation and labels

- if the TI is less than 1 and the surface dose rate is less than 0.5 mSv/h the package is a Category II-Yellow category. The label shown in figure 1 must be attached to the package on two opposite sides
- the contents of 'LSA–1' and the maximum activity of the package contents must be marked on the label. The TI of the package is to be included on the label
- sender and receiver details should be marked on the outside surface

- the package is marked ‘UN2912’ and ‘Radioactive material, low specific activity (LSA–1)’ on the outside surface
- packages exceeding 50 kg the mass to be marked on the outside
- if the surface dose rate of any package exceeds 0.5 mSv/hr contact the EPA for further advice.

Placards

- The vehicle transporting the LSA packages must have placards attached as shown in the figures below.

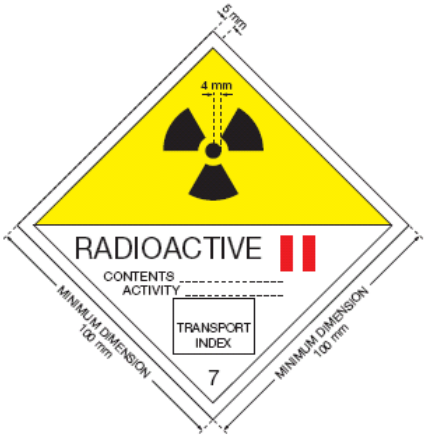

Figure 1 Category II–Yellow Package Label

Figure 2 Placard for Radioactive Material